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List of Acronyms

Acronym	Definition
ABC	Active, Beautiful, Clean
AECOM	AECOM Singapore Pte. Ltd.
ALARP	As Low As Reasonably Practicable
ASEAN	Association of Southeast Asian Nations
BIA	Biodiversity Impact Assessment
BTO	Build-To-Order
CCNR	Central Catchment Nature Reserve
DGPS	Differential Global Positioning System
DO	Dissolved Oxygen
ERSS	Earth Retaining Stabilising Structure
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
ha	Hectare
HASP	Health and Safety Plan
HDB	Housing & Development Board, Singapore
LTA	Land Transport Authority, Singapore
N4	Neighbourhood 4
N5	Neighbourhood 5
NAS	National Archives of Singapore
NEA	National Environment Agency, Singapore
NParks	National Parks Board, Singapore
NSRs	Noise Sensitive Receptors
NTU	Nanyang Technological University, Singapore
NUS	National University of Singapore
PUB	Public Utilities Board, Singapore
QECP	Qualified Erosion Control Professional
SCDF	Singapore Civil Defence Force
TBU	To be updated
TDS	Total Dissolved Solids
TN	Total Nitrogen
TOL	Temporary Occupation Licence
TP	Total Phosphorus
TPZs	Tree Protection Zones
TSS	Total Suspended Solids
UK	United Kingdom
URA	Urban Redevelopment Authority, Singapore
USEPA	United States Environmental Protection Agency
WHO	World Health Organisation

1 Executive Summary

Project Description and Objectives

AECOM Singapore Pte. Ltd. was appointed by the Housing & Development Board (HDB), through the Letter of Acceptance dated 27 December 2022 (Contract Number L/468/22), to provide *Specialist Consultancy Services for Environmental Impact Assessment at Sembawang N4 (Part)*. An Environmental Impact Assessment (EIA) is essential for establishing the current environmental baseline conditions, inclusive of topography, biodiversity, water resources (i.e. hydrology, surface water quality and groundwater level) and airborne noise. This EIA will also evaluate the potential direct impacts (e.g. habitat degradation, mortality, accidental injury, mortality, etc.) and indirect impacts (i.e. due to changes in hydrology, surface water quality, groundwater level and airborne noise) resulting from the construction and operational phases of the proposed developments in Sembawang Neighbourhood 4 (N4) (hereafter referred to as 'the Project').

The Project site spans approximately 53 hectares (ha), and currently consisting of urbanised areas, construction worksites, managed turf vegetation and forested area (i.e. N4 Forested Area). It is bounded by Admiralty Road West and Admiralty Street to the north, Canberra Road to the east, residential areas to the south and Sungei Sembawang to the west.

According to the gazetted URA Master Plan 2019, the Project site is zoned for Residential, Commercial, Civic and Community Institution, Educational Institution, Place of Worship, Road and Waterbody (refer to Figure 1.1). Note that the N5 Forested Area, though zoned for "Residential", is not part of the Project site. Details of its development were not known at the time of writing the Report and was not included in this Study. Based on the latest land use plan provided by HDB, the developments within the Project site will also include a park spanning from Admiralty Road West to Admiralty Lane. HDB shared a working draft of the plan for the Project with AECOM to facilitate the environmental impact assessment. However, since the plan is subject to change and refinements, it will not be disclosed in this Report.

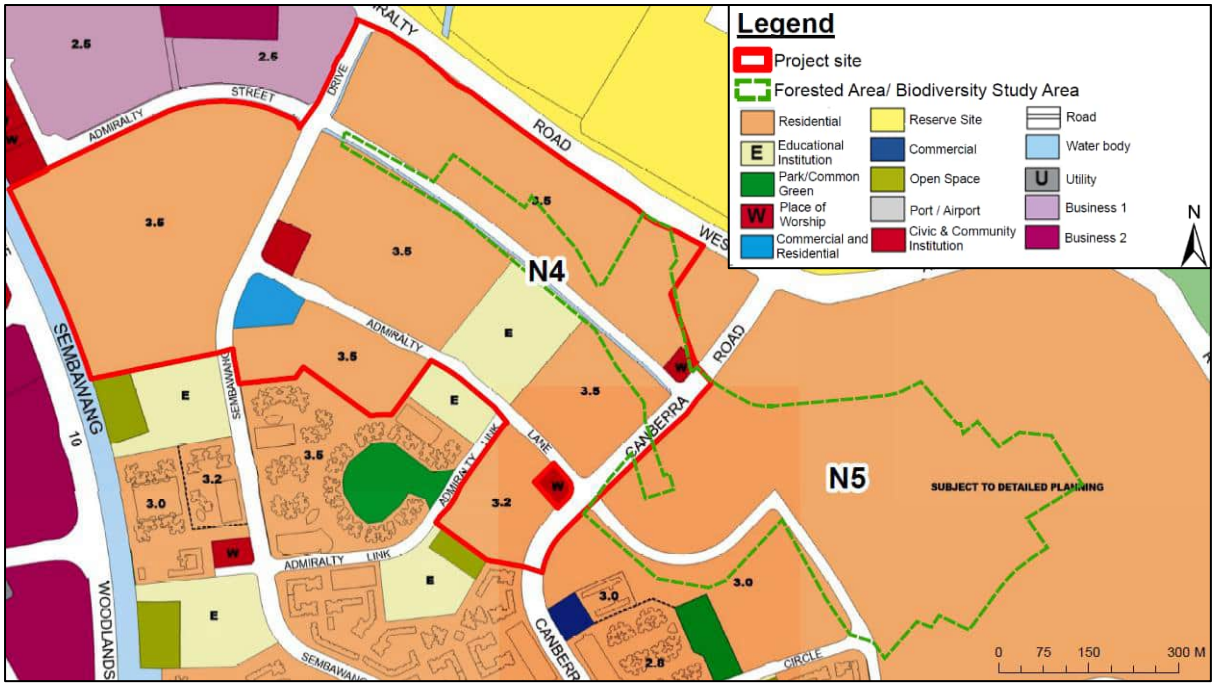


Figure 1.1 Proposed land use of Project site and its surroundings

This EIA, therefore, includes the findings of the following study:

(1) Identification and understanding of baseline conditions of biodiversity, water resources (i.e. hydrology, surface water quality and groundwater level) and airborne noise, as well as topography of the Study Area (i.e. N4 and N5 Forested Areas);

(2) An assessment of potential direct impacts on identified ecological receptors within the Study Area;

(3) An assessment of potential indirect impacts (i.e. due to changes in water resources and airborne noise) on biodiversity and identified ecological receptors within the Study Area;

(4) Proposed mitigation measures to minimise potential significant adverse impacts; and

(5) Development of a Preliminary Environmental Management and Monitoring Plan (EMMP).

Findings from each of the steps above are summarised in the sections below.

Environmental Baseline Findings

Baseline studies on biodiversity, water resources (i.e., hydrology, surface water quality and groundwater level) and airborne noise were conducted for the respective Study Areas. A summary of the findings is provided below, with detailed information available in Section 6 of the Report.

(1) Habitats and Vegetation Distribution (see Figure 1.2) – Generally, the Study Area is dominated by exotic-dominated secondary forest which occupies around one third of the Study Area (33.5%). N4 Forested Area consists of four (4) different habitat types, namely exotic-dominated secondary forest, scrubland, grassland, and semi-naturalised drain, from the most dominant to the least dominant habitat. Within N5 Forested Area, five (5) different habitats have been identified – abandoned-land forest, scrubland, exotic-dominated secondary forest, grassland, and urban vegetation.

(2) Biodiversity, Flora, Large Plant Specimens and Other Specimens of Value (see Figure 1.2) – In total, more than 240 species were found across the N4 and N5 Forested Area. Out of 128 species found within N4 Forested Area, 57 were found to be native (44.5%), 66 were exotic (i.e. 51.6%) and 5 were cryptogenic (3.9%). Five species within N4 Forested Area were of conservation significance (i.e. *Calophyllum inophyllum*, *Cyperus compressus, Macaranga griffithiana*, *Tectaria cf semipinnata*, *Trema tomentosum*).

In the N5 Forested Area, 198 species were identified: 98 native species (49.5%), 95 exotic species (48%) and 5 cryptogenic species (2.5%). Seventeen (17) species in the N5 forested area were of conservation significance (i.e. *Adenia cordifolia*, *Callicarpa longifolia*, *Calophyllum inophyllum*, *Cissus repens*, *Cnestis palala*, *Goniophlebium percussum*, *Horsfieldia crassifolia*, *Horsfieldia polyspherula* var. *polyspherula*, *Lindera lucida*, *Litsea umbellata*, *Macaranga griffithiana*, *Melicope lunu-ankenda*, *Microlepia speluncae*, *Neoscortechinia sumatrensis*, *Pittosporum ridleyi*, *Santiria laevigata*, *Uncaria cordata*).

Additionally, 28 large plant specimens were recorded within N4 Forested Area and 112 within N5 Forested Area. Noteworthy specimens in the N4 Forested Area include a single record of small Malayan banyan (*Ficus microcarpa*). In the N5 Forested Area, 11 valuable plant specimens include five albizia trees (*Falcataria falcata*) with a raptor's nest, three weeping fig (*Ficus benjamina*) stranglers, two Malayan banyan (*Ficus microcarpa*) and a cluster of golden bamboo (*Bambusa vulgaris*).

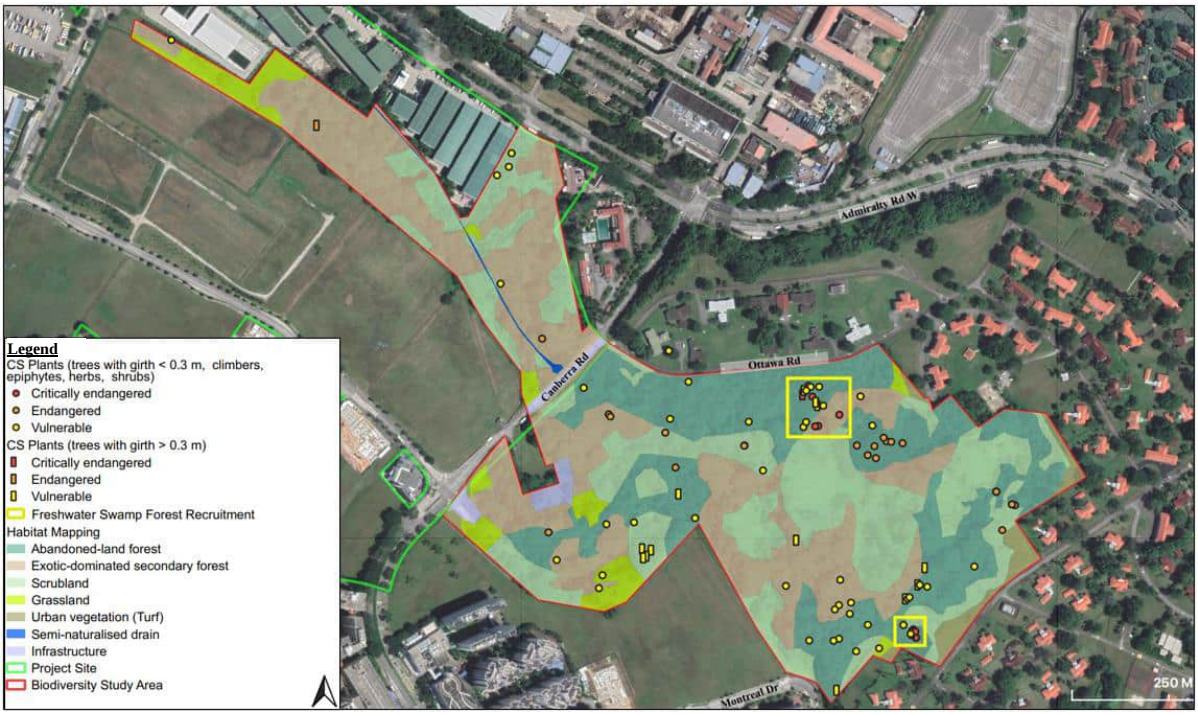


Figure 1.2 Habitat map with distribution of plant specimens of conservation significance within N4 and N5 Forested Area

(3) Biodiversity, Fauna (see Figure 1.3 and Figure 1.4) – The field assessment recorded a total of 212 species, with birds (61 species) and butterflies (56 species) comprising more than half of the species assemblage. The recorded fauna included 20 species of odonates (dragonflies and damselflies), 29 species of aculeate hymenopterans (bees and stinging wasps), 17 species of mammals, three (3) species of molluscs and 21 species of herpetofauna (amphibians and reptiles). Additionally, four (4) species of freshwater fish and one (1) species of decapod crustaceans were also documented. A total of 13 species of conservation significance were identified, all of which are birds and mammals.

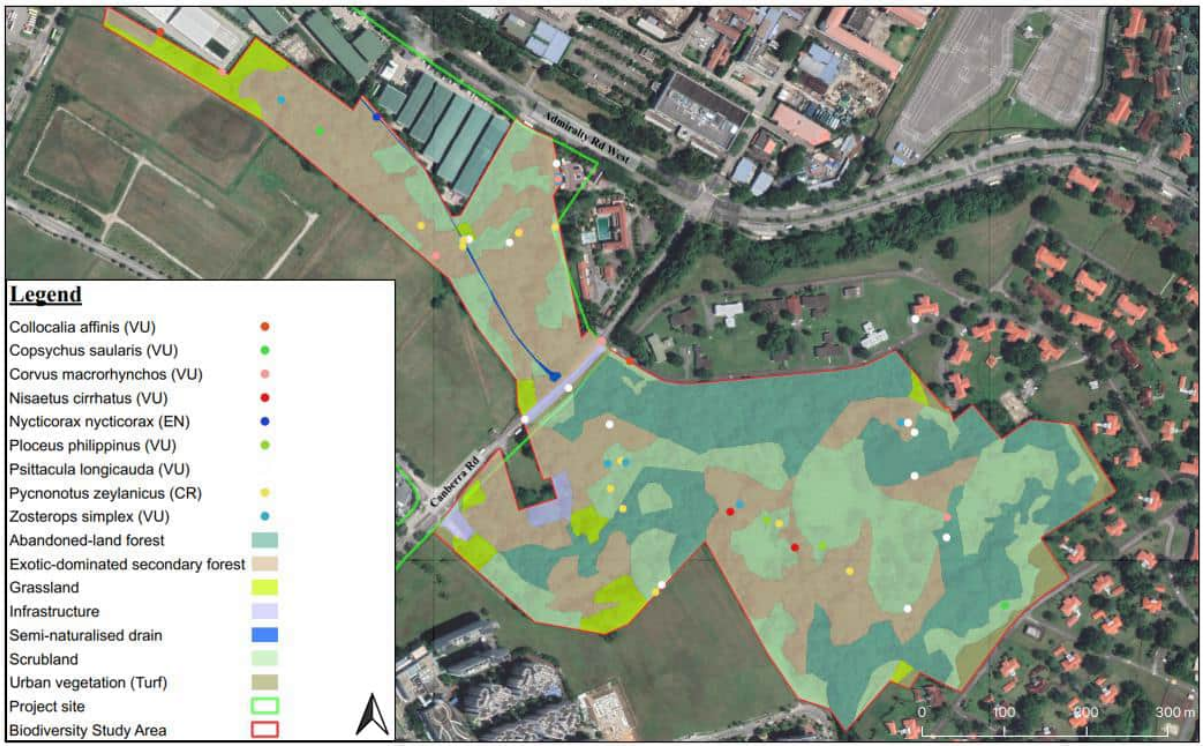


Figure 1.3 Birds of conservation significance within N4 and N5 Forested Area



Figure 1.4 Non-volant mammals of conservation significance within N4 and N5 Forested Area

The biodiversity Study Area, which comprises of N4 and N5 Forested Area, is one of a few remaining large and continuous vegetated patches in the urban matrix of Sembawang region. The larger size and position of N5 Forested Area makes this forest patch a much more effective stepping-stone habitat. As such, N4 forested area will be cleared during the construction phase as it resides within the Project Site whereas N5 development is not included in this Study. However, a small portion of the N5 Forested Area will be within the impact zone, after accounting for the existing 'setback' provided by Canberra Road.

The main impacts on the N4 Forested Area were assessed to be due to inevitable loss of habitats and plant species. More specifically, the impact due to the loss of habitats was assessed as Major, while the plant mortality impacts were assessed as Moderate to Major. As such, compensatory measures such as habitat creation using native planting with Active, Beautiful, Clean Water features running through the future park within the Project Site will be explored. The degradation of habitats within N5 Forested Area as well as decline in plant health were assessed Negligible as only the fringes of it facing the Canberra Road will be affected.

(4) Hydrological Conditions (see Figure 1.5) – One concrete drain (D1) and one semi-naturalised drain (D2) have been identified as key watercourses within N5 and N4 Forested Areas, respectively. Other watercourses within the future N4 development area consist of smaller, roadside concrete drains with ephemeral flow. The N5 Forested Area can be divided into 4 smaller catchments with the largest (C4) discharging water into a concrete drain. This concrete drain subsequently releases the water into a semi-naturalised drain via a culvert below Canberra Road. In addition to the water discharge from N5, the semi-naturalised drain also collects water from the largest catchment area within N4. All water from the Project site eventually discharges into the sea.

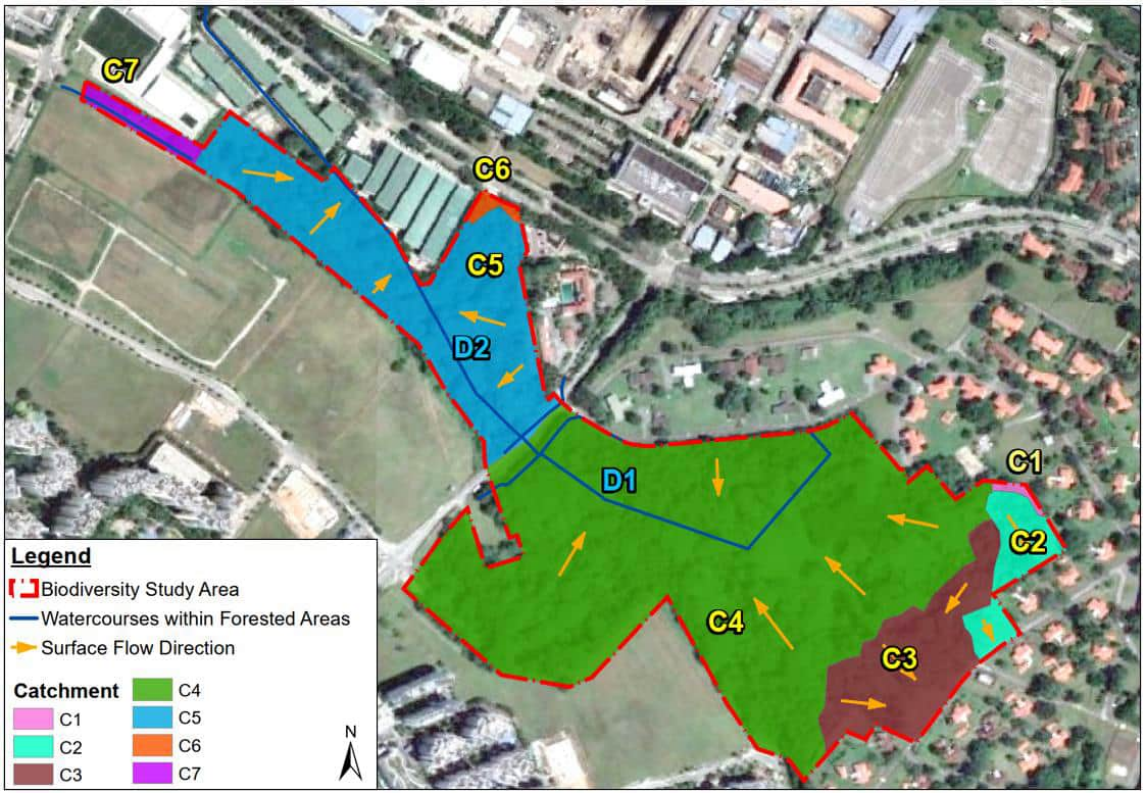


Figure 1.5 Catchment map of N4 and N5 Forested Area

(5) Surface Water Quality – The surface water quality conditions were established based on surface water sampling events conducted at 11 locations during both dry and wet weather conditions and across 3 watercourses (i.e. concrete drain within N5 Forested Area, semi-naturalised drain within N4 Forested Area and Sungei Sembawang). Generally, slight exceedances of nutrients such as phosphorous and nitrogen were noted along the watercourses which is commonly documented in heavily vegetated areas due to dead and decomposing matter from vegetation in the water courses, releasing the nutrients in the water body.

(6) Airborne Noise – Based on the baseline monitoring results, the airborne noise levels recorded in the N5 Forested Area are considerably low ranging from 44 – 54 dB(A) and are below the most-stringent NEA construction noise criteria. This is reflective of an isolated and vegetated nature of this area. One exceedance (i.e. max L_{Aeq} (5 mins) 7pm-10pm) was observed over the course of one week, which was potentially due to air traffic noise from the nearby Sembawang Air Base.

Impact Assessment Methodology

Section 5 of this EIA Report discuss the methodologies used for impact identification, prediction and assessment on environmental parameters including biodiversity, water resources (i.e. hydrology, surface water quality and groundwater level) and airborne noise during the construction and operational phases of the Project.

Minimum controls and recommended mitigation measures

Table 1.1 summarises the mitigation measures and best management practices to minimise the adverse impacts throughout the course of the Project. More details can be found in Section 7 and 8 of the Report for proposed mitigation measures during the construction and operational phase respectively.

Table 1.1 Summary of minimum controls and recommended mitigation measures

Environmental Parameter	Minimum Controls and Key Recommended Mitigation Measures	
	During Construction Phase	During Operational Phase
Biodiversity	• Establish Tree Protection Zones (TPZs) around trees or other plant specimens that are to be retained within the worksites. No construction activities are allowed within these zones. This should be executed by certified arborists and in accordance with NParks' guidelines (NParks, 2019). • Develop a Light Management Plan for night works to minimise light disturbance to sensitive receptors and obtain NParks' approval. • Prior to vegetation clearance, conduct a pre-felling fauna inspection by an Ecologist capable of identifying wildlife or active nesting structures, such as bird nests, tree hollows, burrows, and bamboos clusters; in compliance with Section 10 Wildlife Act. • Implement soil erosion control measures, such as biodegradable erosion control blankets, ECM tanks immediately after vegetation has been removed and soil is exposed for the purpose of installing these, as described in Section 7.3.2 under Water Resources. • Store materials that could leach harmful chemicals and fuel-powered equipment away from waterbodies or sensitive habitats as described in Section 10 of Wildlife Act. • Install hoarding to clearly delineate worksite boundaries. • Execute Wildlife Response Plan when a trapped, injured, dead, dangerous animal is encountered around or within the worksite according to Section 10 of the Wildlife Act. • Implement preventive measures to limit mosquito breeding by removing sources of stagnant water and water-bearing receptacles. Measures include maintaining pitched roofs, clearing discarded items daily, storing materials appropriately, levelling up ground depression/ uneven surfaces. These actions reduce the need for fogging. • Conduct daily checks by an Environmental Control Officer (ECO) on site for trapped fauna and roadkill.	• Ensure noise levels are within noise criteria set for ecological receptors in this report. Refer to Section 8.5 under airborne noise-related impacts for details. • Ensure dust levels are within approved limits as defined by NEA's regulated Environmental Protection and Management Act and its regulations.
Impacts on Biodiversity due to Changes in Other Environmental Parameters		
Water Resources	• Finalise a complete inventory of all anticipated wastewater streams and volumes before the onset of construction phase works. • Maintain daily records of wastewater volume, as well as the volumes of sludge and other produced onsite. • Ensure containment ponds are made	• Implement a storage system for stormwater. The storage system needs to be in place to reduce the peak flow at the operational phase to be the same or less than that of the existing condition. • Geotechnical aspect of site's slope stability (such as Earth Retaining

Environmental Parameter	Minimum Controls and Key Recommended Mitigation Measures	
	During Construction Phase	During Operational Phase
	of impervious material and designed with sufficient capacity to hold the volumes of wastewater produced on site, accounting for stormwater runoff and firefighting needs as well. • Provide temporary storage volumes for overflow situations of untreated wastewater. This temporary storage should have sufficient capacity to capture any unexpected additional volumes, ensuring that untreated wastewater is not released to watercourses unless it complies with NEA guidelines on trade effluent discharge concentrations. • Equip containment ponds, as well as wastewater generating areas on site with spill clean-up kits. • Design adequate drainage systems, including cut-off drains, sump pit, road kerb, piping and toe walls to channel construction process wastewater streams (e.g. wash water) and stormwater runoff separately through detailed design for capture and treatment in the containment pond(s)/ kerb(s). Where applicable, include oil-water separators. • Seek approval from relevant authorities (i.e. PUB and NEA) in accordance with PUB Sewerage and Drainage (Trade Effluent) Regulations, if the wastewater is planned to be disposed to public sewer, or NEA's Trade Effluent Discharge Limits to watercourse if disposal to surface watercourses is intended. If such discharges are not approved, the trade effluent will be stored, treated or recycled on site and finally disposed off-site. • Obtain comments and approval from relevant authorities (e.g., Singapore Civil Defence Force [SCDF] and NEA) for the use of treated wastewater for firefighting purposes. • Provide appropriate concrete washout areas, ensuring these are not located near watercourses. • All vehicles are to undergo a wheel washing process before leaving the site to prevent earth, mud, and debris from being disposed of on surrounding roads. The wastewater generated from this activity should be stored and removed for treatment and disposal offsite by an approved Waste Management Contractor. • Establish regular and dedicated procedures for the inspection and maintenance of wastewater collection, storage, and treatment infrastructure (e.g., pipes, oil-water separators). • Implement regular and dedicated	Stabilising Structure [ERSS]) will be included in detailed design engineering for the operational phase. • Providing more softscape area should be considered in the design of the development which will help to reduce the peak flow and reduce flood risk at downstream area. Active, Beautiful, Clean (ABC) Water design approach can be considered to reduce the peak flow. • Provide more pervious areas to increase the seepage of surface water into the soil. • Installation of recharge wells, if necessary. • Adequate drainage, piping and/ or channelling of stormwater runoff to be assured through detailed design [e.g. ABC Water design approach] for capturing and treatment before discharge into receiving watercourses. • Regular and dedicated procedures for the inspection and maintenance of stormwater collection, storage, and treatment infrastructure, such as pipes, oil water separation and silt screens etc. • Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of 'clean' water to surface waters, including associated measures required to prevent high sediment concentration stormwater drainage to surface waters. • Prepare sufficient disposal bins surrounding the Project to avoid improper disposal of waste. • Conduct regular inspection on wastes' storage system of the Project. • Monitor the proposed watercourses and its surroundings with CCTV surveillance regularly to ensure no contamination occurred. • Develop an Emergency Response Plan and conduct adequate training to maintenance workers to cope the accidental contamination of water. • Raise awareness of various stakeholders with community/ stakeholder engagement (e.g. signage boards, warning signs, etc.). • No vehicles allowed within the future managed vegetation (i.e. proposed park) at development area.

Environmental Parameter	Minimum Controls and Key Recommended Mitigation Measures	
	During Construction Phase	During Operational Phase
	procedures for the management of stormwater collection, settling, testing, and eventual discharge to watercourses. • Develop a training program for all onsite workers, including subcontractors, to educate them on their obligations regarding proper water quality management. • Prohibit the discharge of pumped groundwater from soil dewatering and other wastewaters into aquatic habitats. • Prohibit the unmanaged discharge of any wastewater stream. • No trade effluent other than the nature or type approved by the NEA Director-General will be discharged into any watercourse or soil. • Apply the principles of reduce, reuse, and recycle to wastewater management onsite. • Store hazardous wastewater, such as oil water, thinners, solvents, or paints, on a hard stand under shelter with a curb around the storage area. Ensure this wastewater is removed for treatment and disposed of offsite by an approved Waste Management Contractor. Handle hazardous liquids as Hazardous Waste. • Implement a construction Environmental Management and Monitoring Plan (EMMP) and ensure full preparation of associated plans and procedures.	
Airborne Noise	• Label all machinery and equipment with a weather-proof sticker clearly indicating its noise emission level (at source) under normal operating conditions. • All machinery and equipment used onsite are sound-reduced as much as practicable. • House stationary noisy equipment in enclosures onsite where necessary. • Train and brief machine operators and workers on quieter work techniques. • Conduct ad-hoc noise monitoring during noisy operations as work progresses. • Install noise barriers to minimise noise pollution affecting biodiversity within the biodiversity Study Area (see Section 7.3.3 for more details). • Limit construction works involving noisy machinery to daylight hours, from 8 am to 6 pm and minimise noisy construction activities during night works period. • Implement additional noise measures	• Consider using low-noise pavement mix for sections of new road networks near existing residential buildings. • If new road networks are in proximity to areas with noise-sensitive receptors (NSRs), consider providing park areas or ecological setbacks between the roads and these areas.

Environmental Parameter	Minimum Controls and Key Recommended Mitigation Measures	
	During Construction Phase	During Operational Phase
	when noise monitoring indicates that levels are approaching or exceeding permissible limits. • Avoid shouting, whistling, sirens, or similar loud intermittent noises, especially in construction zones near ecologically sensitive receptors (e.g., N5 Forested Area), which can be impacted by such disturbances.	

Summary of Impact Assessment

With the implementation of key mitigation measures, the overview of impact evaluation for both construction and operational phases are summarised in Table 1.2.

Table 1.2 Summary of impact significance for construction and operational phases (range, if applicable)

Environmental Parameter	Impact Significance (with Minimum Controls/Best Practices)	Residual Impact Significance (with Mitigation Measures)
Biodiversity	Construction Phase Habitat: N4 Forested Area: Major N5 Forested Area: Negligible Flora: N4 Forested Area: Negligible – Major N5 Forested Area: Negligible Fauna: Negligible – Major Operational Phase Habitat: Negligible Flora: Not assessed Fauna: Negligible – Moderate	Construction Phase Habitat: N4 Forested Area: Major N5 Forested Area: Negligible Flora: N4 Forested Area: Negligible – Minor N5 Forested Area: Negligible Fauna: Negligible – Major Operational Phase Habitat: Negligible Flora: Not assessed Fauna: Negligible – Minor
Impacts on Biodiversity due to Changes in Other Environmental Parameters		
Water Resources (Hydrology)	Negligible – Minor	Negligible – Minor
Water Resources (Surface Water Quality)	Negligible – Minor	Negligible – Minor
Airborne Noise	Construction Phase Major Operational Phase Minor	Construction Phase Major Operational Phase Minor

2 Introduction

AECOM Singapore Pte. Ltd. was appointed by the Housing & Development Board (HDB), through the Letter of Acceptance dated 27 December 2022 (Contract Number L/468/22), to provide *Specialist Consultancy Services for Environmental Impact Assessment at Sembawang N4 (Part)*. An Environmental Impact Assessment (EIA) is essential for establishing the current environmental baseline conditions, inclusive of topography, biodiversity, water resources (i.e. hydrology, surface water quality and groundwater level) and airborne noise. This EIA will also evaluate the potential direct impacts (e.g. habitat degradation, mortality, accidental injury, or mortality, etc.) and indirect impacts (i.e. due to changes in hydrology, surface water quality, groundwater level and airborne noise) resulting from the construction and operational phases of the proposed developments in Sembawang Neighbourhood 4 (N4) (hereafter referred to as 'the Project').

The Project will consist of two main components:

- Residential developments with accompanying infrastructure (e.g. internal roads, drains, sewers, etc.) and supporting facilities (i.e. institutions/places of worship, commercial developments, schools, and parks)
- Road network developments including widening of existing roads (i.e. Admiralty Street, Admiralty Lane, Admiralty Road West, Canberra Road), extension of Admiralty Street to Canberra Road and extension of Admiralty Lane to Woodlands Avenue 10

The Project site spans approximately 53 hectares (ha), and currently consists of urbanised areas, construction worksites, managed turf vegetation and a forested area (i.e. N4 Forested Area). It is bounded by Admiralty Road West and Admiralty Street to the north, Canberra Road to the east, residential areas to the south and Sungei Sembawang to the west. For the purpose of this Impact Assessment study, each discipline has a specific zone of impacts from activities within and in the vicinity of the Project site. Section 5.1.1 of this report defines the Study Areas in relation to various disciplines such as biodiversity, water resources and airborne noise.

Based on environmental consultations with government agencies, the forested areas within the Project site (i.e., N4 Forested Area) and N5 Forested Area (east of the site, across Canberra Road) have been identified as a continuous habitat likely facilitating the movement of migratory species. Consequently, these areas shall be considered as part of the biodiversity Study Area.

This Report provides a Project overview, identifies relevant regulatory framework, and details the approach and methodology used for the assessment of potential impacts on identified ecological receptors by studying each environmental discipline such as biodiversity, water resources (i.e. hydrology, surface water quality and groundwater level) and airborne noise as well as include findings of the environmental baseline monitoring and evaluation of predicted environmental impacts from the development of the Project site. A preliminary Environmental Monitoring and Management Plan will also be outlined. It should be noted that this report does not account for the impacts on human receptors in the vicinity of the Project site.

2.1 Scope of Work

The scope of this EIA was documented in the form of Inception Report Rev 02, which was approved by HDB and other relevant agencies (i.e. NParks and PUB) on 24 May 2023. This EIA progressed only after the acceptance of the Inception Report.

The services under this EIA include, but are not limited to the following:

- Field surveys and monitoring, including topography survey, floral survey, faunal survey, hydrological survey, surface water quality sampling, groundwater level survey and airborne noise monitoring
- Collation and analysis of environmental baseline findings, including both collected field survey data and secondary data
- Formulation of biodiversity inventory and distribution maps
- Prediction and evaluation of direct and indirect impacts (i.e. via water resources and airborne noise) on biodiversity
- Recommendation of mitigation measures and assessment of residual impacts
- Development of preliminary EMMP

- Presentation of the findings of all the above in an EIA Report (this Report)

This EIA assessed the development plan, design elements, construction methodology, Project components and assumed operational activities available at the time of writing this Report. Understanding of the Project construction methods and operational activities has been stated in Section 3.3 and Section 3.4, respectively. Detailed additional assumptions, if any, are described in the individual assessment sections thereafter. Should the detailed design conducted at a later stage require modifications to these assumptions/ approaches, a revised impact assessment will be undertaken by the developer/developing agent to address these changes.

2.2 Report Structure

The structure of this EIA Report is as follows:

- **Section 1** – **Executive Summary** provides a brief description of the Project, environmental baseline findings, as well as a summary of preliminary EIA findings.
- **Section 2** – **Introduction** of the Project outlines the scope of work, Report structure and the Study limitations, assumptions, and constraints.
- **Section 3** – **Project Overview,** provides a general description of the Project's components, including the location of the Project site, planned activities during construction and operational phases and tentative Project schedule.
- **Section 4 – Environmental Legislation, Policies, Standards and Criteria** provides the legislative requirements relevant to the Project.
- **Section 5** – **EIA Approach and Methodology** provides an overview of the methodology used for this impact assessment, detailing the Study Areas for different parameters, criteria used for categorisation of ecologically sensitive receptors, the approach and methodologies for baseline studies (including the safety contingency plan) with the methods of data collection and analysis for each of the environmental parameters (i.e. biodiversity, water resources [hydrology, surface water quality and groundwater level] and airborne noise), methodology used for impact assessment of environmental impacts arising from construction and operational phases and the preliminary EMMP for this Project.
- **Section 6** – **Environmental Baseline Conditions,** provides the details about historical and current land use, descriptions of the physical environment (i.e. geology, topography, and regional climate) and baseline conditions of each of the environmental parameters (i.e. biodiversity, water resources [hydrology, surface water quality and groundwater level] and airborne noise).
- **Section 7 – Prediction and Evaluation of Impacts During Construction Phase** details minimum control measures assumed to be implemented during the construction phase of the Project, describes the potential direct and indirect impacts to biodiversity based on the proposed activities and identifies sensitive ecological receptors. This section also presents the evaluation of direct and indirect impacts during the construction phase, along with recommendations for mitigation measures, if any. Where applicable, residual impact (i.e. after mitigation measures) is also assessed.
- **Section 8 – Prediction and Evaluation of Impacts During Operational Phase** details minimum control measures assumed to be implemented during the operational phase of the Project, describes potential the direct and indirect impacts on biodiversity based on the proposed activities and identifies sensitive ecological receptors. This section also presents the evaluation of direct and indirect impacts during the operational phase, along with recommendations for mitigation measures, if any. Where applicable, residual impact (i.e. after mitigation measures) is also assessed.
- **Section 9 – Preliminary EMMP** details the organisational framework, stakeholder roles and responsibilities, monitoring, and management requirements.
- **Section 10** – **Summary** of the EIA study outcomes is provided conclusively.

2.3 Study Limitations, Assumptions and Constraints

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During this study, there will be inherent limitations associated with data acquisition in flora surveys due to the variability of vegetation communities across a site and changes to the detectability and presence of species with time (i.e. inaccessible areas due to the nature of arduous terrain that might be present). Therefore, it may be possible that some flora species occurring within the Project site, or perhaps not visibly present during the survey period, were not recorded. However, the surveys will be considered to be comprehensive as survey routes were strategically planned to cover ecologically and geographically representative samples of the Project site, and all plant species sighted will be identified and recorded to the best of the team members' abilities. Project team members who will carry out the survey and identify the species post-survey have prior experience in conducting such flora assessments in Singapore.

As for the fauna surveys conducted, not all species present within the site could be captured via fauna field surveys due to the rapid nature of this study, as well as the activity patterns, weather conditions, seasonal variations and other factors. Species that were highlighted in the literature review were therefore considered to be potentially present in the site and were included in the baseline assessment. Professionals who carried out the fauna surveys are experienced field biologists and familiar with the local fauna.

Due to the above, the statements, conclusions and opinions contained in this Report are approximations of the existing environmental conditions within the Project site, based on available literature (e.g. information on concurrent project development timelines), expert observations and opinions at the time of reporting and will be

included when further information is made available in future iterations of the Report. Reliance on the Report after the date of issuance as an accurate representation of current site conditions shall be at the user's sole risk. Government agencies will not be held liable for any claims arising from the conduct of the study.

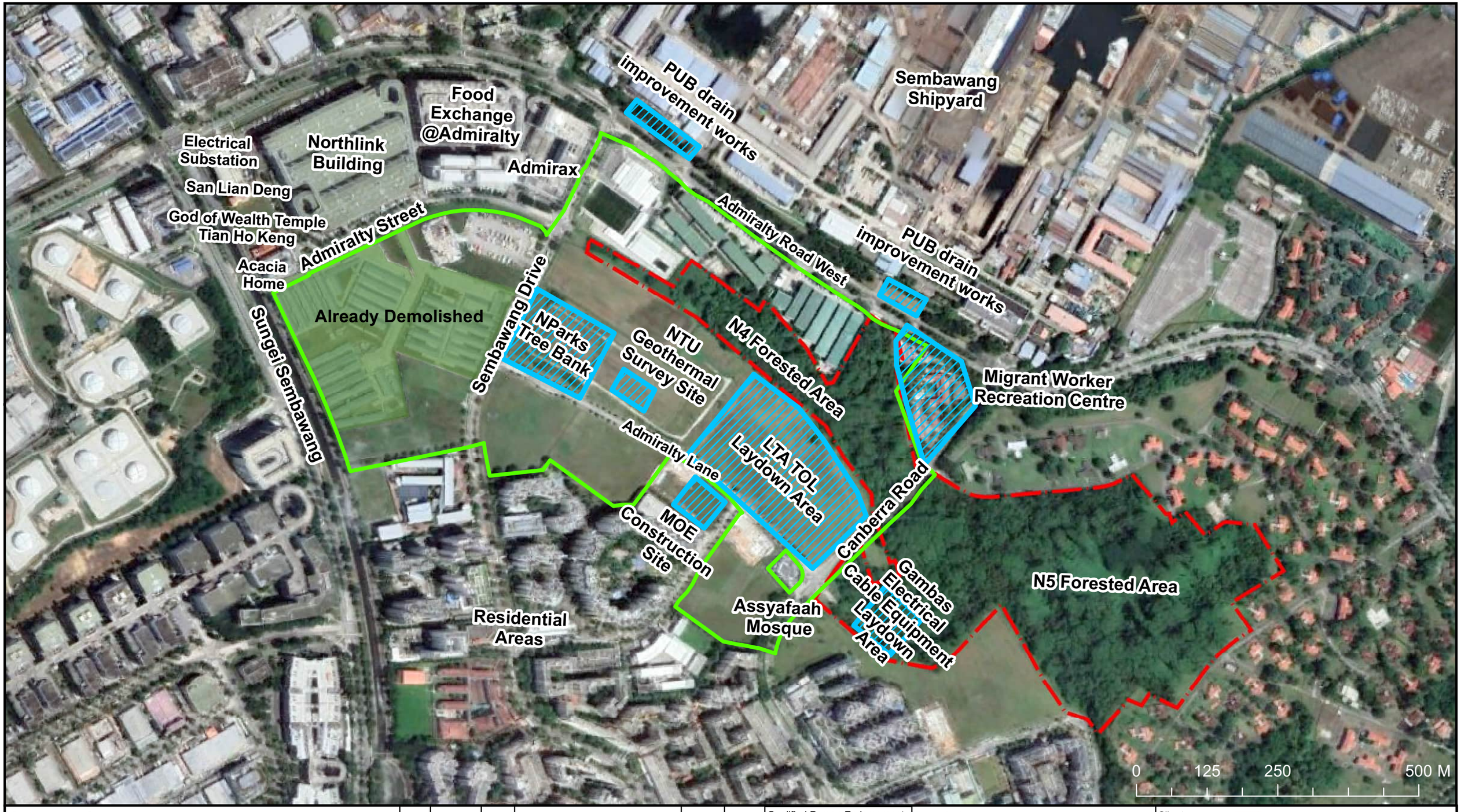
3 Project Overview

This section will provide a background overview of the Project in terms of its location, conceptual development plan and assumed activities during the construction and operational phases of the Project.

3.1 Project Location

The Project site for proposed N4 developments is located in the north of Singapore and it spans across a total area of approximately 53 ha. It is bounded by Admiralty Road West and Admiralty Street to the north, Canberra Road and N5 Forested Area to the east, residential developments to the south and Sungei Sembawang to the west. It is to be noted that the existing Assyafaah Mosque in the southeast and the Migrant Worker Recreation Centre and its premises in the northeast are not part of the Project site. Industrial developments (i.e. Northlink, Food Exchange@Admiralty and Admirax), welfare home (i.e. Acacia Home), places of worship (i.e. Sembawang God of Wealth, Tian Ho Keng and San Lian Deng) and Sembawang Shipyard are located north of the site.

Currently, the Project site consists of urbanised areas such as recreation centre, carpark, active worksites (i.e. LTA's laydown area under Temporary Occupation Licence [TOL], NParks' Tree Bank and NTU's geothermal survey site), managed turf vegetation and forested area (i.e. N4 Forested Area). More details about current land uses can be found in Section 6.2 of this Report. The Project site and its surroundings are shown in Figure 3.1.1.



Legend

- Project site
- Demolished Buildings
- Forested Area/ Biodiversity Study Area
- Existing Worksites

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	TYL	Final Report	SAG	JAG
-	JUL 2024	TYL	Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :
Location of Project site and its surrounding land uses

Designed	Checked	Approved
TYL	SAG	JAG
	Drawn: TYL	Date: AUG 2024

Figure No. : 3.1.1 | Rev. 1 | Sheet 1 of 1

CAD File Name : NA | A3

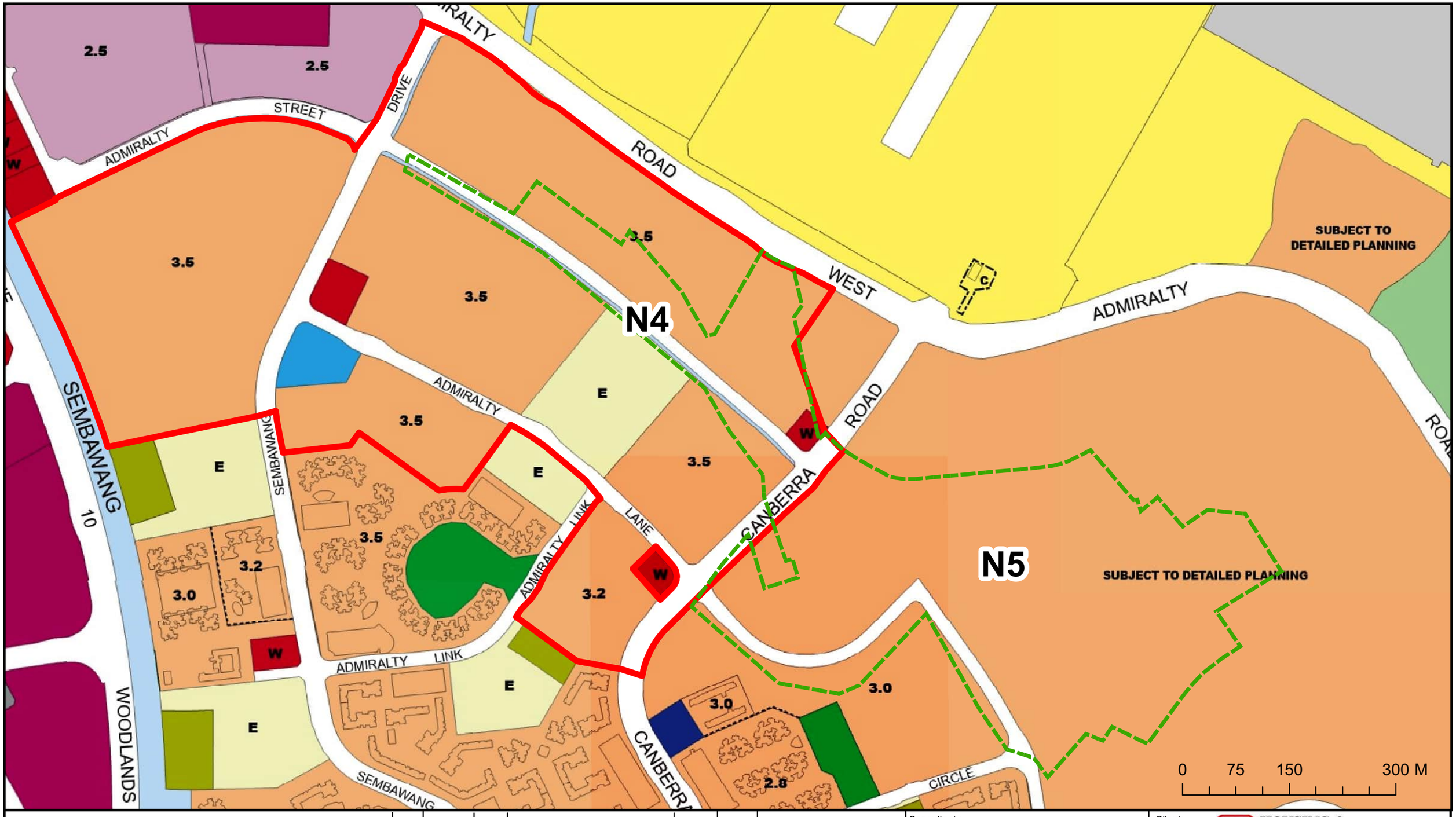
Note: Source of basemap - Google Earth Map

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3.2 Project Description

As shown in the gazetted URA Master Plan 2019 [M-5] (Figure 3.2.1), the Project site is zoned for multiuse development to include Residential, Educational Institution, Place of Worship, Commercial and Residential, Civic and Community Institution, Road and Waterbody. Although the N5 Forested Area is zoned for Residential (Subject to detailed planning) and will be developed in the future, details of its development were not known at the time of writing this Report and were not included in this Study.

The land use plan (based on URA Master Plan 2019) has been further revised by HDB and provided to AECOM on 27 January 2023. By comparing the two, it can be noticed that the latest land use plan incorporates more green areas (e.g. parks) for future residents and visitors to use. It can also be observed that a more extensive road network is proposed for the site, improving the overall connectivity within and around the Project site. For the purposes of this EIA, impact assessment for the construction and operational phases of the Project will be carried out based on the revised land use plan. However, due to the sensitivity of this information, the updated land use plan will not be included in this Report.



Legend

- Project site
- Forested Area/ Biodiversity Study Area
- Residential
- Educational Institution (E)
- Park/Common Green
- Place of Worship (W)
- Commercial and Residential
- Reserve Site
- Commercial
- Open Space
- Port / Airport
- Civic & Community Institution
- Road
- Water body
- Utility (U)
- Business 1
- Business 2

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	JOL	Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

CONTRACT L/025/21 SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Proposed land use of the Project site and its surroundings

Designed	Checked	Approved
JOL	SAG	JAG
	Drawn: JOL	Date: AUG 2024

Figure No. : 3.2.1 | Rev. 1 | Sheet 1 of 1

CAD File Name : NA | A3

Note: Source of basemap - URA Master Plan 2019

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3.3 Proposed Activities During Construction Phase

At the time of writing this Report, limited information was available regarding the construction phase activities planned for the proposed Project. For the purposes of this EIA, the activities expected to occur during the construction phase were further categorised into site preparation, pre-construction activities and main construction activities. It should be noted that site preparation and pre-construction activities may take place concurrently with the main construction activities.

The identified pre-construction and construction activities, typical construction machinery as well as equipment to be utilised for each of the activities were summarised in the table below. More details regarding each of the assumed activities during the construction phase can be found in the subsequent sub-sections.

Table 3.1 Typical construction phase activities and construction machinery and equipment for each of the activities

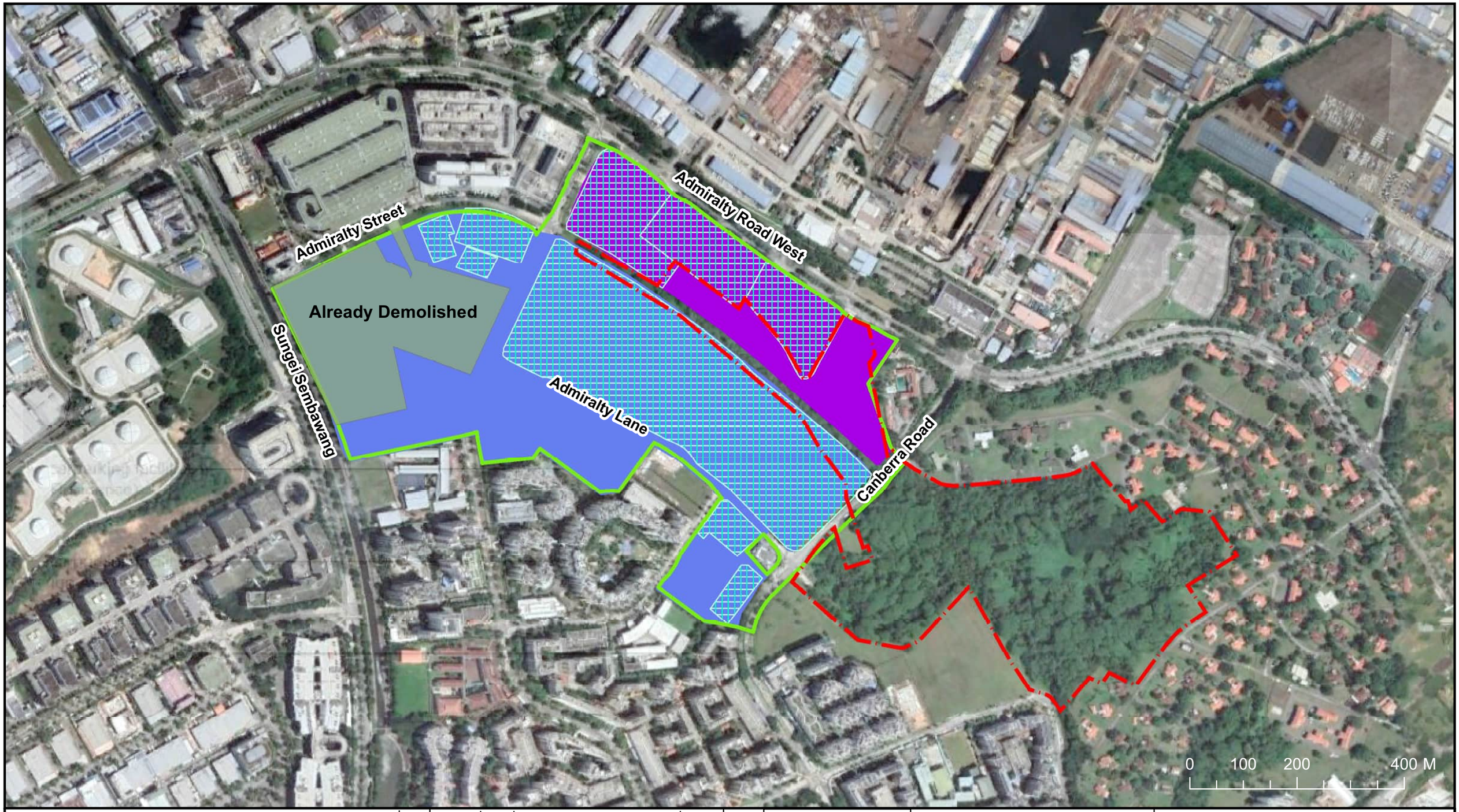
Main Activities	Related Activities	Typical Construction Machinery and Equipment Used for the Activity
Site Preparation and Pre-Construction Activities		
Site Clearance	• Tree felling and removal of other vegetation (e.g. bushes, turf, etc.) not planned to be preserved • Demolition and removal of structures currently present on the site not intended to be preserved	• Excavators • Bulldozers • Lorries
Pre-Construction Earthworks[1]	• Soil dewatering • Soil excavation, cut and fill • Site levelling to obtain planned platform levels • Soil excavation for foundations (i.e., excavation of soil to depth at which the foundations of the future structures will be placed)	• Temporary water pumps • Excavators • Bulldozers • Graders • Rollers • Lorries • Generators
Establishment of Temporary Structures and Infrastructure	• Construction of access roads and other infrastructure required for construction activities • Construction of temporary structures (e.g. dormitories) required for the construction phase of the Project	• Temporary water pumps • Excavators • Graders • Rollers • Lorries • Concrete trucks • Concrete vibrators • Generators
Main Construction Activities		
Foundation Works	• Delivery and installation of construction machinery (i.e., crawler crane for lifting operations and boring rig for soil drilling) • Soil dewatering • Installation of bore casings • Soil boring work • Installation of rebar cage and tremie pipe • Concreting works – construction of piles and pile caps • Pile head hacking/ removal • Delivery of steel sections	• Temporary water pumps • Mobile cranes • Crawler cranes • Bore pilling machines • Ready-mix concrete trucks • Breakers • Welding equipment • Trailers • Excavators (with and without lifting appliance) • Mini Excavators • Dump trucks

[1] Including Soil Investigation (SI) Works

Main Activities	Related Activities	Typical Construction Machinery and Equipment Used for the Activity
	• Hot works – welding of steel beams, brackets, etc. • Stage excavation • Hoisting of walers and struts • Stage excavation with walers and struts • Spoil and slurry removal	• Generators
Superstructure Works (Prefab Installation)	• Soil dewatering (i.e., groundwater extraction and pumping of rainwater) • Establishment of power supply (e.g. for lighting, pumps, temporary ventilation fans) • Excavation below ground surface (e.g. for working platform, for preparing lean concrete) • Spoil removal • Formwork construction and cleaning before casting • Rebar handling and positioning • Hoisting of falsework • Casting of concrete • Scaffolding • Finishing works (e.g. plastering, waterproofing, tiling, etc.)	• Temporary water pumps • Excavators • Mini excavators • Cranes • Mobile cranes • Air compressor • Dump trucks • Ready-mix concrete trucks • Concrete pumps • Generators
Landscape Works	• General landscaping activities • Construction of landscape amenities/ constructions (e.g. gazebos, pathways)	• Generators • Excavators mounted sheet pile vibrator • Mobile cranes • Welding and cutting equipment
Removal of Temporary Structures and Reinstatement	• Removal of Earth Retaining and Stabilising Structures (ERSS) • Reinstatement of the area to original (or required) condition	• Generators • Excavators mounted sheet pile vibrator • Mobile cranes • Welding and cutting equipment • Trucks

3.3.1 Tentative Project Timeline

The Project is planned to be constructed in two phases, tentatively corresponding to southern and northern parcels (refer to Figure 3.2.1). Site clearance of the existing structures at the southern and northern parcels will start approximately at the same time. However, the main construction works (i.e. foundation works, superstructure construction) will first start at the southern parcels, starting east towards the west. Superstructure works at the northern parcel will start towards the end of superstructure construction works at the southern ones.



Legend

- Project site
- Forested Area/ Biodiversity Study Area
- Northern Parcel
- Southern Parcel
- Sites to be demolished
- Demolished Buildings

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	TYL	Final Report	SAG	JAG
-	JUL 2024	TYL	Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Tentative southern and northern parcels

Designed	Checked	Approved
JOL	SAG	JAG
	Drawn: TYL	Date: AUG 2024

Figure No. : 3.3.1 | Rev. : 1 | Sheet : 1 of 1

CAD File Name : NA | A3

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3.3.2 Site Preparation and Pre-Construction Activities

Site preparation and pre-construction activities will be carried out in the initial stage of the Project and their objective is to prepare the site so that the main construction activities (e.g. foundation works, superstructure works) can be carried out. This phase usually includes site clearance (i.e. demolition of existing structures and removal of existing trees and vegetation not intended to be preserved), earthworks (i.e. cutting and filling to achieve desirable platform levels required for the proposed developments), construction of access roads and other infrastructure for construction work machinery as well as the establishment of temporary structures and infrastructure and utility diversion. Although Environmental Site Assessment (ESA) and Soil Investigation (SI) are planned to be carried out prior to site clearance and earthworks, these do not fall under the scope of the Project and will not be included in this Report.

3.3.2.1 Site Clearance

Site clearance is one of the first activities to be carried out as a part of site preparation for construction works. It will involve the demolition of existing structures and the removal of trees and vegetation not deemed to be pre-served.

3.3.2.1.1 Demolition of existing structures

A number of existing sites within and surrounding the Project site have been identified for demolition prior and/ or during the construction phase of the Project. Existing buildings/ structures within the Project site (refer to Figure 3.1.1) which are planned to be demolished are listed in Table 3.2.

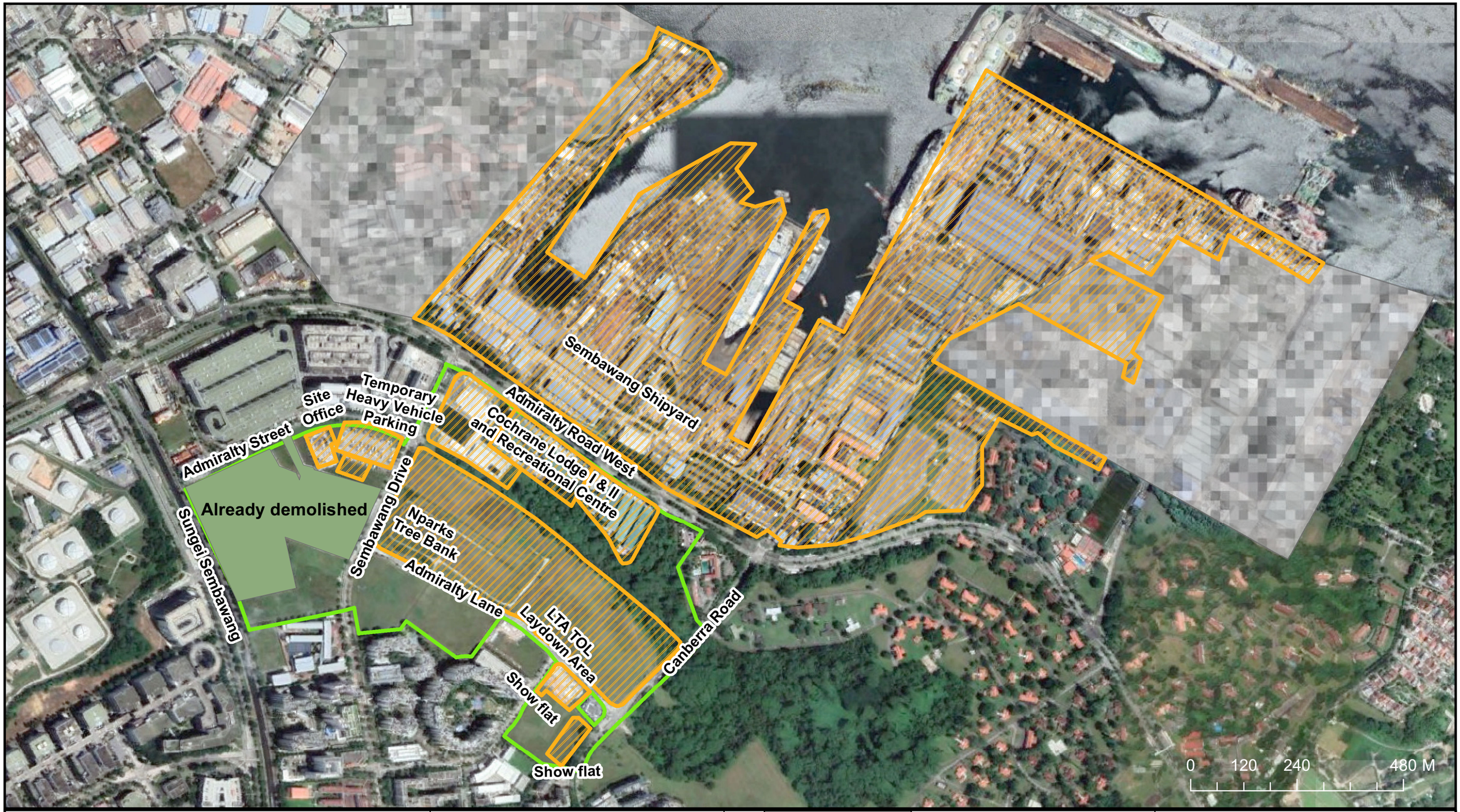
Table 3.2 Sites planned for demolition

Existing Sites to be Demolished
• Admiralty Street Dormitories • Site office adjacent to Admiralty Street • Temporary heavy vehicle parking adjacent to Sembawang Drive • Cochrane Lodge I & II and Recreation Centres • Showflat adjacent to Canberra Road • NParks' Tree Bank • Land Transport Authority's (LTA) Laydown Area under Temporary Occupation Licence (TOL)

3.3.2.1.2 Tree clearance

Removal of the trees, turf, other vegetation, and topsoil from the site is also planned to be carried out during site clearance as majority of the site will experience land use change (i.e., construction of commercial and residential developments, educational institutions, and accompanying infrastructure such as roads). This will be done by using excavators and/ or bulldozers. It should be noted that prior to removal of vegetation, an arboriculture assessment of the trees should be carried out and selected trees should be transplanted. Furthermore, wildlife specialists should be consulted to develop and carry out pre-felling inspection and wildlife shepherding, as necessary.

In addition to noise, site clearance activities generally also generate substantial amounts of waste such as excavated topsoil (spoil material not intended to be reused), organic material (e.g. trees, vegetation) and debris from demolished structures. Generated solid waste will be safely collected, stored, and removed from the site by dump trucks and lorry cranes, while topsoil is retained on site and reinstated by the earthworks contractor as much as possible. Potential impacts arising from site clearance (and other potential construction phase impacts) were assessed in Section 7 of this Report.



Legend

- Demolished Buildings
- Areas expected to have demolition works
- Project Site

N

Rev.	Date	By	Description	Chk'd	App'd
1	JUN 2024	TYL	Draft Final Report	SAC	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Sites to be demolished before and during the construction phase

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3.3.2.2 Pre-Construction Earthworks

Following the demolition of existing structures and removal of existing vegetation and topsoil, earthworks will be carried out. This will include activities during which the soil will be excavated, transported, placed at the new location and compacted. The excess soil which is not used for backfilling will be permanently removed from the site. It should be noted that earthworks usually also require soil dewatering to ensure dry conditions of soil, which is especially important during foundation works.

3.3.2.2.1 Civil Engineering Earthworks

Civil engineering earthworks will be carried out prior to or concurrently with civil engineering works and they will include earthworks required for foundation works (refer to Section 3.3.3.1), as well as earthworks for construction of accompanying infrastructure (e.g. temporary and permanent roads, drainage and sewerage systems, etc.).

Internal temporary roads for the movement of personal vehicles, heavy vehicles and machinery are generally constructed from aggregate/ soil which is placed on the selected location and then compacted. Compaction of the material used for temporary roads may be carried out by machinery and equipment such as rollers or rammers. The information regarding the location of future site access(es) and the layout of temporary roads is not available at the time of writing this Report.

Other civil engineering earthworks (e.g. excavation of trenches for drainage and sewage systems, soil excavation for foundation) are usually carried out prior to the related main construction activity.

3.3.2.2.2 Site Levelling

Currently, the northern and western portions of the Project site are urbanised, while the remaining parts are mostly vegetated, covered in managed turf. The exception is the N4 Forested Area that, together with the N5 Forested Area (across Canberra Road), forms a habitat continuum. The terrain is generally flat, with mild slopes that will be levelled for the main construction activities to start. This may involve cutting of the areas where proposed platform levels are lower than the existing terrain levels and filling and stabilising of slopes in areas which are currently lower than the proposed future platform levels. In this case, geotechnical engineers will develop Earth Retaining Stabilisation Structures (ERSS) schemes to stabilise the exposed slopes in their engineering design. Qualified Erosion Control Professional (QECP) considers measures to prevent erosion of soil into the nearest watercourses (i.e., Sungei Sembawang at the west boundary of the Project site). This may or may not accompany ground improvement works depending on the nature of the soil in the area. One example of site levelling in a construction site is shown in Figure 3.3.3. Site levelling would involve large machinery such as excavator, lorry, concrete vibrator, grader, roller, etc.

The earthworks as described above may cause adverse impacts on biodiversity due to reduced habitats. Surface water flow conditions may be impacted due to changes in hydrology of the site (i.e., increased runoff due to decreased permeability into the soil) while the quality of the receiving watercourses may be impacted by potential contaminants from earthworks activities (e.g. silty water). Impacts on other environmental conditions also include elevated airborne noise due to operation of machinery. These potential impacts have been assessed in Section 7 of this Report.



Figure 3.3.3 An example of site levelling at construction worksite in Singapore (AECOM©)

3.3.2.3 Establishment of Temporary Structures and Infrastructure

Following the earthworks, and prior to construction activities, the temporary structures and infrastructure will be set up within construction site. Usually, this entails construction and/ or installation of site features such as offices, toilets, storage areas (e.g. for materials, waste, equipment, chemicals, etc.), internal temporary roads for vehicular movement, site hoardings, noise barriers, perimeter drains (i.e. C7 perimeter drain) as well as waste management facilities. At the time of writing this Report no information regarding the establishment of temporary structures and infrastructure was available. However, the potential impacts arising from use of these structures (e.g. water contamination due to spills and leaks of chemicals) and related activities have been addressed in Section 7 of this Report.

3.3.3 Main Construction Activities

Once the site preparation and pre-construction activities are completed, the main construction activities, such as foundation works, superstructure works, construction of proposed new roads, widening of existing roads and laying of utilities/ services will take place.

3.3.3.1 Foundation Works

Once demolition works and site clearance are completed and temporary worksites are established, foundation works for substructures, including piles and pile caps will be carried out. According to the tentative Project development timeline, foundation works will firstly start at southern parcels. Foundation works at the northern parcels are expected to start after the construction activities at the southern parcels have finished.

To begin the foundation piling process, installation of crawler crane and boring rig are required, and mobile crane may be used for lifting and transporting actions. After setting up the pile position, a temporary guide casing with an internal diameter same as pile diameter is installed using crawler crane to the pile centre of the marked position to prevent collapse of the surrounding soil. The temporary casing also serves as a guide in forming a uniform basis for the following boring works until the designed depth using a bored piling machine. This can be very intensive and generate noise and vibration. Thereafter, the reinforced bars (rebar) are installed using a crawler crane to enhance the strength of concrete pile, followed by the tremie pipe installation to better support the concreting works. The ready-mix concrete, transported by a concrete truck, is poured into the borehole using crawler crane. During circumstances when there is extra pile head after the completion of bored piling, pile head hacking is conducted using breaker and excavator.

To seal the pile foundation, a pile cap is necessary. For this, steel waler and struts are required to hold the temporary formworks to proceed with pile cap concreting. The steel is delivered with a 40-feet trailer where hot works (e.g. welding of steel beams, brackets, etc.) may be required with the usage of welding equipment. Hoisting of waler and struts is carried out using an excavator with lifting appliance.



Figure 3.3.4 An example of piling/ foundation works in Singapore (AECOM©)

3.3.3.2 Superstructure Works

As mentioned earlier, superstructure works are expected to start firstly at the southern parcel (following the foundation works). After finalisation of construction activities in the southern parcels, activities such as site-clearance, earthworks, foundation works and superstructure works are planned to start in the northern parcels. Therefore, it is to note that operational phase of the southern parcels will coincide with the construction phase of the northern parcels.

The on-site power supply for lighting, pumps and temporary ventilation fans operation will be provided by generators. Before the installation of superstructures, temporary water pumps are positioned to pump the water from ground or collected rain in order to prevent it from affecting the quality of concrete. To form the working platform, excavation below surface is conducted using an excavator, followed by the formation of lean concrete as the first ground layer for waterproofing purposes. Crane is used for the spoil removal as well. To construct building until the designated height, temporary formwork is necessary at each level before casting, where air compressor will be used for cleaning. During this process, mobile crane is used to transport rebar and for the hoisting of falsework, formwork, scaffolding and the construction of temporary working platforms. A concrete truck is used to transport ready mix concrete to the site and concrete pump is used for the superstructure's concreting works.

The completion of superstructure is generally followed by finishing works, such as interior plastering, exterior plastering, waterproofing and tiling, mechanical/ electrical/ plumbing (MEP) rough-in a ceiling installation, painting, lift installation, exterior glass walls, windows and doors installation, as well as setting up building systems (i.e., electrical, plumbing, air-conditioning, etc.).



Figure 3.3.5 An example of superstructure construction works in Singapore (AECOM©)

3.3.3.3 General Landscaping Works

As part of the proposed development, it is expected that landscaping features will be developed in order to enhance sensory (e.g., visual) experience of the future users (i.e., parks, open areas for public, future permanent residents, general public, etc). These may include planting of trees and shrubs, lawn space, etc. Based on the

latest land use plan green features (i.e. park) is proposed to be developed within the site. However, at the time of writing this Report, there were no detailed plans regarding the landscape enhancements planned to be incorporated into this green feature.

Generators may or may not be used at this stage to provide the power supply for lighting and running of machinery during landscaping works. If needed, excavator and mobile crane will be used to remove patches of soil and relocate them or transport from the site. Welding and cutting equipment are commonly used to form landscape structures. The potential environmental impacts associated with the general landscaping works will be assessed and incorporated as a whole in the relevant section of this Report.

3.3.3.4 Removal of Temporary Structures and Reinstatement of the Project Site

As the final step towards completion of construction activities, the developer and/ or contractor will remove all the temporary structures for the reinstatement of working area to its original condition and/ or required conditions. A well-reinstated and stabilised land will also enhance the landscape and visual amenity values to create a better living environment for the public and residents of this development. Therefore, the potential environmental impacts associated with the removal of temporary structures and reinstatement of the Project site will be assessed and incorporated as a whole in the relevant section of the Report.

3.4 Proposed Activities During Operational Phase

Following the reinstatement period, human activity will increase as the development area becomes operational. The Project site will likely see an associated increase in human activity such as traffic movement, lighting, and general human activities. During the operational stage, the vehicular traffic volume in the vicinity and within the site is predicted to increase when the proposed public housing and its associated road network starts operating. These abovementioned activities may cause potential noise nuisance, water pollution and disturbance to biodiversity in the vicinity of the development (i.e. N5 Forested Area). In addition, more impervious surfaces are expected due to the potential change of natural landscape to urbanised area which will reduce stormwater infiltration into the ground and increase surface water runoff.

Concurrent projects in the vicinity of the Project site such as demolition works will be phased out in the future during operational phases. Hence, it is expected that there will be an overall reduction in airborne noise levels. This will be considered in the Airborne Noise Impact Assessment study.

3.5 Concurrent Projects

During both construction and operational phases, there will be concurrent projects in the vicinity of the Project site. Table 3.3 lists the concurrent projects and their respective timelines.

Table 3.3 List of concurrent projects and their timelines

Concurrent Projects	Project Timeline
Demolition works within Sembawang Shipyard	Expected to occur during this Project's timeline.

The timeline and construction activities of these concurrent projects in the vicinity will also be considered in the Impact Assessment study.

4 Environmental Legislation, Policies, Standards and Criteria

Indicative lists of relevant local and international legislative requirements applicable to the Project are provided in Table 4.1 and Table 4.2, respectively.

Table 4.1 Relevant regulatory framework in Singapore

Environmental Parameter	Applicable Legislation, Standards, and Guidelines	Key Points
General	Singapore Environmental Protection and Management Act, 1999 (2020 Revised Edition) [R-2]	• An Act to consolidate the laws relating to environmental pollution control, to provide for the protection and management of the environment and resource conservation, and for purposes connected therewith; • For surface water, it regulates the discharge of trade effluent, oil chemical, sewage or other pollution onto land and drains.
	Singapore Environmental Public Health Act, 1987 (2020 Revised Edition) [R-22]	• An Act to consolidate the law relating to environmental public health and to provide for matters connected therewith; • With regards to waste management, it regulates removal of refuse, disposal and treatment of industrial waste, disposal facilities and general health requirements for buildings.
	Singapore Energy Conservation Act, 2012 (2020 Revised Edition) [R-21]	An Act to mandate energy efficiency requirements and energy management practices to promote energy conservation, improve energy efficiency and reduce environmental impact.
	Singapore NEA Code of Practice (COP) on Environmental Health (2021 Edition) [R-20]	• The COP on Environmental Health provides the guidelines for Qualified Professionals (QP) (e.g. architects, engineers, developers) on the environmental health concerns and requirements in the design of the buildings. It defines the objectives to be met and sets out the minimum design criteria; • It stipulates the design requirements for various aspects of developments such as refuse storage and collection system, public toilets, ventilation, cooling towers, aquatic facilities, storage, and anti-mosquito breeding.
	Singapore Biodiversity Impact Assessment (BIA) Guidelines, 2021 [R-1]	• This document is published by NParks to provide a framework guiding biodiversity impact assessments in Singapore. It recommends methods for conducting baseline survey and impact assessment, and subsequently provide information on developing the biodiversity component of an Environmental Management and Monitoring Plan (EMMP); • Section 2 of this BIA Guidelines detailed the baseline study methods recommended for vegetation mapping, habitat mapping, hydrology (including waterbody mapping, water conditions, water quantity and water quality); • Section 4 of the BIA Guidelines detailed the impact study methods recommended for air, noise, soil, water related biodiversity impacts • Section 5 of the BIA Guidelines detailed the mitigation measures developing protocols, i.e., avoid, minimise, remedy/ repair/ restore, and compensate/ offset; • Section 6 of the BIA Guidelines outlined the requirements for developing an EMMP.

Environmental Parameter	Applicable Legislation, Standards, and Guidelines	Key Points
Biodiversity	Flora of Singapore: Checklist and Bibliography, 2022 [P-2]	• Updated checklists of all flora of Singapore that is with reference to 'Flora of Singapore: Checklist and bibliography' by Lindsay et al., 2022; • Published by Gardens' Bulletin Singapore; • Provides the scientific name, national conservation status and the bibliographical information of each plant listed.
	Singapore National Biodiversity Strategy and Action Plan (NBSAP), 2019 [R-29]	• This document provides a framework to guide biodiversity conservation efforts in Singapore. It intends to establish both policy frameworks and specific measures to ensure better planning and co-ordination in the sustainable use, management, and conservation of biodiversity; • A holistic approach has been adopted where the input of various public sector agencies and nature groups have been taken into consideration in the preparation of the document.
	Singapore Wildlife Act, Chapter 351, 2000 (Act 18 as of 2020) [R-30]	• An Act for the protection, preservation, and management of wildlife for the purposes of maintaining a healthy ecosystem and safeguarding public safety and health, and for related matters; • 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 the health, welfare or safety of any wildlife or class of wildlife; public health in relation to wildlife or health of ecosystem.
	Singapore Parks and Trees Act, 2006 [R-31]	• An Act to provide for the planting, maintenance and conservation of trees and plants within national parks, nature reserves, tree conservation areas, heritage road green buffers and other specified areas, and for matters connected therewith; • No tree with a girth exceeding one meter (when measured 1-m from the ground) located within tree conservation areas and vacant lands should be cut or damaged without the prior approval of the relevant authorities; • No tree or plant will be cut or damaged if located within the heritage road green buffer; • Prohibitions and regulations on trees and animals within national park, nature reserve or public park.
	Singapore Parks and Trees (Heritage Road Green Buffers) Order, 2006 [R-32]	Lists the areas designated as heritage road green buffers.
	Singapore Parks and Trees (Preservation of Trees) Order, 1998 [R-33]	• Lists the designated tree conservation areas; • No cutting or damaging of tree having girth of more than one metre.
	Species List (Red Data Book List) by the National Parks Board, 2023 [W-2]	• Lists the threatened plants and animals in Singapore; • Published by National Parks Board; • Provides the scientific name, common name and status.

Environmental Parameter	Applicable Legislation, Standards, and Guidelines	Key Points
Water Resources (i.e. Hydrology, Water Quality and Groundwater Level)	Singapore Sewerage and Drainage Act, 1999 (2020 Revised Edition) [R-13]	• An Act to provide for and regulate the construction, maintenance, improvement, operation and use of sewerage and land drainage systems, and to regulate the discharge of sewage and trade effluent; • Regulates the protection, maintenance and provision of sewerage and stormwater drainage systems.
	Singapore Sewerage and Drainage (Surface Water Drainage) Regulations, 1999 (2007 Revised Edition) [R-14]	Regulations that limit TSS concentration of water to be discharged into stormwater drainage system and to put into effect COP on Surface Water Drainage (specifies minimum engineering requirements and control measures for surface water drainage).
	Singapore Sewerage and Drainage (Trade Effluent) Regulations, 1999 (2007 Revised Edition) [R-15]	Regulations that specify nature and type of trade effluent as well as allowable limits of certain chemicals in trade effluent to be discharged into public sewers. Any discharge of effluent into public sewer has to comply with these regulations.
	Singapore Environmental Protection and Management (Trade Effluent) Regulations, 1999 (2008 Revised Edition) [R-3]	Regulations that specify nature and type of trade effluent as well as allowable limits of certain chemicals in trade effluent to be discharged into controlled watercourses and other watercourses. Any discharge of effluent into a watercourse and/ or controlled watercourse has to comply with the regulatory standards established in these regulations.
	Singapore SS 593: 2013 – Code of Practice for Pollution Control (COPPC) [R-11]	• Provides guidelines for the appropriate discharge of any effluent into public sewer or watercourse; • Provides guidelines for the appropriate storage and accidental release of oils & chemicals.
	Singapore PUB COP on Surface Water Drainage, 2018 (2021 Addendum) [R-16]	Provides guidelines for measures to be implemented to protect the stormwater drainage system and manage surface water drainage (e.g. development and implementation of an Earth Control Measures [ECM] plan).
	Singapore Allowable Limits for Trade Effluent Discharge to Watercourse or Controlled Watercourse (NEA) [R-37]	Provides allowable limits for trade effluent discharge to watercourse or controlled watercourse in Singapore.
	Singapore PUB Circular on Preventing Muddy Water from the Construction Site, October 2015 [R-17]	All new construction sites with site area of 0.2ha and above, sites with problematic ECM, and sites within sensitive areas are required to implement closed-circuit television (CCTV) including a Silty Imagery Detection System (SIDS) at the public drain to monitor the surface run-off discharges from the sites.
Airborne Noise	Singapore Environmental Protection and Management (Control of Noise at Construction Sites) Regulations, 2008 [R-24]	• Stipulates a set of maximum allowable noise limits for construction sites for different time periods of the day and for different types of premises affected by construction noise; • Stipulates the correction factor that needs to be applied to the applicable noise criteria based on background noise levels.
	Singapore SS 593: Code of Practice for Pollution Control (COPPC), 2013 [R-11]	Specifies recommended pollution control requirements and good practices for prevention of impacts to noise.

Environmental Parameter	Applicable Legislation, Standards, and Guidelines	Key Points
	Singapore SS602:2014 Code of Practice for Noise Control on Construction and Demolition Sites [R-34]	Specifies recommendations and good practices for prevention of noise impacts from construction and demolition activities.
	Singapore Technical Guideline for Land Traffic Noise Impact Assessment from National Environment Agency (NEA) [R-26]	Airborne noise limit (from MRT trains) of LAeq1hr of 67 dB when measured at 1 m from the façade of existing residential buildings/noise sensitive premises are set by the National Environment Agency (NEA).
	Singapore Technical Guideline on Boundary Noise Limit for Air Conditioning and Mechanical Ventilation Systems in Non-Industrial Buildings by National Environmental Agency (NEA); Code of Practice on Pollution Control by National Environment Agency [R-25]	Legislative requirements for boundary noise due to noise emissions from mechanical ventilation systems for non-industrial buildings.

Table 4.2 Relevant international standards and guidelines

Environmental Parameter	Applicable Legislation, Standards, and Guidelines	Key Points
Biodiversity	The International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threated Species [R-36]	Provides taxonomic, conservation status and distribution information on plants, fungi and animals that have been globally evaluated.
	The Hong Kong Environmental Impact Assessment Ordinance - Technical Memorandum (HK EIAO TM)[2] [R-40]	Sets out the principles, procedures, guidelines, requirements, and criteria for deciding whether the Project is environmentally acceptable.
Water Resources (i.e. Hydrology, Water Quality and Groundwater Level)	United States Environmental Protection Agency (USEPA) Water Quality Standards Handbook, 2017 [R-5]	Provides standards for water quality assessment relating to aquatic life for surface watercourses.
	Strategic Plan of Action on Water Resources Management ASEAN (2005) [R-12]	Provides a consolidated framework for the classification of water resources and associated water quality standards for each class.
	Australian & New Zealand Guidelines for Freshwater and Marine Water Quality, 2000 [R-6]	Provides standards for water quality assessment relating to aquatic life for surface watercourses.
	Canadian Water Quality Guidelines for the Protection of Aquatic Life, 2007 [R-7]	Provides standards for water quality assessment relating to aquatic life for surface watercourses.

[2] The HK EIAO TM was added as an applicable legislation for biodiversity because: (1) Singapore does not have an established standard for biodiversity assessment yet; (2) Singapore and Hong Kong share similar urban development setting; and (3) HK EIAO TM has previously been used for other environmental impact studies in Singapore.

Environmental Parameter	Applicable Legislation, Standards, and Guidelines	Key Points
	World Health Organisation (WHO) Water Quality Requirements [R-4]	Provides standards for water quality assessment relating to aquatic life for surface watercourses.
	United Nations Economic Commission for Europe (UNECE) Standard Statistical Classification of Surface Freshwater Quality for the Maintenance of Aquatic Life, New York and Geneva 1994 [R-18]	Provides standards for water quality assessment relating to aquatic life for surface watercourses.
	Philippines Mitigating Impact from Aquaculture (PHILMINAQ) [R-8]	Provides standards for water quality assessment relating to aquatic life for surface watercourses.
	Malaysia Department of Environment (DOE) National Water Quality Standards [R-9]	Provides standards for water quality assessment relating to aquatic life for surface watercourses.
Airborne Noise	UK Biodiversity 2020: A strategy for England's wildlife and ecosystem services [R-35]	• "Theme 3: reduce environmental pressures - integrate consideration of biodiversity within the sectors which have the greatest potential for direct influence and reduce direct pressures." • The guide does not provide airborne noise criteria for biodiversity impact assessment but only serves as a reference that sets out biodiversity policies and strategies to conserve biodiversity for AECOM to consider and implement in the EIA.

5 EIA Approach and Methodology

The overall EIA workflow is shown in Figure 5.1 and the general approach to the EIA is listed as follows:

- Prediction of Impacts;
- Evaluation of Impacts;
- Recommendations of Mitigation Measures; and
- Environmental Management and Mitigation Plan (EMMP).

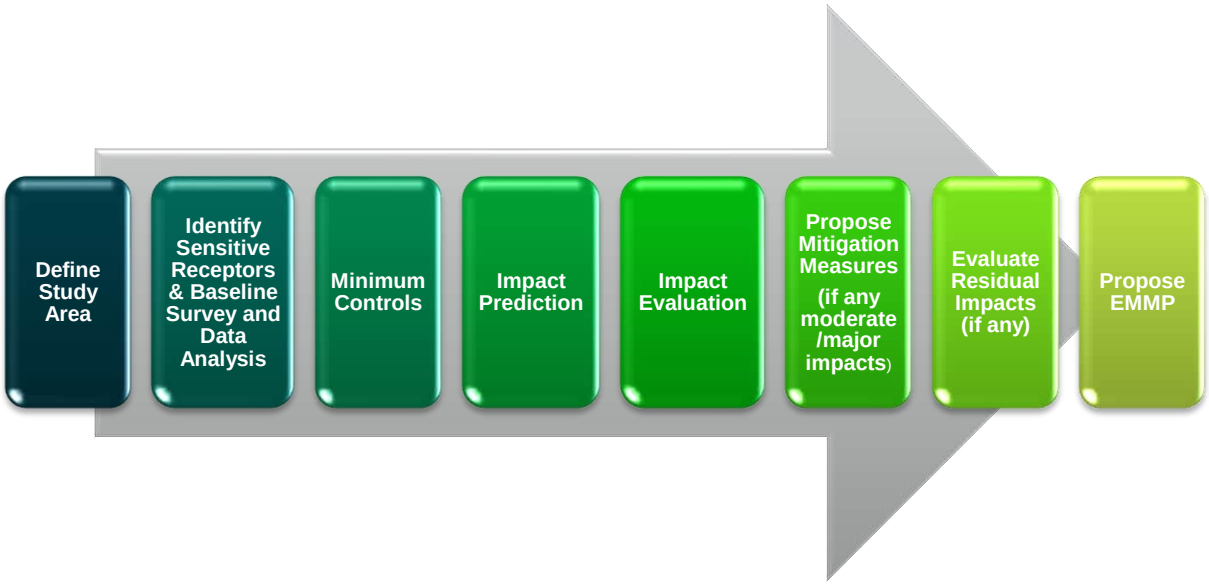


Figure 5.1 Overall EIA workflow

5.1 Scoping of Project

Referring to the Inception Report Rev 02, the environmental impacts resulting from the proposed activities during construction and operational phases of this Project are assessed in this EIA Report as follows:

Impacts during the construction phase of the Project, including:

- Direct impacts on biodiversity (e.g. construction phase activities, proposed developments, etc.)
- Impacts on biodiversity due to potential changes in baseline conditions of water resources and airborne noise

Impacts during the operational phase of the Project, including:

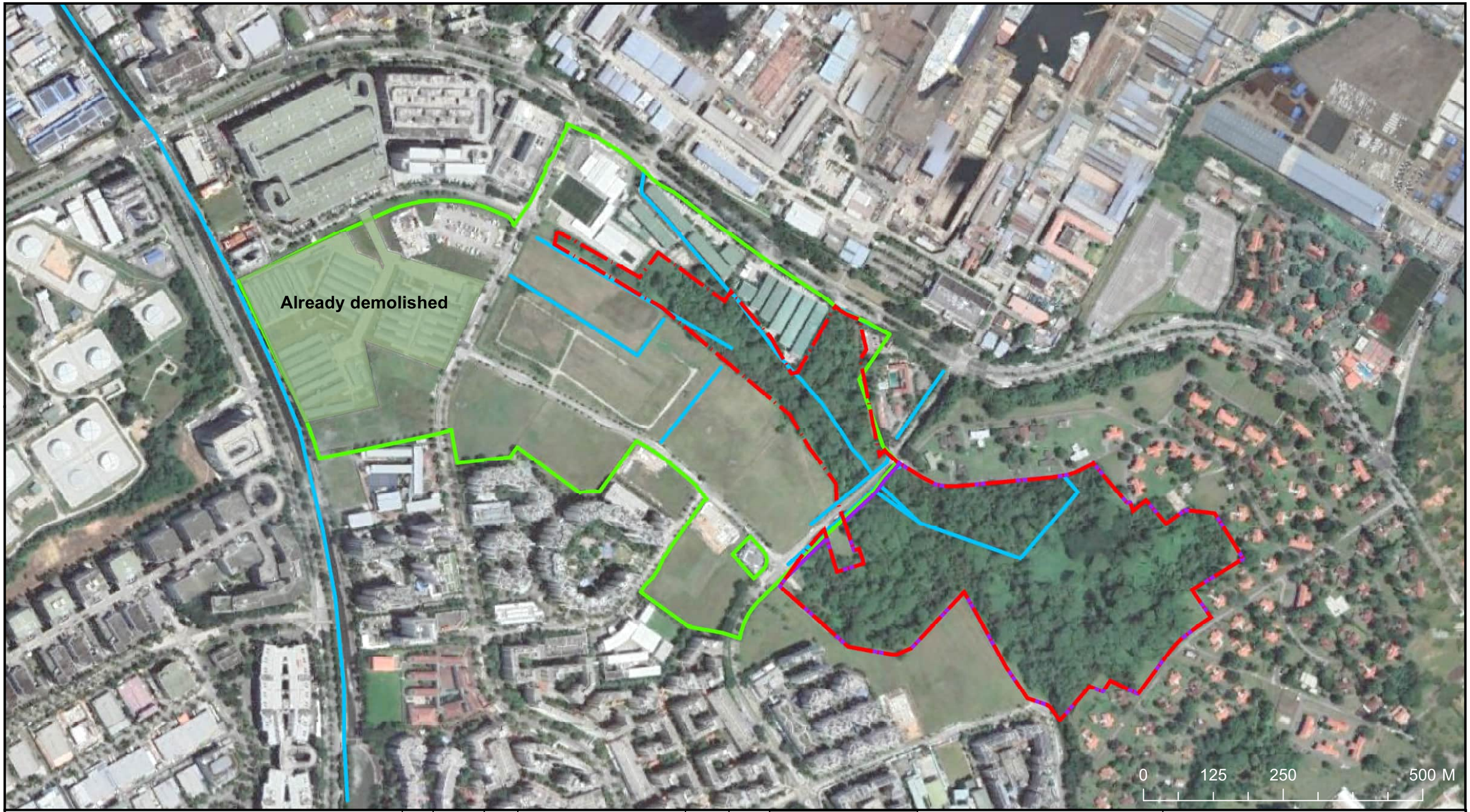
- Direct impacts on biodiversity (e.g. operational phase activities, permanent land use changes, etc.)
- Impacts on biodiversity due to potential changes in baseline conditions of water resources and airborne noise

5.1.1 Identification of Study Areas

The environmental parameters that were proposed to be studied in the EIA and the extent of their respective Study Areas are summarised in Table 5.1.

Table 5.1 Environmental parameters assessed in this EIA and their respective Study Areas throughout the construction and operational phases

Environmental Disciplines	Definition of Study Area	Key Impacted Parameters
Biodiversity	The Study Area for biodiversity impacts is defined as the habitats, flora and fauna within the biodiversity Study Area (i.e. N4 and N5 Forested Areas).	• Habitats • Flora • Fauna • Ecological Connectivity
Water Resources	Waterbodies/ Watercourses with direct impact from the proposed development.	• Hydrology • Surface Water Quality • Groundwater Level
Airborne Noise	<u>Construction Phase</u> • Biodiversity Study Area outside of Project site (i.e. N5 Forested Area). <u>Operational Phase</u> • Immediate boundary of the operational footprint and 70 m from roads.	Airborne Noise on Fauna



Legend

- Project site
- Forested Area/ Biodiversity Study Area
- Airborne Noise Study Area
- Water Resources Study Area
- Demolished Buildings

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	TYL	Final Report	SAG	JAG
-	JUL 2024	TYL	Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Study Areas for environmental parameters

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
TYL	SAG	JAG	5.1.1	1	1 of 1
	Drawn TYL	Date AUG 2024	CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

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5.1.2 Identification and Categorisation of Sensitive Receptors

Sensitive receptors are those ecological receptors within or in the vicinity of the Project site which may potentially be impacted by the Project's construction and operational phases. Environmentally sensitive receptors are categorised into three categories: Priority 1, Priority 2 and Priority 3 (from the most sensitive to the least) as shown in Table 5.2. The identification of sensitive receptors for each environmental parameter will be developed based on the findings of the environmental reconnaissance surveys, baseline surveys and review of the proposed Project Study Areas.

Table 5.2 Receptor sensitivity classification

Environmental Parameter	Receptor Sensitivity		
	Priority 1	Priority 2	Priority 3
Biodiversity	Flora, fauna species and habitats of high ecological value. (i.e., presence of conservation significant flora and fauna species; identified keystone species; flora species that is essential for the survival of threatened fauna species)	Flora, fauna species and habitats of moderate ecological value. (i.e., mainly native species of flora, fauna and habitats)	Flora, fauna species and habitats of low ecological value. (i.e., mainly exotic or cryptogenic flora, fauna and habitats; managed vegetation which can provide habitat for significant species)
Water Resources **(Hydrology)**	• Aquatic habitats and/ or biocenosis of high ecological value that are highly dependent on surface water flow conditions and/ or quantities. Examples of fauna include fish, amphibians, odonates in aquatic or semi-aquatic habitats; • Aquatic habitats and/ or biocenosis of high ecological value which would be permanently impacted by changes in surface water flow conditions.	• Aquatic habitats and/ or biocenosis of high ecological value that are resilient of changes in water quantities and water flow conditions; • Terrestrial habitats of high ecological value that obtain water from multiple sources.	• Habitats and/ or biocenosis that are not of high ecological value; • Habitats and/ or biocenosis that will not be disturbed due to changes in existing hydrology.
Water Resources **(Surface Water Quality)**	Aquatic or semi-aquatic habitats and its biocenosis of high ecological value with low tolerance [3] to changes in surface water quality.	Aquatic or semi-aquatic habitats and its biocenosis of medium ecological value with medium to high tolerance to changes in surface water quality.	• Aquatic or semi-aquatic habitats and its biocenosis of low ecological value; • All terrestrial habitats.

[3] Tolerance to changes in surface water quality for identified ecological receptors will be determined with biodiversity specialists

Environmental Parameter	Receptor Sensitivity		
	Priority 1	Priority 2	Priority 3
Water Resources **(Groundwater Level)**	Watercourses highly dependent on groundwater inflow which support habitats and/ or species of high ecological value.	Watercourses partially dependent on groundwater inflow which support habitats of high ecological value.	• Watercourses that are not dependent on groundwater inflow and which support habitats of high ecological value; • Watercourses not supporting habitats of high ecological value.
Airborne Noise[4]	Areas inhabited by fauna Conservation Significance (CS)/ non-CS species that use sound for communication, foraging and breeding, and are known to have their behaviours disrupted by increase in baseline noise (e.g., due to immobility from impacted area such as raptor nests).	Areas inhabited by species of Conservation Significance (CS) that are less affected by airborne noise; or CS species which have the ability to move away temporarily to neighbouring areas which are not impacted by the construction noise.	Area inhabited by species that are less affected by airborne noise and are not of Conservation Significance.

Habitats and species recorded or deemed probable during the baseline study were assessed for their ecological value. Habitats and species accorded with higher ecological value were regarded of greater importance for conservation. Those of high ecological value were assigned the Priority 1 sensitivity level, while those of moderate or low ecological value were assigned the Priority 2 or 3 sensitivity levels, respectively.

Habitats

The ecological value assessment framework for habitats is based on the distinguishing features of the habitats, including species richness, irreplaceability, rarity in the national context, and the degree to which the habitats support species rarely found in other habitats (Table 5.3) (Crosher et al., 2019).

All habitats were accorded an ecological value, i.e., high, medium, or low, based on the criteria in Table 5.3.

Flora

All plant species were first accorded with a tentative ecological value, i.e., high, medium, or low, based on the basic framework (Table 5.4):

- High ecological value (Priority 1): Species of conservation significance
- Medium ecological value (Priority 2): All other native species
- Low ecological value (Priority 3): Exotic and cryptogenic species

For species that were tentatively assigned Priority 2 (i.e., all other native species) or Priority 3 (i.e., exotic and cryptogenic species), their ecological values were evaluated individually based on the criteria listed in Table 5.5.

The evaluation of individual species served to either maintain, raise, or reduce the pre-assigned ecological value. The following paragraphs detail how each criterion was considered in the evaluation:

[4] The fact is that different species are likely to react differently to disturbance and that will be influenced by various other factors such as how percussive the noise is (e.g., from blasting and piling), how far away the receptor is generally, behaviour of the fauna, and other factors such as whether the species is feeding or breeding/nesting and in particular from the complication of visual disturbance (particularly humans on foot nearby).

Local and national distribution (native species only): The ecological value of native plant species takes into consideration the local and national distribution of the plant species. Local distribution—i.e., occurrence of specimens of native plant species at one or multiple locations within the Study Area— are first assessed for all native species.

Following that, the national distribution of the plant species was assessed. A plant species is considered to have a restricted national distribution if specimens of the species can mostly be found in certain forest patches of generally higher ecological value, such as the primary and old growth secondary forests of the nature reserves in Singapore, or offshore islands. On the other hand, a plant species is regarded as nationally widespread if specimens of the plant species occur at several secondary forest patches throughout Singapore.

Generally, plant species with restricted local and national distribution will have their ecological value raised. Plant species with widespread local distribution but restricted national distribution, or vice versa, will maintain their pre-assigned ecological value. On the other hand, plant species with widespread local and national distribution will result in the reduction of their pre-assigned ecological value.

Association with important fauna (native, exotic, and cryptogenic species): The ecological value of plant species that directly support the growth and survival of important fauna at one or various life cycle stages was raised to high, irrespective of plant species origin, cultivation intensity and effects, as well as national distribution. Examples of such plant species include caterpillar host plants for rare butterfly species and bamboos that are refugia for nationally threatened bamboo bats. The ecological value of plant species without associations with important fauna was maintained at the original level, i.e., medium, or low.

There are, however, a few exceptions in which the highest ecological value was automatically assigned to species regardless of the criteria listed below. They are (1) species endemic to Singapore; and (2) keystone fig (Ficus sp.) as they fruit all year round and provide a steady source of food for frugivores (Lok et al., 2013); and (3) species planted for reforestation and/ or previously thought to be extinct and which are planted for species reintroduction.

Additionally, the exotic rain tree (*Samanea saman*) was also automatically raised from low to medium ecological value given that it often supports the growth of epiphytes that provide habitats for fauna species.

Fauna

All recorded faunal species and probable faunal species of conservation significance were accorded an ecological value based on their conservation significance and origin (Table 5.6).

Table 5.3 Criteria for assessing the ecological value of habitats

Criterion	Definition	Classification			
		High (Score 3)	Medium (Score 2)	Low (Score 1)	NA (Score 0)
Flora and fauna species richness	Terrestrial habitats The total number of flora (vascular plant) and fauna (bird, butterfly, odonate, amphibian, reptile, mammal) species that can be expected to occur in a particular habitat in Singapore, excluding introduced fauna species.	High flora and fauna species richness (>899 species)	Moderate flora and fauna species richness (600 to 899 species)	Low flora and fauna species richness (300 to 599 species)	Very low flora and fauna species richness (<300 species)
	Aquatic habitats The total number of flora (vascular aquatic plants including submerged, partially submerged, and floating species) and water-dependent fauna (bird, odonate, amphibian, reptile, mammal, decapod crustacean, fish, mollusc) species that can be expected to occur in a particular habitat in Singapore,	High flora and fauna species richness (>135 species)	Moderate flora and fauna species richness (90 to 135 species)	Low flora and fauna species richness (45 to 89 species)	Very low flora and fauna species richness (<45 species)

Criterion	Definition	Classification			
	excluding introduced fauna species.				
Irreplaceability	The difficulty of recreating or replacing the habitat to its ecologically optimal structure and species composition via human intervention, natural or accelerated succession within 30 years, with reference to known localities where such habitats have been successfully recreated in Singapore. This also takes into account re-establishing of habitat or ecosystem health, and ecological (biotic and abiotic) dynamics required to establish an effectively functioning habitat.	Impossible to recreate/ replace	Difficult to recreate/ replace	Easy to recreate/ replace	Not ideal to recreate/ replace for biodiversity
Local rarity of habitat	Terrestrial habitats Area of habitat remaining as percentage of all vegetated areas in Singapore.	Habitat is rare in Singapore (<5%)	Habitat is uncommon in Singapore (5–30%)	Habitat is common in Singapore (> 0%)	Habitat is ubiquitous in Singapore (e.g., buildings)
	Aquatic habitats The rarity of the habitat in Singapore.	Habitat is rare in Singapore (e.g., freshwater swamp forest, hill stream, freshwater marsh, mangrove forest)	Habitat is uncommon in Singapore (e.g., forest/rural river, forest/rural stream, unmanaged soft-bank pond, quarry lake)	Habitat is common Singapore (e.g., naturalised river, naturalised stream, managed soft-bank pond, hard-bank pond, reservoir, rain garden, swale, biotope)	Habitat is ubiquitous in Singapore (e.g., concrete drain).
Unique flora and fauna species	Terrestrial habitats The total number of unique flora (vascular plant) and fauna (bird, butterfly, odonate, amphibian, reptile, mammal) species that can be expected to occur in a particular habitat in Singapore. Unique species are those that are not typically found in other habitats.	Supports a high number of unique flora and fauna species (>14 species)	Supports some unique flora and fauna species (10 to 14 species)	Supports few unique flora and fauna species (<10 species)	Does not support any unique flora and fauna species
	Aquatic habitats The total number of unique flora (vascular aquatic plants including submerged, partially submerged, and floating species) and fauna (bird, butterfly, odonate, amphibian, reptile, mammal) species that can be expected to occur in a particular habitat in Singapore. Unique species are those that are not typically found in other habitats.	Supports a high number of unique flora and fauna species (>34 species)	Supports some unique flora and fauna species (23 to 34 species)	Supports few unique flora and fauna species (<23 species)	Does not support any unique flora and fauna species

Table 5.4 Sensitivity criteria for ecology (flora species). Refer to Table 5.3 for Criteria for assessing ecological value

Sensitivity	Typical Criteria (Ecology – Flora Species)
Priority 3 / Low	Low ecological value: • Common native species with widespread local and national distribution • Exotic and cryptogenic species
Priority 2 / Medium	Medium ecological value: • Common native species with either widespread local or national distribution • Species of conservation significance with widespread local and national distribution • All other native species
Priority 1 / High	High ecological value: • Species of Conservation Significance with either restricted local and/or national distribution • Common native species with restricted local and national distribution • Species of any origin associated with important fauna • Keystone species (*Ficus* spp.) • Species of conservation significance

Table 5.5 Criteria for assessing the final ecological value of plant species

Criterion	Definition
Conservation significance	Listed as nationally threatened, i.e., Vulnerable, Endangered, Critically Endangered, or Extinct, and are considered of conservation significance in this study
Local distribution	Occurrence of specimens of native plant species at one or multiple locations within the Project site
National distribution	Extent of spread and/ or occurrence at one or multiple forest patches in Singapore
Association with important fauna	Directly associated with the survival of important fauna at one or various life cycle stages

Table 5.6 Sensitivity Criteria for Ecology (Fauna Species)

Sensitivity	Typical Criteria (Ecology – Flora Species)
Priority 3 / Low	Low ecological value: Exotic species
Priority 2 / Medium	Medium ecological value: All other native and migratory bird species, and species of indeterminate status
Priority 1 / High	High ecological value: Species of conservation significance

5.2 Baseline Approach and Methodology

The baseline study aims to establish the extent and conditions of the existing environment that may be potentially affected by the execution of the proposed Project. The baseline study provides the basis for the prediction of potential impacts of the Project across each environmental parameter. The collection of pre-construction baseline environmental status at the Study Areas will be conducted using both primary and secondary sources and will help to identify sensitive receptors.

The sample collection and survey locations were selected for baseline data collection based on their proximity to the Project and receptor priority. These locations were confirmed during site reconnaissance surveys. Site visits were undertaken as tabulated in the following Table 5.7.

Table 5.7 Site visits for data collection

Environmental Parameter	Site Visits
Biodiversity	Surveys carried out June 2023 – September 2023

Environmental Parameter	Site Visits
Water Resources (i.e. Hydrology, Surface Water Quality and Groundwater Level)	Site reconnaissance survey: • 18th January 2023 • 9th June 2023 Surface water sampling dates: • 20th July 2023 (wet sampling – WQ1, WQ2, WQ3, WQ4, WQ5, WQ6, WQ7, WQ8, WQ9) • 24th July 2023 (dry sampling – all sampling locations) • 13th September 2023 (dry sampling – all sampling locations) • 16th November 2023 (wet sampling – WQ10, WQ11) • 17 October 2023 (environmental borehole drilling)
Airborne Noise	Site reconnaissance survey: • 18 January 2023 Monitoring dates: • 08 August 2023 – 15 August 2023

It should be noted that as part of this study a topographic survey was conducted to gather the data about the elevation of points within the N4 and N5 Forested Area. The purpose of a topographic survey is to collect survey data about the natural and man-made features of the land, as well as its elevations to support the impact study on the other environmental parameters.

5.2.1 Safety Contingency Plan

All on-site personnel shall be in general compliance with the requirements of the Health and Safety Plan (HASP) and Job Safety Risk Assessment developed for this site and which are respectively presented in Appendix A and Appendix B. All field surveys shall be conducted in accordance with AECOM safety procedures and requirements as documented in the HASP and Job Safety Risk Assessment.

All personnel completing the onsite baseline surveys shall be formally inducted with the HASP and Job Safety Risk Assessment. Subcontractors may follow the HASP and Job Safety Risk Assessment prepared by AECOM but it is expected that they have their internal policies and procedures in terms of health and safety. The subcontractors may adopt the HASP and Job Safety Risk Assessment prepared by AECOM at their own risk.

Potential hazards that may be encountered during the field surveys are enumerated in the HASP and Job Safety Risk Assessment. Appropriate mitigation measures are included to lower the identified risk as low as reasonably practicable (ALARP). The AECOM ES Lead shall coordinate activities and meetings with AECOM subcontractors in order to ensure that tasks associated with the Projects are completed smoothly. The procedures and emergency contacts for the Projects are documented in the HASP.

5.2.2 Biodiversity

The biodiversity baseline study aims to establish baseline biodiversity information of the Study Area. Baseline information was first gathered through reviews of past and present biodiversity records, published literature, and in consultation with taxonomic experts. Faunistic and floristic field assessments were then carried out. Through desktop and field assessments, important habitats, species of flora and fauna of conservation significance was identified. The information was used to identify core conservation areas and key potential ecological corridors for various fauna groups. In the subsequent stages of the study, the baseline information was analysed to evaluate the extent of impacts that may arise from the proposed development, and to recommend mitigation measures to address these impacts.

5.2.2.1 Desktop Assessment

5.2.2.1.1 Land Use History

Historical and present-day land use of the Study Area were reviewed to obtain an understanding of the vegetation types. Information on land use history was primarily gathered from published literature, old maps in the online collection of the National Archives of Singapore (NAS) as well as historical maps on the OneMap and NUS Historical Maps [W-3].

5.2.2.1.2 Taxonomy and Nomenclature

Taxonomy and nomenclature referenced in this study were crossed-checked against relevant key references that include books, scientific publications, and online databases. Key local and/ or regional references for the various taxonomic groups are listed in Table 5.8.

Table 5.8 Key references for the nomenclature and taxonomy for each taxonomic group

Taxon	Key References
Plants	Chong et al., 2009 [P-1]; Lindsay et al., 2022 [P-2]; NParks, 2023 [W-2]; Royal Botanical Gardens Kew, 2023b [P-3]; GBIF, 2023 [P-4]
Aculeate hymenopterans	Ascher et al., 2022 [P-5]
Odonates	Ngiam & Ng 2022 [P-39]; Ngiam & Davidson 2011 [P-6]; NParks, 2022 [W-2]
Butterflies	Jain et al., 2018 [P-7]; Khew, 2015 [P-8]; NParks, 2022 [W-2]
Freshwater decapod crustaceans	Ng, 1997 [P-9]; Cai et al., 2007 [P-10]
Freshwater fishes	Kottelat, 2013 [P-11]; Suzuki et al., 2015 [P-12]; Ho et al., 2016 [P-13]; NParks, 2022 [W-2]
Freshwater molluscs	Tan & Clements, 2012 [P-14]
Herpetofauna (amphibians and reptiles)	NParks, 2022 [W-2]
Birds	Gill et al., 2022 [P-15]
Mammals	NParks, 2022 [W-2]

5.2.2.1.3 Species of Conservation Significance

The assessment of whether certain species are of conservation significance is important for highlighting the needs and priorities for conservation.

Threatened species of flora — i.e., listed in NParks Red Data Book List [W-2] as nationally Vulnerable, Endangered, Critically Endangered, or Presumed Extinct (which indicates a rediscovery) — were assessed to determine whether they are of conservation significance. While the national conservation status of threatened species is true of wild populations that originate in an area without direct or indirect human intervention, some populations may be relics that persist from past cultivation or escapees from present-day cultivation that do not belong to native genetic stock. The assessment of whether a threatened species is of conservation significance will be based on, but not limited to, information on the following: (1) land use history; (2) presence of large parent tree(s); (3) commercial availability; (4) data from previous environmental impact assessments; (5) reforestation efforts' (6) natural range; and (7) importance for associated fauna. Where the origin of a threatened species population is disputable or difficult to determine, the more conservative approach will be adopted, i.e., they will be considered of conservation significance, with or without corroborating findings from field surveys of fauna. In carrying out such assessments, conservation needs can then be prioritised, and resources gathered in conserving them.

Faunal species of conservation significance include both non-threatened species regarded as species of public interest as well as threatened species. Threatened species of fauna are those listed as nationally or globally Vulnerable, Endangered, Critically Endangered, or Extinct. The national conservation statuses reference the Singapore Red Data Book (SRDB) [P-16], and other more updated local checklists, where available, such as Species List [W-2] for odonates, butterflies, freshwater fishes, amphibians, reptiles, and mammals. The global conservation status references the Red List of Threatened Species by the International Union for Conservation of Nature (IUCN, 2023).

Information on Sunda pangolin (*Manis javanica*) roadkill, sightings, and rescues will be obtained from the Singapore Pangolin Working Group to aid in the analysis of existing gaps in ecological connectivity. Due to the confidentiality of the data, precise locations will not be shown in this Report.

5.2.2.2 Field Surveys

All floristic field assessment and faunistic field assessment were carried out within the biodiversity Study Area (red) which encompasses both N4 and N5 Forested Area (refer to Figure 5.1.1).

5.2.2.2.1 Site Reconnaissance

Site reconnaissance surveys were conducted to obtain an initial understanding of the existing habitats and biodiversity. Field observations were used for planning and execution of the actual surveys. The objectives of the reconnaissance survey are as follows:

- Determine site accessibility and terrain
- Conduct a preliminary assessment to determine the dominant vegetation types
- Identify locations of existing natural permanent waterbodies, such as streams, ponds, and swampy areas (if any)
- Mark out survey sampling routes and points, and potential locations for camera traps

5.2.2.2.2 Floristic Field Assessment

The field assessments for flora consisted of: (1) habitat and vegetation mapping; (2) general walking floristic surveys; (3) vegetation plot sampling; and (4) tree tagging and assessment.

5.2.2.2.2.1 Habitat and Vegetation Mapping

A preliminary vegetation map was first prepared based on visual interpretations of satellite images from Google Earth 7.1.2.2041 [O-1]. Preliminary classification of the vegetation types — for example, forests, grasslands, or managed vegetation — was determined using visual features, such as textures and colours, observed in the satellite images. Adjustments were made to the preliminary maps according to actual observations during ground truthing. Ground truthing was conducted throughout the survey area with the aid of a GPS receiver (Garmin GPSMap® 64s). Photographs of the vegetated areas was also captured. The boundaries of each vegetation type were tracked on the GPS receiver and mapped out on Google Earth 7.1.2.2041 [O-1]. The classification of vegetation types were referenced from NParks [R-1].

5.2.2.2.2.2 General Walking Surveys

All plants observed within the Study Area during floristic surveys were identified to species whenever possible. A checklist of all the plant species recorded from the present floristic surveys were compiled. The nomenclature and national conservation status follow that of Chong et al. (2009) [P-1], Lindsay et al. (2002) [P-2], and/ or other published papers with updated information. The latter is usually for one or a few individual species. Other information on the plant species have been crosschecked with online databases, namely the National Parks Board Flora and Fauna Web and Singapore Biodiversity Online.

For plants that cannot be immediately identified with certainty in the field, photographs and/ or voucher specimens were retrieved. They were identified using identification keys, taxonomic descriptions, online plant photo databases, with the help of taxonomic experts, and/ or by matching the pressed and dried collected specimens with existing specimens in the Singapore Botanic Gardens' Herbarium (SING). Samples of both the Nationally Vulnerable *Pittosporum ridleyi* and the Critically Endangered *Neoscortechinia sumatrensis* were brought to SING for further confirmation.

For very tall unidentifiable trees with leaves that are too high in the canopy to photograph, dried leaves matching these trees have been collected from the forest floor and used to aid in species identification.

5.2.2.2.2.3 Species of Conservation Significance

The geographic locations of plants of conservation significance - i.e., listed in Chong et al. (2009) [P-1] and Lindsay et al. (2002) [P-2], as nationally Vulnerable, Endangered, Critically Endangered or Presumed Extinct (which indicates a rediscovery) — were marked using a Global Positioning System ("GPS") receiver (Garmin GPSMap® 64s), which records locations with accuracy of ± 4 m, during floristic surveys. Where there are clusters of plants of conservation significance — i.e., more than one individual occurring within 5 m or less of another individual — the approximated centre of the area was marked using the GPS receiver.

5.2.2.2.2.4 Large Plant Specimens

Similarly, trees of ≥ 3 m girth, as well as bamboo clusters, palm clusters, and strangling *Ficus* species of ≥ 3 m spread were recorded by the GPS receiver. Individuals were identified to species whenever possible. The girth (for trees) and spread (for bamboo clusters, palm clusters, and strangling *Ficus* species) was measured and estimated, respectively. For all specimens, the height was also estimated.

5.2.2.2.2.5 Other Plant Specimens of Value

Locations of other plants that are of value but do not meet the minimum size requirement, as detailed above, were recorded using the GPS receiver. Examples of such include bamboo clusters of < 3 m spread that may be important refugia for rare bamboo bats, exotic albizia trees (*Falcataria moluccana*) with raptor nests, amongst others.

5.2.2.2.2.6 Vegetation Plot Sampling

One 10 × 10 m plot was set up for every 1.25 ha of spontaneous vegetation (i.e., forested area) that is accessible on foot (excluding areas of steep terrain). A total of 21 plots were set up.

Locations of vegetation plots were first randomly generated, and the actual locations subsequently adjusted on-site based on accessibility and suitability, i.e., not covered in excessively dense vegetation and/ or tree falls that would render the plot inaccessible. All woody tree and shrub specimens as well as single-stemmed palms of ≥ 0.05 m girth were identified to species and their girth will be measured. The number of specimens with < 0.05 m girth were counted, but the exact girth will not be recorded. For *Ficus* stranglers and palm clusters, the circumference of each woody aerial root or stem, respectively, of ≥ 0.05 m stem diameter at breast height (DBH) was measured. All other plant species observed in the plots were also recorded.

The data from the vegetation plot sampling were used to visualise the differences among vegetation types using non-metric multidimensional scaling (NMDS) ordination. Data was also assessed to understand the successional stages of forests to inform recommendations on habitat enhancement.

5.2.2.2.2.7 Tree Tagging

Tree tagging was conducted for all trees within the biodiversity Study Area. All trees, single-stemmed palms (i.e., defined as having one obvious and erect stem), strangling *Ficus* species of ≥ 1.0 m girth or spread were tagged with a unique serial number. Other specimens that are considered of conservation significance with ≥ 0.3 m girth or spread were tagged. Geographic locations, girth/ spread and height were also recorded.

Differential Global Positioning System (DGPS) that can achieve up to sub-meter accuracy was used to record geographic locations of the specimens using the SVY21 plane coordinate system. This local datum provides a more accurate representation of the areas of coverage in Singapore as compared to a global datum and is used by the Singapore Land Authority (SLA) [W-4].

Where there are specimens that are inaccessible due to any obstructions, (e.g., stream, nearby tree fall, dense scrubland), specimens were not given a physical tag on site. However, the location of these specimens will still be marked using the DGPS.

5.2.2.2.2.8 Stream Mapping

The semi-naturalised drain (lined drain excluded) within the proposed development were captured using GPS at approximately 5 m apart or less if a significant bend in the streams occur. All stream lines of 5 m or more in length were recorded. The stream dimension was characterised through details in an interval of 20 m (Figure 5.2.1) including stream cross-section, pool length and depth, substrate type, riparian vegetation composition, wetted width and flow velocity. Photographs were also be taken, and a cross sectional-diagram of each sampling point were generated. Stream mapping was carried out for major natural streams with ecological value located within the biodiversity Study Area.



Legend

- Stream mapping point
- Semi-naturalised drain
- Project site
- Biodiversity Study Area

N

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SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Stream mapping points at 20 m intervals in Sembawang N4 Forested Area

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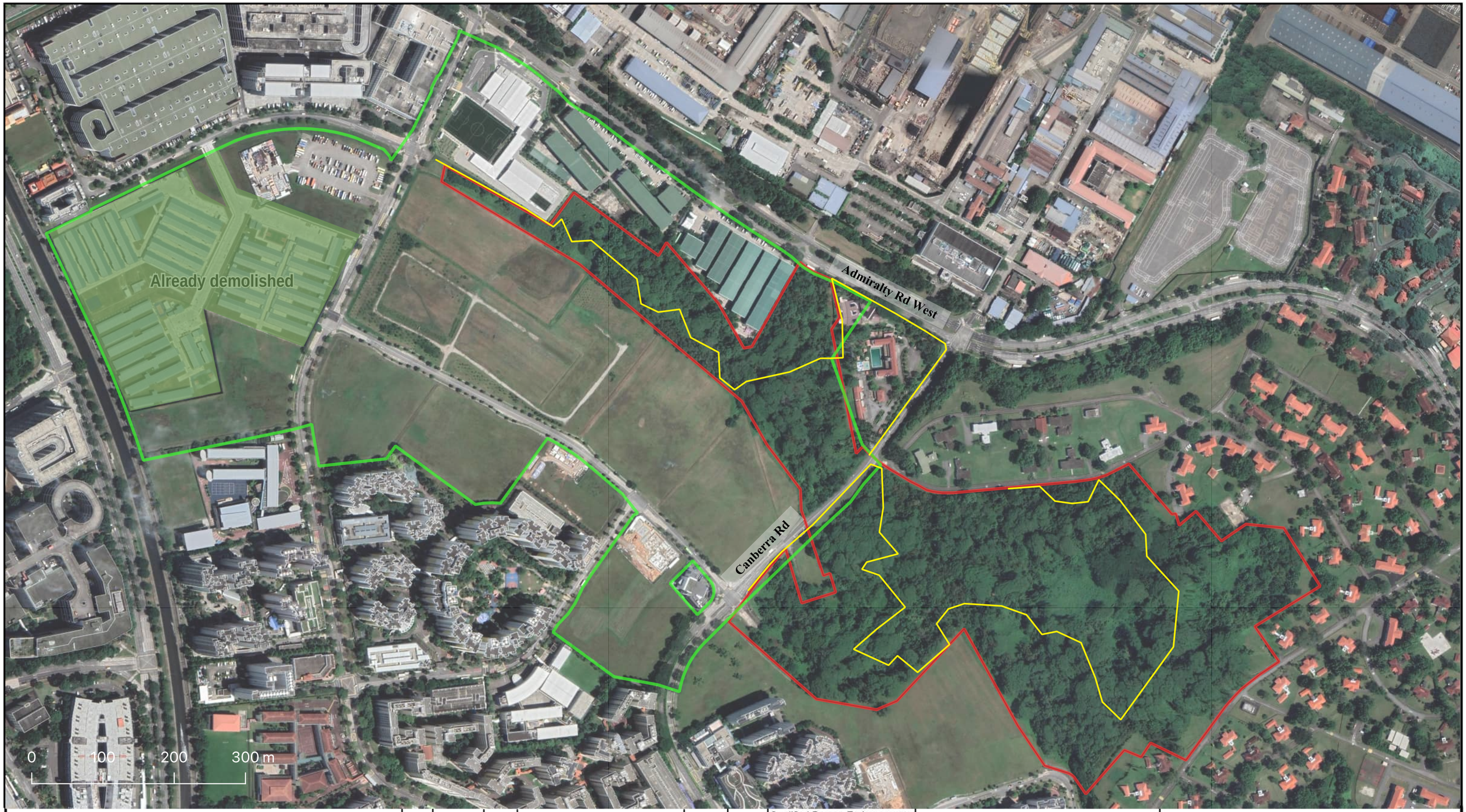
Note: Source of basemap - Google Earth Map

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5.2.2.2.3 Faunistic Field Assessment

Faunistic field surveys were carried out for the following taxa: (1) butterflies; (2) odonates (damselflies and dragonflies); (3) aculeate hymenopterans; (4) herpetofauna (amphibians and reptiles); (5) birds; (6) mammals (including bats); and (7) freshwater fauna (fish, decapod crustaceans, and molluscs). Each survey was conducted twice with an interval of at least one month between the survey cycles, unless otherwise stated. All observations of species of conservation significance from the aforementioned taxa were recorded if seen outside the stated survey times. A checklist of all species of fauna observed from the surveys were compiled.

Figure 5.2.2 shows the fauna transects where diurnal transect surveys, nocturnal transect surveys and bioacoustics surveys were carried out. As part of the fauna transects, roadkill surveys were conducted along Canberra Road where connectivity of fauna between forest patches was disrupted by vehicular traffic. Table 5.9 summarises all the surveys that were carried out for each fauna group. Each survey was performed by at least two (maximum three) surveyors. All fauna encountered were identified to species, or to the next lowest taxonomic level possible, and the location of each sighting were recorded using a handheld GPS (Garmin GPSMAP 64s). The number of individuals observed were documented.



Legend

- Fauna transect
- Project site
- Biodiversity Study Area

N

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1	AUG 2024	IT	Final Report	SAG	JAG
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Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Fauna transects in biodiversity Study Area of Sembawang N4

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	Drawn IT	Date AUG 2024	CAD File Name : NA		A3

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Table 5.9 Summary of fauna surveys

Survey Type	Taxon	Timing(h)	Duration	Sampling Unit*	Technique
Diurnal transect surveys	Butterflies	0900 – 1600	20–30 minutes per transect; two cycles	200-m continuous transects along a sampling route	Visual only; up to 25 m left, right, and front of surveyor
	Odonates (damselflies and dragonflies)	0900 – 1600	20–30 minutes per transect; two cycles	200-m continuous transects along a sampling route	Visual only; up to 25 m left, right, and front of surveyor
	Aculeate hymenopterans (bees and stinging wasps)	0900 – 1600	20–30 minutes per transect; two cycles	200-m continuous transects along a sampling route	Visual only; up to 25 m left, right, and front of surveyor
Diurnal and nocturnal transect surveys	Herpetofauna (amphibians and reptiles)	0700–1000; 2000–2300	20–30 minutes per transect; two cycles	200-m continuous transects along a sampling route	Visual and auditory; up to 50 m left, right, and front of surveyor
	Birds	0700–1000; 2000–2300	20–30 minutes per transect; two cycles	200-m continuous transects along a sampling route	Visual and auditory; up to 50 m left, right, and front of surveyor
	Mammals (non-volant)	0700–1000; 2000–2300	20–30 minutes per transect; two cycles	200-m continuous transects along a sampling route	Visual and auditory; up to 50 m left, right, and front of surveyor
Camera trapping	Mammals (non-volant)	24 h a day	60 days per camera trap	24-h continuous period of recording on a camera trap	Infrared motion sensing
Bioacoustics surveys (for bats)	Mammals (bats)	2000–2300	20–30 minutes per transect; two cycles	200-m continuous transects along a sampling route	Auditory only
Roost emergence surveys	Mammals (bamboo bats only)	1830–2100	Once per bamboo cluster	Bamboo clusters (if any)	Visual and auditory
Harp Trapping	Mammals (bats)	1930-2100; 2100-0800	Overnight	Harp trap	-

Survey Type	Taxon	Timing(h)	Duration	Sampling Unit*	Technique
Mist netting	Mammals (bats)	1930-2100	-	Mist net	-
Aquatic point counts	Odonates (damselflies and dragonflies)	0900–1600	20 minutes per point with; two cycles	Sampling points at waterbodies (at 50-m intervals for streams)	Visual only; up to 25 m from sampling point or the extent of waterbodies, whichever is smaller
	Herpetofauna (amphibians and reptiles)	0900–1600; 2000–2300	20 minutes per point; two cycles	Sampling points at waterbodies (at 50-m intervals for streams)	Visual and auditory; up to 25 m from sampling point or the extent of waterbodies, whichever is smaller
	Aquatic fauna (fish, decapod crustaceans, and molluscs)	0900–1600; 2000–2300	20 minutes per point; two cycles	Sampling points at waterbodies (at 50-m intervals for streams)	Visual only; up to 25 m from sampling point or the extent of waterbodies, whichever is smaller
Push and scoop netting	Aquatic fauna (fish, decapod crustaceans, and molluscs)	0900–1600	20 minutes per netting event; two cycles	Sampling points at waterbodies (at 50-m intervals for streams)	–
Minnow trapping	Aquatic fauna (fish and decapod crustaceans)	Overnight	Once per location	Traps inside waterbodies (at 50-m intervals along the lengths for streams where feasible)	Baited
Note: *A sampling unit is the building block of the dataset that will be used for statistical analyses. For transect surveys, one sampling unit is defined as a 200-m long transect. Hence, a sampling route may consist of several 200 m transects.					

5.2.2.2.3.1 Butterflies

Diurnal transect surveys were carried out for adult butterflies along 200 m continuous transects on a sampling route between 0900h and 1600h. Butterfly caterpillars, pupae, eggs, and host plants were also be recorded when observed. Adult butterflies were identified visually (with binoculars where necessary), photographed, or caught using insect nets, if required. Captured individuals were released immediately after identification.

5.2.2.2.3.2 Odonates (Dragonflies and Damselflies)

Diurnal transect surveys were carried out for adult damselflies and dragonflies along 200 m continuous transects on a sampling route between 0900h and 1600h. Twenty-minute point counts with two surveyors were conducted at aquatic sampling points (Figure 5.2.6) during the same survey window. Each point count was carried out along a 10-m transect, where possible, considering limitations imposed by steep terrain and/or dense vegetation. Owing to difficulties in sampling and identification, aquatic larvae and exuviae was not surveyed. Adult odonates

were identified visually (with binoculars where necessary), photographed, or caught using insect nets, if required. Captured individuals were released immediately after identification.

5.2.2.2.3.3 Aculeate hymenopterans (Bees and Stinging Wasps)

Surveys for aculeate hymenopterans were carried out subject to the availability of resources. Diurnal transect surveys were carried out for aculeate hymenopterans along 200 m continuous transects on a sampling route between 0900h and 1600h. Aculeate hymenopterans were identified visually (with binoculars where necessary), photographed, or caught using insect nets, if required. Captured individuals were released immediately after identification. When identification in the field is not possible, live specimens were collected and examined *post-hoc* under a microscope. The specimens were identified to the lowest taxonomic level using relevant references, identification keys, or in consultation with taxonomic experts.

5.2.2.2.3.4 Herpetofauna (Amphibians and Reptiles)

Diurnal (0700h–1000h) and nocturnal (2000h–2300h) surveys were carried out for amphibians and reptiles along 200 m continuous transects on a sampling route. Twenty-minute point counts were conducted at aquatic sampling points (Figure 5.2.6) during the same survey window. Each point count was carried out along a 10-m transect, where possible, considering limitations imposed by steep terrain and/or dense vegetation. As herpetofauna occupy a wide range of habitat types, both the diurnal and nocturnal surveys involved active searches for individuals on the ground, below rocks, logs, leaf litter and debris, in the water, and/or on vegetation. Rocks, logs, and other structures were returned to their original positions if moved during the searches. Torches and/or headlamps were used to elicit eyeshine during nocturnal surveys. Vocalising fauna were located or identified by call recognition, whenever possible. For species that are capable of quick retreats and escapes, the individuals were captured by hand, or using hooks, tongs, or dip nets for identification. Captured individuals were released immediately after identification.

5.2.2.2.3.5 Birds

Diurnal (0700h–1000h) and nocturnal (2000h–2300h) surveys were carried out for birds along 200 m continuous transects on a sampling route. Birds were identified visually (with binoculars where necessary) and photographed. Torches and/or headlamps were used to elicit eyeshine during nocturnal surveys. Vocalising birds will also be located or identified by call recognition, whenever possible.

Additional diurnal (0700h–1000h) surveys were carried out for migratory bird surveys during the peak bird migratory season in Singapore, which is between September and February (Lim, 2009).

5.2.2.2.3.6 Mammals (Non-Volant)

Diurnal (0700h–1000h) and nocturnal (2000h–2300h) surveys were carried out for non-volant mammals along 200 m continuous transects on a sampling route. Both the diurnal and nocturnal surveys also involved searches in burrows and tree holes. Tracks and scats were also recorded. Mammals were identified visually (with binoculars where necessary) and photographed. Torches and/or headlamps were used to elicit eyeshine during nocturnal surveys. Vocalising mammals, such as the squirrels, were also located or identified by call recognition, whenever possible.



Legend

- Camera trap location
- Project site
- Biodiversity Study Area

N

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SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Camera trap locations in biodiversity Study Area of Sembawang N4

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Mammals were surveyed via camera trapping. A total of 27 terrestrial camera traps were deployed across the Study Area. Of these 27 cameras, two forest-edge camera traps (E1 & E2) were placed on the road-side railings of Canberra Road facing the eastern forest edge (Figure 5.2.2) in order determine movement of non-volant fauna moving out of N5 Forested Area. Reconnaissance surveys revealed a steep drop of several meters where the forest edge of N4 meets Canberra Road, hence no camera traps were placed on the western side of Canberra Road. The actual number of cameras deployed after site reconnaissance is contingent on the accessibility and terrain of forest.

Each terrestrial camera trap was set up approximately 20–30 cm above ground (Figure 5.2.4). They operated for a period of 24 hours a day and were programmed to record one 10-second footage per motion trigger with a 10-second capture delay following each trigger. Each camera trap was deployed for a period of 60 days.



Figure 5.2.4 A terrestrial camera trap set up.

5.2.2.2.3.7 Mammals (Bats Only)

Acoustic surveys were carried out for bats along 200 m continuous transects on a sampling route between 2000h and 2300h. The Echo Meter Touch 2 Pro (Wildlife Acoustics, Inc.) were used to record, stream, and attenuate ultrasonic calls between 18 and 192 kHz at a sampling frequency of 384 kHz to low frequency signals below 20 kHz, a range that is audible to the human ear.

Owing to the difficulty in finding roost sites and the inability to visually identify bats to the species-level in flight, bats were sampled using live-trapping and acoustic detection. Two harp traps and two mist nets were deployed; one harp trap and mist net per Forested Area. Mist nets target the larger-sized fruit/nectar bats (Megachiroptera), while harp traps target the smaller insectivorous bats (Microchiroptera). Typically, each ground mist net and harp trap are placed near each other. Traps were set up between 1730h–1930h and trapping duration occurred between 1930h–2100h, during which traps were repeatedly checked. Mist nets were disassembled by 2100h, while harp traps were left overnight and checked the following morning between 0800h and 0900h and removed. Bats collected in the traps were identified and released immediately.

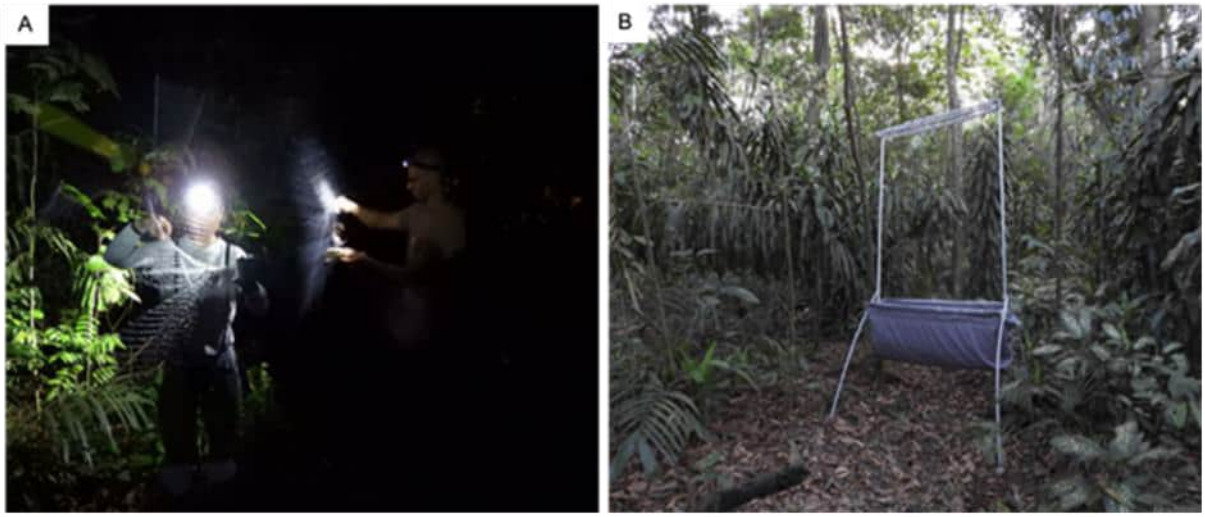


Figure 5.2.5 Set up of (A) mist net and (B) harp trap for bat trapping

Roost emergence surveys were also carried out between 1830h and 2100h for bamboo bats, specifically, at a total of six bamboo clusters at N5 Forested Area (Figure 5.2.5). Bamboo bats were identified visually and photographed, and calls were recorded using the Echo Meter Touch 2 Pro detector. Bamboo slits that were actively used for entry and exit, as well as the number of bats residing within each internode were recorded.



Legend

- Bamboo cluster
- Project site
- Biodiversity Study Area

N

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SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Bamboo clusters in Sembawang N5 Forested Area

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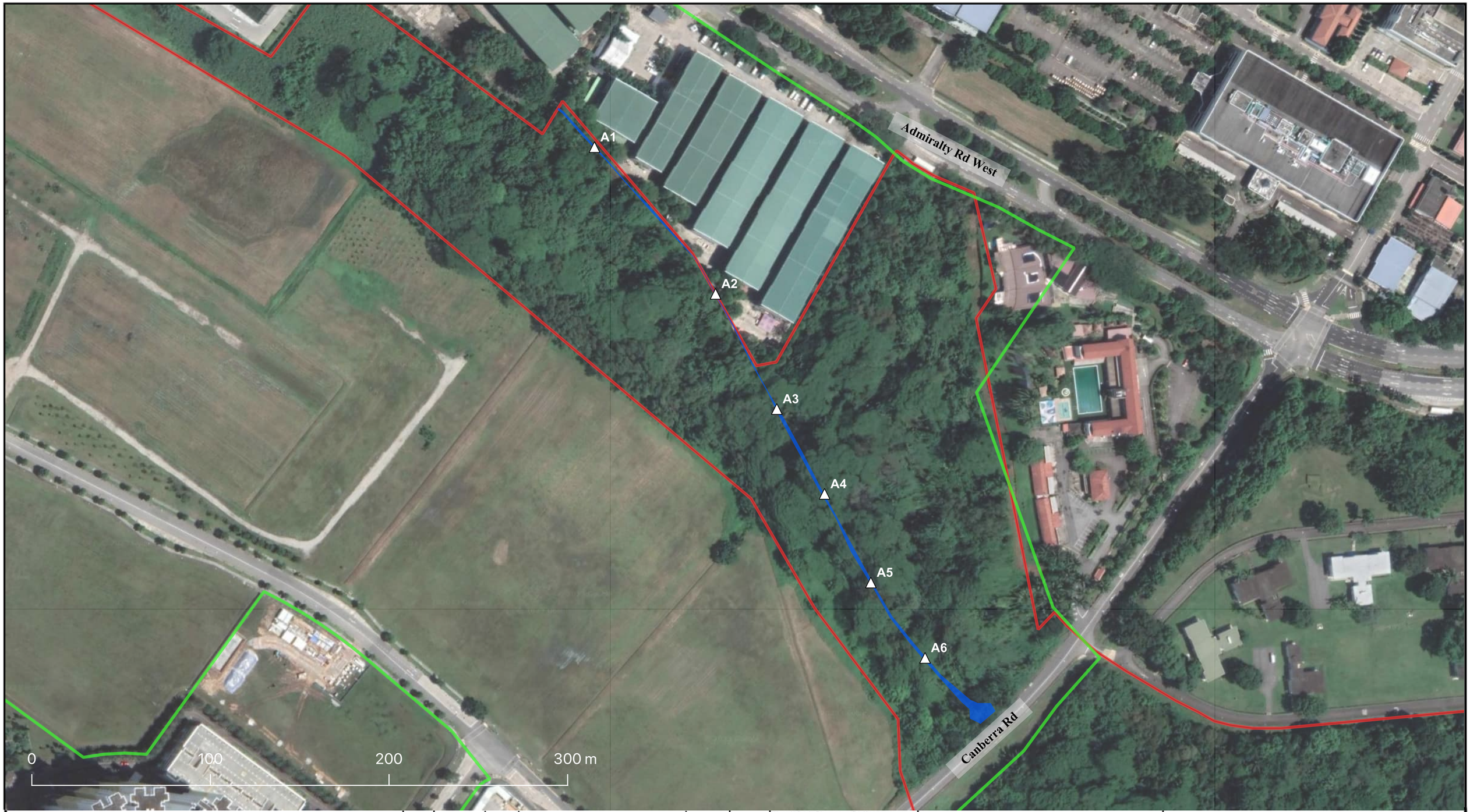
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5.2.2.2.3.8 Freshwater Fauna

The freshwater faunal groups that were surveyed are freshwater fish, decapod crustaceans, and molluscs. Diurnal and nocturnal twenty-minute point counts with three surveyors were conducted at aquatic sampling points in the streams and ponds between 0900h and 1600h, and 2000h and 2300h. Within the semi-naturalised drain in N4 Forested Area, a total of six aquatic sampling points were identified (Figure 5.2.7) and only fully-naturalised portions of drain were sampled. Each point count was carried out along a 10-m transect, where possible, considering limitations imposed by steep terrain and/or dense vegetation. Torches and/or headlamps were used to elicit eyeshine during nocturnal surveys.

Push and/or scoop netting were carried out for freshwater fish, decapod crustaceans, and molluscs at sampling points (Figure 5.2.7) inside waterbodies during the day. Push netting was carried out, usually in deeper waters, using a rigid-frame tray net (61 × 49 cm; 5 mm mesh) to catch specimens on the banks or the streambed. Scoop netting was carried out, usually in shallower waters, using hand nets (net size 25 × 18 cm; 2 mm mesh) to catch specimens within the stream column. Captured individuals were released immediately after identification.



Legend

- △ Aquatic sampling point
- Semi-naturalised drain
- Project site
- Biodiversity Study Area

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Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Aquatic sampling points in Sembawang N4 Forested Area

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	Drawn: IT	Date: JUL 2024

Figure No. : 5.2.7 | Rev. | Sheet 1 of 1

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5.2.3 Water Resources

Baseline conditions of water resources (i.e. hydrology, surface water quality, groundwater level) were established through a combination of primary and secondary data collection. Secondary data, such as regional catchment data, historical maps, weather and rainfall data, other publicly available data and data provided by the Client, was also gathered and reviewed. These collated data were then verified and/ or supplemented through the field surveys, where applicable. The proposed methodology for the water resources baseline study is detailed in the following sub-sections.

5.2.3.1 Desktop Research

Desktop research consisted of a review of secondary data (including topographic survey data, vegetation cover, historical land use maps, existing land use and activities, satellite images, etc.) which aided in determining the location of existing watercourses within the Project site and its vicinity. The information retrieved during the desktop research, comprised publicly available data from the government and Technical Agencies, existing available data (e.g. rainfall data, online satellite images), as well as published books, journals, relevant articles and other online sources.

5.2.3.1.1 Historical, Current and Future Land Uses

The information pertaining historical, current and future land uses of the Project site was collected and reviewed. Information regarding the historical land use was primarily collected from various online collections such as the ones from National Archives of Singapore (NAS) [M-1], OneMap [M-3] and the National University of Singapore (NUS) [M-4] as well as historical satellite imagery from Google maps. This information was used to identify the potential watercourses present within the Study Area, watercourses characteristics (i.e. natural or man-made) and also to understand the hydrological changes within the Project site over time, if any.

Information regarding current land uses was collected primarily through satellite imagery and online maps and verified through site visits and supplemented by topographic survey data. Future land uses within the Project site were provided by the Client. Current and future land uses aided in the identification of the impacted watercourses and the extent of impacts by the proposed developments during both construction and operational phases.

5.2.3.1.2 Land Cover and Geology

Land cover and geology of the Study Area was assessed from various available secondary sources, such as Google satellite imagery and geological map of Singapore by Building and Construction Authority (BCA) [M-6]. Similar to the understanding provided by the elevation data, land cover information allowed for better understanding of the local hydrology within the site. Underlying the site geology aided in assessing the interdependency of surface water and groundwater, and also helped in the understanding of the hydrogeology of the area.

5.2.3.1.3 Catchment Area

As Singapore does not have extensive natural aquifers or lakes, maximisation of stormwater harvesting is key. Stormwater is collected through a network of rivers, canals and drains and channelled into 17 reservoirs. Likewise, most of Singapore's land can be divided into 17 regional catchments as well. Public Utility Board's (PUB's) water catchment map [M-7] was referenced to identify the regional catchment where the final runoff discharge from the Project site will flow into. This information helped to identify the potential receiving watercourses and waterbodies and allowed for the assessment of potential impacts on them due to the proposed developments.

5.2.3.2 Field Surveys and Sampling Events

The activities performed as part of the field assessment included the following:

- Hydrological survey and surface water quality sampling:
  - Evaluation of the accessibility of the watercourses through existing tracks during site reconnaissance
  - Verification of the information from the available secondary data sources (e.g. topographic surveys and satellite images)
  - Identification and mapping of the existing watercourses within and in the vicinity of the Project site

  - Assessment of the flow conditions and bank characteristics of the identified watercourses during dry and wet weather conditions
  - Observation of water quality indicators in existing identified watercourses (e.g. physical parameters such as colour, turbidity, odour, etc.)
  - Sampling of representative surface water samples for the purposes of in-situ and ex-situ water quality analysis

- Groundwater level investigation:
  - Evaluation of accessibility of the site during site reconnaissance and underground utilities detection
  - Soil excavation and assessment of groundwater depth

5.2.3.2.1 Hydrological and Topographical Survey and Stream Mapping

Hydrological survey aimed to identify the watercourses currently present within and in the vicinity of the Project site and to understand their conditions such as stream bank characteristics and flow conditions. Data collected as part of hydrological survey was subsequently used to establish hydrological baseline conditions and to carry out impact assessment due to proposed activities during the construction and operational phases of the Project.

Prior to site visit, Google satellite images were analysed and used for preliminary identification of the watercourses currently present within the site (refer to the Section 5.2.3.1). Following this, hydrological site survey was conducted by casual exploration methods to verify/ identify the exact locations of the watercourses. A Global Positioning System (GPS) device was used to track the hydrological survey route.

During the survey, characteristics of stream banks (e.g. natural bank or artificial bank) and their flow conditions (e.g. flow direction, velocity) were estimated based on the visual observations and recorded in the form of photographs and field notes. Water velocity was calculated based on time taken by a light object such as leaf to traverse a known fixed distance. The qualitative data was then coupled and synchronised with the GPS data and used for establishment of hydrological baseline condition. Hydrological survey also included on-site verification of local topography and land uses of the site in order to estimate the likely routes of surface runoff and identify the main water sources feeding the watercourses. These data gathered from the hydrological survey aided catchment delineation.

Stream mapping was conducted by capturing the stream lines within the Project site using GPS along natural streams and waterbodies. The characteristics of the identified streams and waterbodies including bank types, stream length and depth, channel wetted width, stream bed substrate, estimated flow velocity during both dry and wet weather conditions was recorded based on visual observations and professional experience. Furthermore, riparian vegetation was also surveyed and recorded in biodiversity findings.

Topographic survey was carried out as part of this EIA to gather the information on the point elevations within the Study Area (i.e. N4 and N5 Forested Area) as well as to collect the data of the natural and man-made features of the site. The elevation data was also used to carry out catchment delineation of the Study Area for further impact assessment.

5.2.3.2.2 Surface Water Quality Sampling

Baseline water quality conditions was examined in the identified watercourses in the potentially impacted area. The surface water quality sampling locations were selected based on the information gathered during the site reconnaissance (carried out on 3rd March 2023) and available secondary data.

Eleven (11) water quality sampling locations were proposed as shown in Figure 5.2.8 while the rationale behind the selected location with site photos is detailed in Table 5.10.

In order to obtain comprehensive surface water quality baseline data that will capture the potential changes in physico-chemical composition of surface water over time and different events, samples were collected during both dry weather and wet weather conditions. Dry weather conditions are defined as flow conditions and water quality in watercourses after continuous 48-hour period of no-rain, while wet weather conditions are defined as flow conditions and water quality within watercourses after the rainfall event having more than 10 mm of rainfall, with samples to be collected up to three (3) hours after the rain stops.

For this study, in-situ water quality parameters were measured using a calibrated multi-parameter digital sensor (YSI ProDSS) with United States Environmental Protection Agency (USEPA) approved testing methods for water quality parameters and will include:

- Temperature
- pH
- Conductivity
- Turbidity
- Dissolved Oxygen (DO)

The ex-situ parameters that were analysed by Marchwood Laboratory Services Pte Ltd (MLS) are listed below:

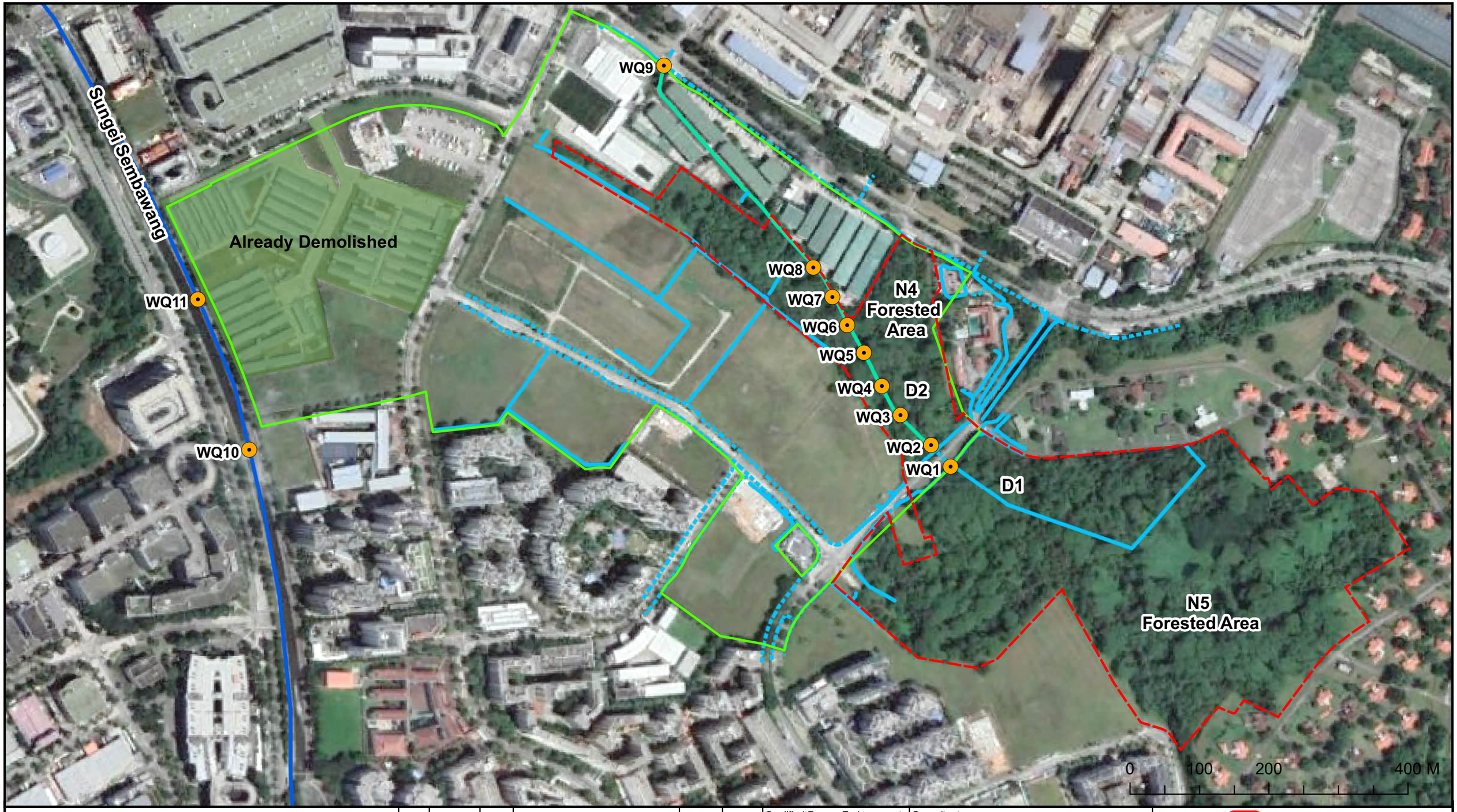
- Total Nitrogen (TN)
- Total Phosphorus (TP)
- Nitrates (NO_3-N)
- Orthophosphates (PO_4-P)
- Total Suspended Solids (TSS)
- Total Dissolved Solids (TDS)

Table 5.10 Rationale for the selection of proposed water quality sampling locations with photos

S/N	Monitoring Location	Justification	Photo of Monitoring Location
WQ1	Downstream of concrete drain of N5 Forested Area.	To capture the water quality of the concrete drain outside of Project site, just before the water flows across the Canberra Road and into the stream in the Project site (i.e. N4 Forested Area).	
WQ2	Upstream of stream in N4 Forested Area.	To capture the water quality at the upstream of the stream, after receiving inflow from the upstream concrete drain at N5 Forested Area.	
WQ3	Upstream of stream in N4 Forested Area.	To capture the water quality at the upstream of the stream, after receiving inflow from the upstream concrete drain at N5 Forested Area. This location is aligned with the proposed aquatic fauna survey location.	

S/N	Monitoring Location	Justification	Photo of Monitoring Location
WQ4	Midstream of stream in N4 Forested Area.	To capture the water quality at the midstream of the stream flowing through N4 Forested Area. This location is aligned with the proposed aquatic fauna survey location.	
WQ5	Midstream of stream in N4 Forested Area.	To capture the water quality at the midstream of the stream flowing through N4 Forested Area. This location is aligned with the proposed aquatic fauna survey location.	
WQ6	Midstream of stream in N4 Forested Area.	To capture the water quality at the midstream of the stream flowing through N4 Forested Area, just before it receives runoff/ discharge from Cochrane Lodge. This location is aligned with the proposed aquatic fauna survey location.	
WQ7	Downstream of stream, just before it flows into a concrete drain.	To capture the water quality at the downstream of the stream, just before it flows into a concrete drain, which is also just after it receives runoff/ discharge from Cochrane Lodge. This location is aligned with the proposed aquatic fauna survey location.	
WQ8	Downstream of stream, just before it flows into a concrete drain.	To capture the water quality at the downstream of the stream, just before it flows into a concrete drain, which is also just after it receives runoff/ discharge from Cochrane Lodge. This location is aligned with the proposed aquatic fauna survey location.	

S/N	Monitoring Location	Justification	Photo of Monitoring Location
WQ9	Discharge outlet of stream.	To capture the water quality of the stream discharging out of the Project site.	
WQ10	Upstream of Sungei Sembawang.	To capture the water quality of the canal just upstream of the future worksite of the Project.	
WQ11	Downstream of Sungei Sembawang.	To capture the water quality of the canal just downstream of the future worksite of the Project.	
Note: The eleven (11) tentative monitoring locations were identified based on the known watercourses observed from preliminary site reconnaissance.			



Legend

- Project site
- Demolished Buildings
- Forested Area/ Biodiversity Study Area
- Surface Water Quality Sampling Locations
- Open drain
- Underground drain
- Sungei Sembawang
- Semi-naturalised drain

N

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Figure Title :

Surface water quality sampling locations

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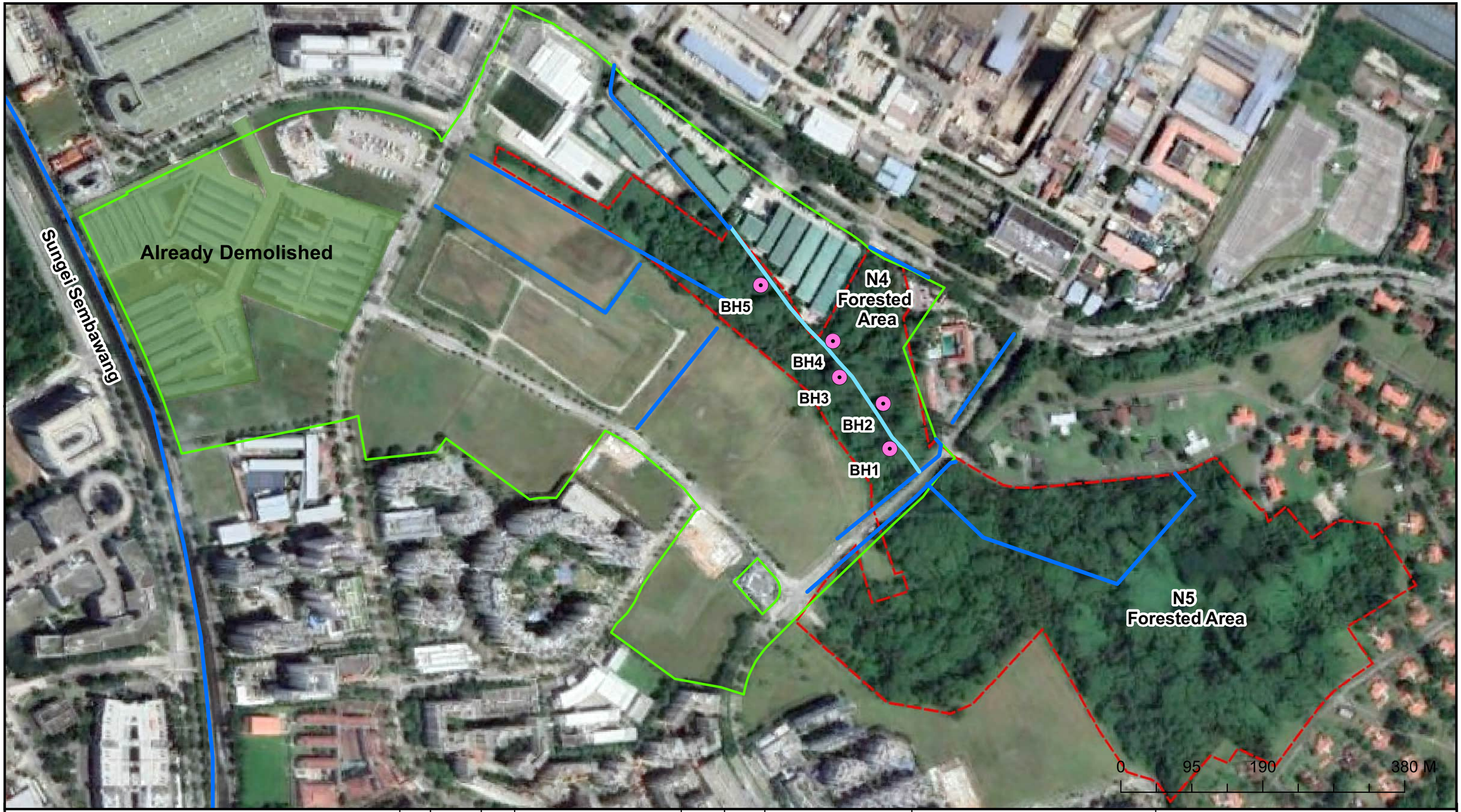
5.2.3.2.3 Groundwater Level Investigation

A total of five (5) groundwater level investigation locations, designated as BH1 – BH5 were established within the Study Area. The locations are presented in Figure 5.2.9 while Table 5.11 below presents the justification for the proposed sampling locations.

Table 5.11 Rationale for the selection of proposed borehole locations

S/N	Monitoring Location	Justification
BH1	Adjacent to upstream of semi-naturalised drain	To assess the semi-naturalised drain's dependency on groundwater inflow.
BH2	Adjacent to mid-stream of semi-naturalised drain	
BH3	Adjacent to mid-stream of semi-naturalised drain	
BH4	Adjacent to mid-stream of semi-naturalised drain	
BH5	Adjacent to downstream of semi-naturalised drain	

Soil drilling was carried out for each of the locations, using hand auger, until groundwater was observed. Observed groundwater depth was then noted and compared to the water levels in the nearby watercourse.



Legend

- Project site
- Demolished Buildings
- Forested Area/ Biodiversity Study Area
- Groundwater Level Monitoring Locations

Watercourses

- Concrete Drain
- Naturalised Stream

N

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Figure Title :

Groundwater level monitoring locations

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5.2.3.3 Baseline Assessment Methodology

The activities performed as part of the analysis and assessment of baseline data included the following:

- Analysis of collected data using various specialised software programmes (e.g. ArcGIS)
- Evaluation of the accuracy of collected primary data and comparison and coupling with relevant available secondary data
- Development of maps and figures for better visualisation and comparison of data
- Comparison of data to selected criteria

5.2.3.3.1 Hydrology and Groundwater Baseline Assessment

Hydrological baseline study aims to establish current hydrological conditions of the site and present watercourses based on the collected primary and secondary data. This includes the overview of site's topography, land use/ cover, understanding the hydrological features present on the site (e.g. slopes), existing drainage network and flow conditions. Groundwater level conditions were determined by review and analysis of available primary and secondary data.

The elevation and slope maps of the Project site were developed based on surveyed topographic survey data using GIS technique. In order to determine the exact locations of each of the identified watercourses, GPS data from surveys was synchronised with the photos taken on site. Catchment analysis was conducted based on surveyed topographic data and publicly available catchment map of Singapore developed by PUB [W-16]. Catchment delineation is a key step in the identification of the main sources of water that feed each of the watercourses within the Study Area and also aids in the understanding of how stormwater runoff flows within the site.

5.2.3.3.2 Surface Water Quality Baseline Assessment and Adopted Criteria

The baseline water quality of the watercourses located within the Study Area was determined by comparing the selected parameters against the NEA Trade Effluent Discharge limits for watercourses [R-3]. This comparison could be used to determine whether the existing baseline water quality of the watercourses within the site complies with NEA limits or already exceeds these limits. However, the NEA Trade Effluent Discharge limits do not provide criteria for the preservation and growth of aquatic life locally. To assess whether the surface water quality within the Project site is suitable for aquatic life, the baseline water quality was compared to the water quality criteria for aquatic life from other countries (i.e., USEPA [R-5], Australian & New Zealand [R-6], Canada [R-7], Philippines [R-8], and Malaysia [R-9]), as well as criteria set up by international organisations (i.e., United Nations Economic Commission for Europe [R-18], World Health Organization [R-4],) which provide guidelines for the protection of aquatic life. The relevant limits and guidelines for water quality parameters were summarised in Table 5.12 however, where no guidelines exist, the monitored results would be considered as the baseline.

Table 5.12 Water quality guidelines and criteria

Parameter	NEA Trade Effluent Discharge Limits[1]	International Water Quality Criteria for Aquatic Life[2]
pH	6 – 9	6.5 – 9
Temperature (°C)	45	-
Salinity (psu)/ Conductivity (µS/cm)	-	-
Dissolved Oxygen, DO (mg/L)	-	> 4.0
Turbidity (NTU)	-	Freshwater: 200 Marine Water: 20
Total Dissolved Solids, TDS (mg/L)	-	Freshwater: 1,000 Marine water: Not applicable
Total Suspended Solids, TSS (mg/L)	50	Freshwater: 150 Marine Water: 80
Total Phosphorous, TP (mg/L)	-	Freshwater: 0.1 Marine Water: 0.015
Orthophosphate as Phosphorous, PO_4-P (mg/L)	1.625 (equivalent to 5 as PO_4)	Freshwater: 0.033 (equivalent to <0.1 as PO_4) Marine Water: 0.05 (equivalent to 0.0163 as PO_4)
Total Nitrogen, TN (mg/L)	-	Freshwater: 8

Parameter	NEA Trade Effluent Discharge Limits[1]	International Water Quality Criteria for Aquatic Life[2]
		Marine Water: 0.25
Nitrate, NO_3-N (mg/L)	-	Freshwater: 7 (equivalent to 44 as NO_3) Coastal Waters: 0.06

Note:

1. NEA Trade Effluent Discharge Limits for discharge into a watercourse.
2. The sources of international water quality criteria for aquatic life includes Australian and New Zealand Environment and Conservation Council (ANZECC, 2000) [R-6], Canadian Council of Ministers of the Environment (CCME, 2007) [R-7], Department of Environment of Malaysia (DOE, n.d.) [R-9], United Nations Economic Commission for Europe (UNECE, 1994) [R-18], World Health Organization (WHO, n.d.) [R-4], United States Environmental Protection Agency (USEPA, 2017) [R-5], and Mitigating Impact from Aquaculture in the Philippines (PHILMINAQ, n.d.) [R-8]

5.2.4 Airborne Noise

Baseline noise monitoring is used to establish the existing noise levels in the Project site. Sensitive receptors within the vicinity of the Project were hence considered before proposing the baseline monitoring locations.

5.2.4.1 Desktop Research

Desktop research consists of a review of secondary data (including existing land use and development activities, satellite images, rainfall data etc.) which aids in determining the baseline noise monitoring location. The information retrieved during the desktop research comprised of publicly available data from government and technical agencies, existing available data, relevant articles, and other online sources.

5.2.4.2 Field Survey and Assessment

A total of one (1) noise monitoring location was proposed for the project, based on the following considerations:

- Identification of the nearest Noise Sensitive Receptors (NSRs) (fauna, and habitats of high ecological value) nearest to the Study Area
- NSRs currently influenced by currently ongoing short-term disruptions such as ongoing construction, which will close before the Project commences, were avoided
- As highlighted in the scoping meeting, the selected location was pushed deep into the forested area carrying the equipment as much as logistically feasible

The selected noise monitoring location is provided in Table 5.13 and Figure 5.2.10 below. Monitoring was conducted for one week (inclusive of weekdays and weekends), to capture baseline noise levels over time periods of 12 hours (long term), 1 hour and 5 minutes (short term) at the location. A NEA-approved Type 1 Sound Level Meter (SLM) Norsonic 131 was used to record the noise levels above. The results of baseline noise monitoring levels were studied for periods from 7am to 7 pm, 7pm to 10 pm and 10 pm to 7 am for weekdays and weekends, over periods of 12 hours, 1 hour and 5 minutes is detailed in Section 6.6 of this Report.

Table 5.13 Rationale for the selection of proposed airborne noise monitoring locations with photos

S/N	Monitoring Location	Justification	Photo of Monitoring Location
NM01	Green Area within Sembawang N5	Representative baseline noise monitoring location for Green Area within Sembawang N5. The selected location represents the baseline noise levels experienced by ecological receptors found within Sembawang N5.	



Legend

- Project site
- Forested Area/ Biodiversity Study Area
- Airborne Noise Study Area
- Proposed baseline monitoring location

N

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Baseline airborne noise monitoring location

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5.3 Impact Assessment

5.3.1 Definition of Minimum Controls

Minimum control measures are the standard practices that should be implemented on-site during construction and operational phases of the Project, based on legislation (where applicable), guidelines and best management practices. Examples include on-site water storage and treatment to comply with NEA Trade Effluent Criteria prior to discharging into receiving watercourses, hoarding of construction worksite on all sides, restricted working hours of noisy equipment, etc.

5.3.2 Prediction of Impacts

Key potential environmental impacts arising from the Project's pre-construction, construction and operational activities were assessed within the Project scope. The methodology for the prediction of impacts is as given in Table 5.14 and Table 5.15.

Table 5.14 Methodology for prediction of construction impacts

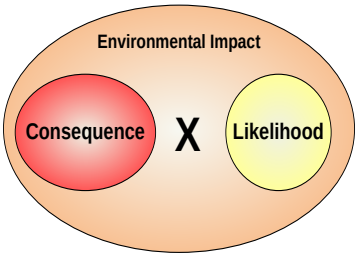
Environmental Parameter	Predictive Methods	Assessment Criteria	EIA Section
Biodiversity	A mix of **quantitative and qualitative** assessment to evaluate the impacts of construction activities on key biodiversity sensitive receptors of floral communities, faunal species, and habitats within the Study Area and its immediate surrounding.	Assessment criteria broadly takes guidance from Hong Kong Environmental Impact Assessment Ordinance - Technical Memorandum Annex 8, with considerations from literature review and local biodiversity standards [R-40].	Section 7
Water Resources (Hydrology, Surface Water Quality, Groundwater Level)	*Hydrology* **Qualitative,** analytical assessment of direct impacts on hydrology, watercourses and their catchments and groundwater baseflow during construction phase of the Project. **Qualitative** assessment of impacts on identified ecological receptors, based on the findings and pre-determined tolerance of sensitive receptors. *Surface Water Quality* **Qualitative,** analytical assessment of direct impacts on surface water resources and their catchments and groundwater baseflow during construction phase of the Project. **Qualitative** assessment of impacts on identified ecological receptors (based on pre-determined tolerance, where applicable).	• Singapore Environmental Protection and Management (Trade Effluent) regulations [R-3] • Singapore NParks Biodiversity Impact Assessment (BIA) Guidelines [R-1] • Water Quality Criteria for Aquatic Life from other countries and organisations including United Nations Economic Commission for Europe [R-18], ASEAN [R-38], World Health Organization [R-4], United States Environmental Protection Agency [R-5], Philippines [R-8], Australian and New Zealand Environment and Conservation Council (ANZECC) [R-6], Canadian Council of Ministers of the Environment [R-7], and Department of Environment in Malaysia (DOE) [R-9]	
Airborne Noise	**Quantitative** assessment was adopted to assess construction noise impacts to noise sensitive ecological receptors.	Environmental Protection and Management (Control of Noise at Construction Sites) Regulations, 2008.	

Table 5.15 Methodology for prediction of operational impacts

Environmental Parameter	Predictive Methods	Assessment Criteria	EIA Section
Biodiversity	**Qualitative** assessment to evaluate the impacts of operational activities on key biodiversity sensitive receptors of floral communities, faunal species, and habitats within the Study Area and its immediate surrounding.	Assessment criteria broadly takes guidance from Hong Kong Environmental Impact Assessment Ordinance - Technical Memorandum Annex 8, with considerations from literature review and local biodiversity standards. [R-40]	Section 8
Water Resources (Hydrology, Surface Water Quality and Groundwater Level)	*Hydrology* **Qualitative,** analytical assessment of direct impacts on hydrology, watercourses and their catchments and groundwater baseflow due to operational activities within the Study Area. **Qualitative** assessment of impacts on identified ecological receptors, based on the findings and pre-determined tolerance of sensitive receptors. *Surface Water Quality* **Qualitative,** analytical assessment of direct impacts on surface water resources and their catchments and groundwater baseflow due to operational activities within the Study Area. **Qualitative** assessment of impacts on identified ecological receptors (based on pre-determined tolerance, where applicable).	• Singapore Environmental Protection and Management (Trade Effluent) regulations [R-3] • Singapore NParks Biodiversity Impact Assessment (BIA) Guidelines [R-1] • Water Quality Criteria for Aquatic Life from other countries including ASEAN [R-38], United Nations Economic Commission for Europe [R-18], World Health Organization [R-4], United States Environmental Protection Agency [R-5], Philippines [R-8], Australian and New Zealand Environment and Conservation Council (ANZECC) [R-6], Canadian Council of Ministers of the Environment [R-7], and Department of Environment in Malaysia (DOE) [R-9]	
Airborne Noise	**Quantitative** assessment was adopted to assess operational noise impacts to noise sensitive ecological receptors. *(Detailed methodology of noise impact prediction provided in Section 7.5.3 and Section 8.5.3)*	• NEA Technical Guideline on Boundary Noise Limits for Air Conditioning and Mechanical Ventilation Systems in Non-Industrial Buildings, 2018 • NEA Technical Guideline for Land Traffic Noise Impact Assessment, 2016	

5.3.3 Evaluation of Impacts

Key potential environmental impacts arising from the proposed Project and significance of impacts will be assessed using the methodology described in the following sections.



In evaluating the Significance of impacts, the following factors will be taken into consideration:

- **Impact Consequence:** The consequence of an impact is a function of a range of considerations including impact spread, impact duration, impact intensity and nature, legal and guideline compliance

- **Likelihood of Occurrence:** The likelihood of the impact occurring in life of the Project

5.3.3.1 Impact Consequence

In evaluating the consequence of environmental impacts, the following aspects will be taken into consideration:

- **Receptor Sensitivity**: categorises receptors according to their susceptibility to adverse impacts from the Project's construction and operational phases (refer to Table 5.2)

- **Impact Intensity**: defines the magnitude of the impact and the status of the impact in relation to regulations (e.g. discharge limits), standards (e.g. environmental quality criteria) and guidelines. The criteria presented in Table 5.16 will be used to categorise the impact intensity.

Table 5.16 Evaluation of impact intensity for construction and operational phases

Environmental Parameters	Impact Intensity			
	Negligible	Low	Medium	High
Biodiversity	No expected changes to species population	Short duration and small-scale localised spatial changes that could cause minimal changes to species population; changes are reversible	Moderate duration and medium-scale spatial changes that could cause moderate reduction in size of species population but would not threaten species long-term viability; changes are reversible with compensatory measures	Extended duration and large-scale spatial changes that could cause substantial reduction in size of species population and threaten species long-term viability; changes are irreversible
Water Resources (Hydrology)	Very minor change to existing hydrology and flow	Small scale localised changes to existing hydrology or flow	Medium scale changes to existing hydrology or flow	Major changes to existing hydrology or flow
Water Resources (Surface Water Quality)	No contamination; or likely to be well within regulatory limits	Small scale localised contamination within regulatory limits	Medium scale contamination or just exceeding regulatory limits	Large scale contamination exceeding regulatory limits by hazardous levels for the habitat/ conservation species
Water Resources (Groundwater Level)	No reduction in groundwater level	Small scale localised groundwater level decrease which is not likely going to extend beyond the Study Area	Medium scale groundwater level decrease that is possibly going to extend beyond the Study Area	Large scale groundwater level decrease that is likely going to extend far beyond the Study Area
Airborne Noise (Construction Phase)	No detectable change to flora, fauna, and habitats	The exceedance of values compared to baseline noise results is within 0-3 dB (A)	The exceedance of values compared to baseline noise results is 3-6 dB (A)	The exceedance of values compared to baseline noise results is greater than 6 dB (A)

Environmental Parameters	Impact Intensity			
	Negligible	Low	Medium	High
Airborne Noise (Operational Phase)	No detectable change to fauna	Potential impacts last a short duration, are reversible and/or of a small magnitude for species with low auditory sensitivity level	Potential impacts last for a moderate duration, are reversible with significant input and compensatory measures, and/or of a moderate magnitude for species with medium auditory sensitivity level	Potential impacts last for a long time, are non-reversible, and/or of a significant magnitude for species with high auditory sensitivity level
Notes: 1. The Flora & Fauna Specialist will be consulted to identify the species sensitivity to the potential change to their habitat, conservation status and foraging regime.				

A consequence category is then derived based on receptor sensitivity and impact intensity, as shown in Table 5.17.

Table 5.17 Impact consequence matrix

Sensitivity / Impact Intensity	Priority 3	Priority 2	Priority 1
Negligible	Imperceptible	Imperceptible	Very Low
Low	Very Low	Very Low	Low
Medium	Very Low	Low	Medium
High	Low	Medium	High

5.3.3.2 Likelihood

Likelihood is estimated on the basis of experience and/or evidence that such an outcome has previously occurred. Impacts resulting from routine/planned events (normal operations) are classified under High Likelihood.

Table 5.18 Likelihood Criteria

Likelihood Criteria	Definition for All Environmental Parameters	Definition for Airborne Noise (Construction)
Unlikely/ Remote	Would be unlikely or not expected to occur during construction and operational activities.	Frequency of exposure of less than 5% to active duration of equipment over daily working period.
Less Likely/ Rare	Would less likely/ rarely occur during construction and operational activities.	Frequency of exposure of 5% and up to 15% to active duration of equipment over daily working period.
Possible/ Occasional	Would possibly/ occasionally occur during construction and operational activities.	Frequency of exposure of 15% and up to 25% to active duration of equipment over daily working period.
Likely/ Regular	Would likely to occur or would occur on a regular basis during construction and operational activities.	Frequency of exposure of 25% and up to 50% to active duration of equipment over daily working period.
Certain/	Would be certain to occur or would occur	Frequency of exposure of more than 50% to

Likelihood Criteria	Definition for All Environmental Parameters	Definition for Airborne Noise (Construction)
Continuous	continuously during construction and operational activities.	active duration of equipment over daily working period.

References:

1. Ecological Impact Assessment (EcIA). EIANZ Guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd Edition. May 2018. [R-27]
2. CIEEM (2018). Guidelines for ecological impact assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. September 2018. [R-28]

5.3.3.3 Impact Significance

The significance of each impact will be determined by assessing the impact consequence against the likelihood of the impact occurring using the Impact Significance Assessment Matrix. A simple risk-based matrix will be used for summation of consequence and likelihood, a sample of which is shown below in Table 5.19.

Table 5.19 Impact significance matrix

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

Positive impacts are classified under a single category. Impacts assessed as negligible or minor will require no additional management or mitigation measures (on the basis that the magnitude of the impact is sufficiently small, or that the receptor was of low sensitivity and/or that adequate controls were already included in the Project design). Negligible and minor impacts are therefore deemed to be “Insignificant”. Impacts evaluated as moderate or major require the adoption of management or mitigation measures. Major impacts are therefore deemed to be “Significant” and moderate impact as “Relatively Significant”. Major impacts always require further management or mitigation measures to minimise or reduce the impact to an acceptable level.

Where the implementation of minimum controls is insufficient to alleviate any significant environmental construction and operational impacts (moderate to major impacts), Project-specific final mitigation measures, in consultation with the HDB and relevant Authorities, will be proposed.

5.3.3.4 Mitigation of Significant Impacts and Residual Impact Assessment

Where applicable and practical, engineering control measures will be accompanied by specifications (product brochures), estimated cost and source of supply. In addition, mitigation measures at receptors’ end will also be recommended on a case-by-case basis. For example, if the unmitigated construction noise levels are found exceeding the relevant criteria, practical direct mitigation measures such as the use of noise barriers, enclosures, quieter powered mechanical equipment (PME) and construction methods, etc. will be recommended. Effective dust control measures will be recommended to minimise dust emission from the site, where necessary. Mitigation measures will be proposed in accordance with the following hierarchy in line with Biodiversity Impact Assessment (BIA) Guidelines published by NParks [R-1]:



Figure 5.3.1 Mitigation hierarchy

Avoid – Where changes to the Project design and construction/ operational methodology can be made to eliminate or avoid an identified impact (e.g. optimisation or reduction of construction footprint, shift or elimination of construction site in critical areas, etc.). If a full elimination is not possible, the next level of mitigation is to minimise the identified impact.

Minimise – Where changes to the Project design and construction/ operational methodology cannot affect impact elimination or avoidance, use of alternative construction methodology or any enhancement measures can be adopted to minimise for identified impacts. For example, a wildlife shepherding plan is put in place to allow any animals trapped on the site to escape into the surrounding vegetation.

Remedy/ Repair/ Restore – Where changes to the Project design and construction/ operation cannot affect impact avoidance and impact minimisation, restoration methodology can be applied after construction is completed to remedy/ repair/ restore the ecological habitat as much as possible. For e.g. after construction, appropriate trees and shrubs are replanted in appropriate locations on the impacted site to restore part of the habitat.

Compensation/ Offset – Where measures taken to compensate or offset the residual impacts after implementing the first three steps of the mitigation hierarchy, wherever technically and financially feasible, e.g. transplanting of rare shrubs or trees to elsewhere in consultation with government authorities, etc.

An “acceptable level” is the reduction of a major impact to a moderate one after mitigation. In seeking to mitigate moderate impacts, the emphasis is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable. It will not always be practical to reduce moderate impacts to minor ones in consideration of the cost-ineffectiveness of such an approach (due to the diminishing return of a reduction of impact versus cost). Residual impact assessment will be conducted for those parameters where impact from the activity is identified to be significant and additional mitigation measures are recommended. Positive impacts were not assessed for significance. Assessment of residual impact will follow similar risk approach as outlined above.

5.4 Preliminary EMMP

Construction phase EMMP and Operational phase EMMP was formulated specifying mitigation measures, monitoring scope, methodology and location, and triggers to report and escalate the irregularities in the baseline conditions at construction/ operational phase. The basis of EMMP is provided in Section 9 which also summarises information about identified sensitive receptors, potential impacts evaluated, residual impacts (if any) and frequency of monitoring (if required), as well as close up actions.

5.5 Stakeholder and Public Engagement

It is known that effective communication and cooperation between various expert groups, the Client and other stakeholders can minimise risks throughout the Project delivery process. Stakeholder and public engagements are necessary to better understand their requirements and concerns for this Project. The scoping meeting with technical agencies (viz. NEA, NParks and PUB) was held on 7th March 2023. There was one public (i.e. Nature groups) engagement session held on 4th April 2024 where AECOM shared the proposed development plans for the area, the environmental baseline study findings, the impact assessment and recommendations. Preliminary Environmental Monitoring and Management Plan (EMMP) was also proposed to mitigate the environmental impact of the development. Feedback from the Nature groups were taken into consideration and included in the final report where deemed appropriate.

6 Environmental Baseline Conditions

6.1 Historical Land Use

As far as possible, a chronological account of the changes in land use of the Project site and forested area is provided in following paragraphs, with inferences drawn from historical resources (maps, sea charts, and aerial photographs) contained within the NUS Libraries Historical Maps of Singapore (NUSLHMSG) [M-4], unless otherwise mentioned.

The earliest available map of the area dates back to 1873 and reveals a relatively undeveloped area with a seemingly natural stream (Sungei Sembawang) passing through it and discharging into the sea at the area which today roughly corresponds to the location of Sembawang Shipyard. Based on the map dating from the 1911, the original vegetation at the area was likely to be a mangrove swamp forest and natural riverbed of Sungei Sembawang was still observed. Furthermore, a new road was constructed at the north of the Project site, which roughly corresponds to the present-day Admiralty Road West. By the early 1940s, the area was cleared for naval operations while Sungei Sembawang was channelled and re-routed to the alignment as we see today. The black and white bungalows located in the east of the N5 Forested Area were constructed between 1930s and 1940s, which were used as accommodation for military personnel from the Sembawang Naval Base and their families.

The majority of the buildings and infrastructure within the Project site were found to be cleared by 1953 (Figure 6.1.1A), giving way to the vegetation (dominated by grassland with tree cultivations at the east of the Project site). Limited roads were present within the Project site, with scarce buildings concentrated mostly along the road which corresponds to present-day Canberra Road. For the first time, a watercourse (likely a drain) can be observed to pass through the Project site and N5 Forested Area. East of the Project site has gone through similar changes, with grasslands and rubber plantations located what is today N5 Forested Area, with buildings and a road in its eastern portion. Buildings and extensive road network can be observed surrounding the N5 Forested Area. The building of the former HomeTeamNS @ Sembawang was built between 1963 and 1966, at the northeast of the Project site, where it remains standing till today. The naval base dockyard north of the Project site, formerly used by the British military forces, was transferred to the Singapore government in 1968, and Sembawang Shipyard was converted for commercial use till the present day.

By 1975, most of the smaller fair-weather roads and several remnant buildings were removed, and the area continued to regenerate back to grassland. The east of the Project site was still dominated by Sundry tree cultivation. For the first time, Sembawang Hospital (converted from the military hospital which was a part of the former Naval Base) was marked on the map from 1975. In addition, mosque can be observed east of the Canberra Road. Between 1975 and 1978, a school was built at the southeast portion of modern-day N5 Forested Area. By the 1990s both the hospital and the school closed down (Figure 6.1.1B).

Since 1993, the area continued to regenerate into spontaneous vegetation (Figure 6.1.1C). By 2002, the majority of the buildings and roads within Project site and N5 Forested Area were found to be cleared. This trend continued until 2010. Based on historical maps, between 2005 and 2010, the existing Assyafaah mosque was relocated from east of the Canberra Road to the west of Canberra Road, where it is located until this day. Currently, both N4 and N5 Forested Areas consist of mixed vegetation (Figure 6.1.1D) such as rain trees (*Samanea saman*), albizia (*Falcataria falcata*), African tulip (*Spathodea campanulata*) and sea almond (*Terminalia catappa*). Cochrane Lodge and Recreation Centre as well as Admiralty Street Dormitories were built sometime after 2010.

In summary, the land use of the area has undergone significant changes over the years, with eventual widespread land conversion from forested to urbanised areas. While the surrounding land area has developed significantly, with vegetation removed to make way for schools, residences and other commercial buildings in the early 2000s, the forested area has been re-vegetated following the closure of the Sembawang Naval Base in the late 1960s.

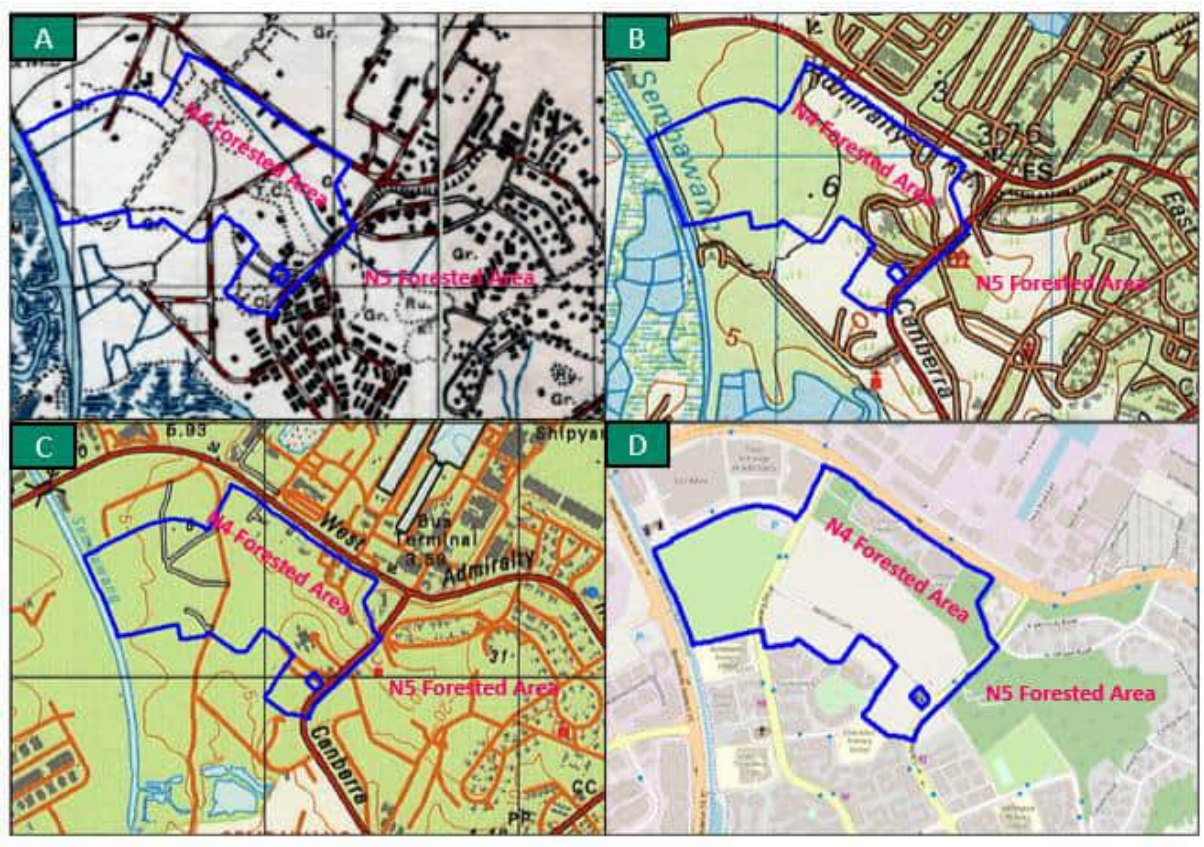


Figure 6.1.1 Maps showing the chronological land use of the Project site in (A) 1953, (B) 1993, (C) 1998, and (D) 2023

6.2 Current Land Use

Currently, the Project site consists of urbanised areas, construction worksites, managed turf vegetation and forested area. Foreign worker dormitories (i.e. Cochrane Lodge I & II) and Recreation Centres are located in the north of the site, along Admiralty Road West. The N4 Forested Area is adjacent to beforementioned developments. Together with N5 Forested Area (located across Canberra Road) it forms a larger, exotic-dominated secondary forest and include a concrete drain that has been naturalised. Although divided by the road, it is expected that the migratory species move between N4 and N5 Forested Area. Furthermore, this habitat has been identified to potentially play an important role in regional connectivity, acting as a stepping stone for the species migrating between CCNR and Simpang.

South of the N4 Forested Area are Nanyang Technological University's (NTU) Geothermal Survey Site and Land Transport Authority's (LTA) Laydown Area under Temporary Occupation Licence (TOL). A heavy vehicle park is located west of the Sembawang Drive. The rest of the Project site is mostly covered with managed turf area.

During the site reconnaissance survey that was carried out on 18th March 2023, six (6) active worksites were observed within and in the vicinity of the Project site. These include:

- Gambas electrical cable equipment laydown area
- Nanyang Technological University (NTU) geothermal survey site
- Land Transport Authority's (LTA) Laydown Area under Temporary Occupation Licence (TOL)
- Ministry of Education (MOE) construction site
- PUB drain improvement works along Admiralty Road West
- PUB drain improvement works at Admiralty Road West equipment laydown area

More details about the current land uses and zoning are provided in table below, while the Project site and its current land uses are shown in Figure 6.2.1.

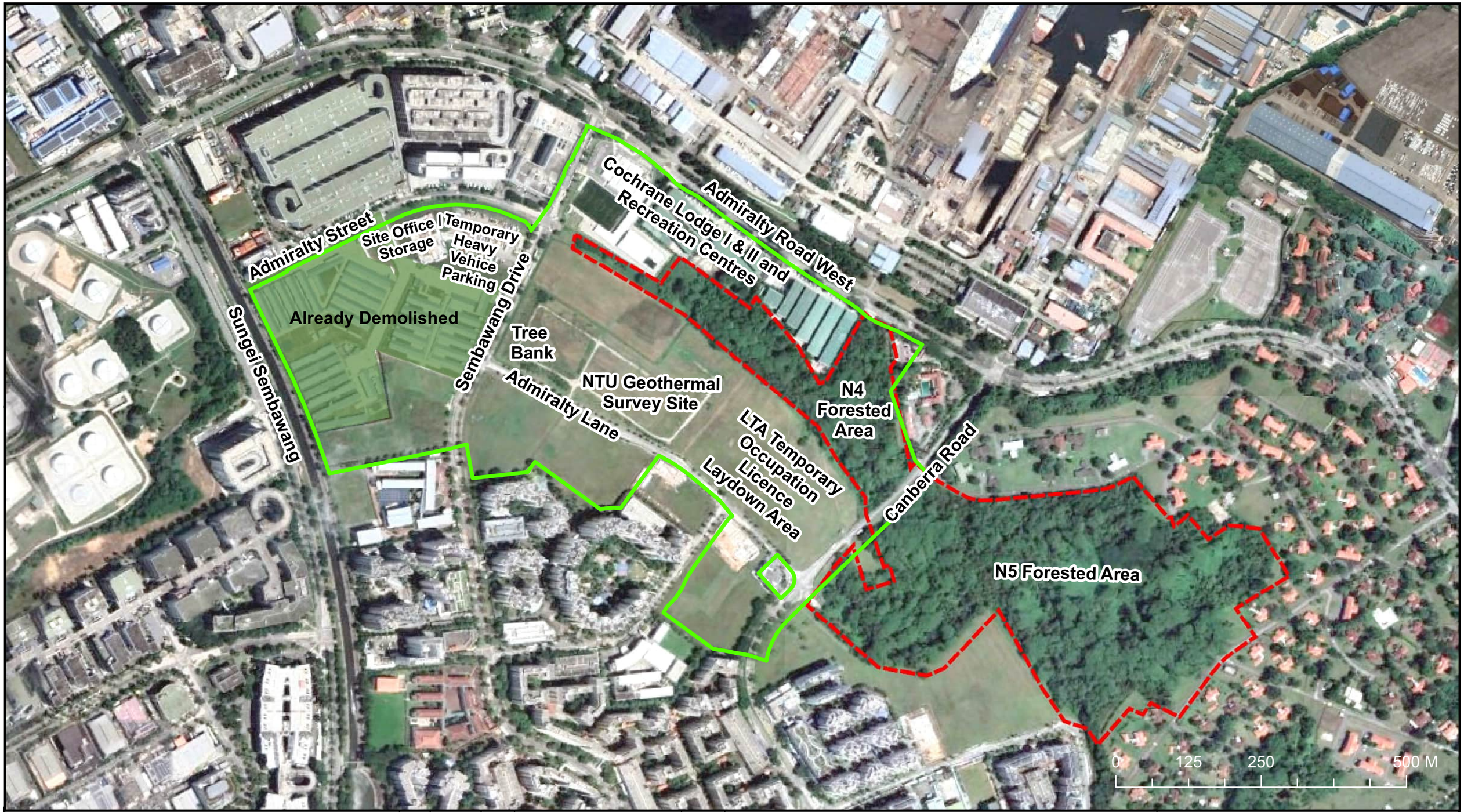
Table 6.1 Current land use uses within and in the vicinity of the Project site

Current Land Features	Current Land Use Type	Future Plans (Demolish/Cleared or Retained)	Proposed Future Land Use (URA Master Plan 2019)
Admiralty Street Dormitories	Foreign worker dormitory	Demolished	Residential
Admiralty Lane	Road	To be retained.	Road
Canberra Road	Road	To be retained.	Road
Cochrane Lodge I & II and Cochrane Recreation Centres	Foreign worker dormitory	To be demolished	Residential
Gambas Electrical Cable Equipment Laydown Area	Construction worksite	To be demolished	Residential (Subject to detailed planning), Road
LTA Temporary Occupation Licence Laydown Area	Construction worksite	To be demolished	Residential
N4 Forested Area	Forested area	To be cleared	Educational Institution, Residential, Road, Waterbody
N5 Forested Area	Forested area	TBU	Residential (Subject to detailed planning)
NParks Tree Bank	Managed turf area with planted trees.	Transplanted	Civic & Community Institution, Residential
NTU Geothermal Survey Site	Hoarded worksite	Cleared	Residential
Migrant Worker Recreation Centre (Old HomeTeamNS Sembawang building)	Migrant Worker Recreation Centre	TBU	Residential (TBU)
Site Office/Storage	Construction worksite	To be demolished	Residential
Sembawang Drive Heavy Vehicle Parking	Parking Facilities	To be demolished	Residential
Acacia Home	Assisted living facility	-	Civic & Community Institution
Admirax	Industrial building	-	Business 1
Assyafaah Mosque	Place of Worship	-	Place of Worship
Admiralty Street	Road	-	Road
Admiralty Road West	Road	-	Road
Canberra Road	Road	-	Road
Food Exchange@Admiralty	Industrial building	-	Business 2
Ministry of Education Sheltered play Court and Hydrotherapy Pool Construction Site	Construction worksite	-	Educational Institution
Northlink Building	Industrial building	-	Business 1
San Lian Deng	Place of Worship	-	Place of Worship

Current Land Features	Current Land Use Type	Future Plans (Demolish/Cleared or Retained)	Proposed Future Land Use (URA Master Plan 2019)
Sembawang Drive	Road	-	Road
Sembawang God of Wealth	Place of Worship	-	Place of Worship
Sembawang Shipyard	Industrial building	-	Reserve Site
Sungei Sembawang	Watercourse	-	Waterbody
Tian Ho Keng	Place of Worship	-	Place of Worship
Utilities	Utilities	-	Utilities

Note:

1. '-' indicates that the land feature is not within the Project site and will be retained.
2. 'TBU' means To be updated, as the plans are not yet finalised.



Legend

- Project site
- Demolished Buildings
- Forested Area/ Biodiversity Study Area

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	TYL	Final Report	SAG	JAG
-	JUL 2024	TYL	Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Current land uses within Project site

Designed	Checked	Approved
JOL	SAG	JAG
	Drawn: TYL	Date: AUG 2024

Figure No. : 6.2.1 | Rev. 1 | Sheet 1 of 1

CAD File Name : NA | A3

Note: Source of basemap - Google Earth Map

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6.3 Physical Environment

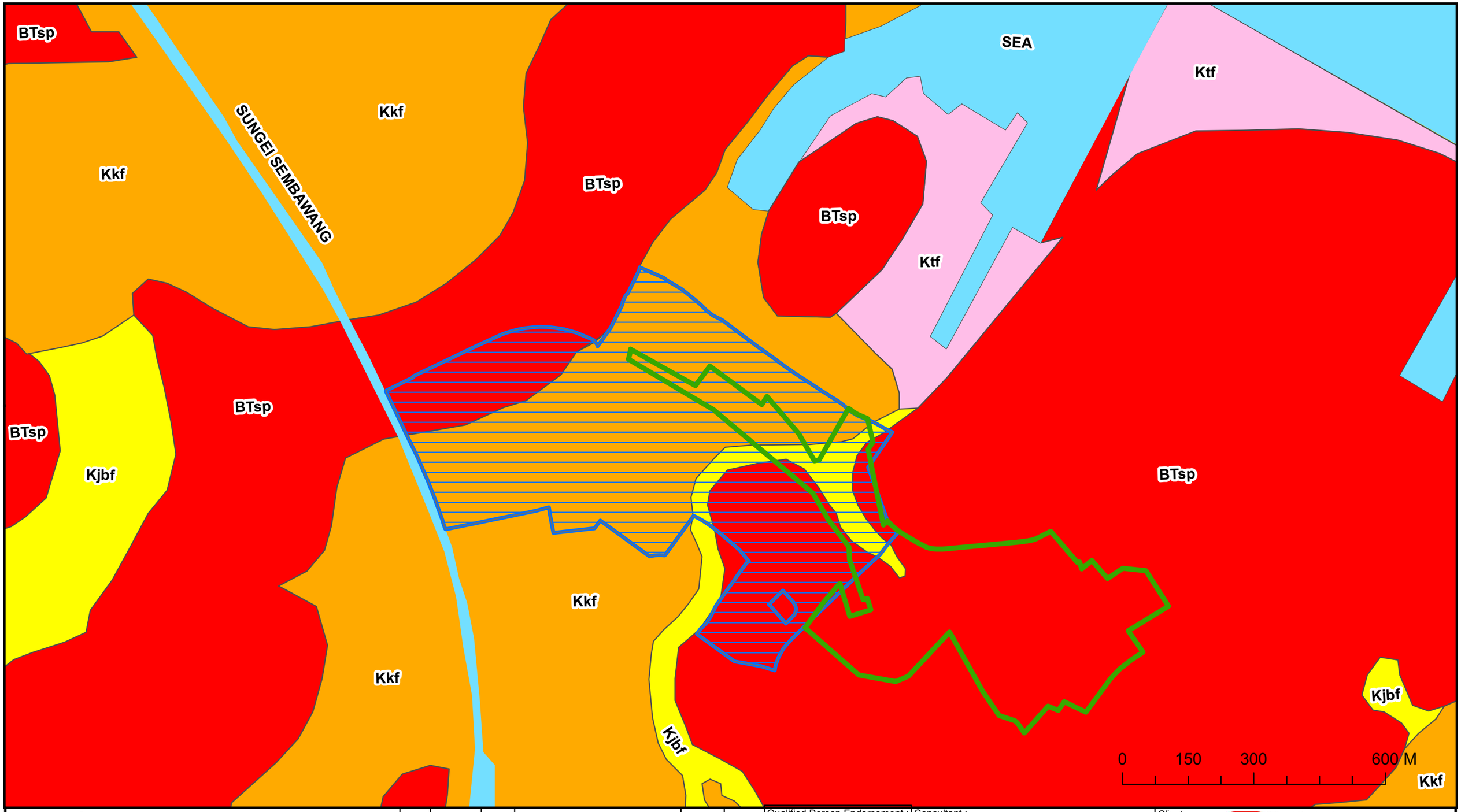
6.3.1 Geology

As shown on the Geological Map of Singapore (refer to Figure 6.3.1), the Project site is mostly underlain by Kranji Formation (Kkf), Simpang Granite Pluton (BTsp) bedrock under the northwest and southeast portions, and a small section of Jalan Besar Formation (Kjbf) through the centre of the Project site.

The Kranji Formation is largely located at river mouths and tidal (typically mangrove) swamps on the coastal fringes of Singapore, it comprises mainly fluvial deposits and is usually peat-rich clay and silt containing decomposed wood and fragments of vegetation with low permeability. The depositional environment of the formation is interpreted to be that of mangrove swamp settings, forming in waterlogged estuaries and low-lying river basins.
The Jalan Besar Formation comprises relatively uniform-sized fluvial deposits, ranging from silty clay to coarse sand, with occasional occurrences of gravel and organic matter [P-17]. The member is usually unconsolidated but lightly consolidated beds might be found. Running sand conditions are possible below the water table.

Both the Kranji Formation (Kkf) and the Jalan Besar Formation (Kjbf) are part of the Kallang Group strata which is the youngest of the existing geological formations of Singapore and is usually located at river valleys, river mouths, river plains, coastal areas, and near-shore. The peat and organic-rich clay deposits within this Group may contain pyrite that can oxidise to produce acidic, sulphate-rich groundwater, which may present a risk to buried steel and concrete and should be accounted for during foundation design. The highly compressible peat and soft clay deposits also provide very poor foundation conditions. Dewatering near coastal areas like these may also result in saline intrusion if groundwater levels are reduced below sea level.

The Simpang Granite Pluton is part of the Bukit Timah centre, formed in the Triassic period by fluvio deltaic deposits and comprises equigranular syenogranite and monzogranite. The Simpang pluton has markedly higher concentrations of radiogenic elements [potassium (K), uranium (U) and thorium (Th)] than other granitic plutons in Singapore. These concentrations are sufficiently elevated to produce moderately high heat production (HP) values (e.g. Rybach, 1976) and also the significant potential for high concentrations of radium (Ra) and therefore for radon (Rn) gas. Hence this Pluton presents a greater risk of hydrothermal groundwater and radon gas than other bedrock units in Singapore.



Legend

- Forested Area/Biodiversity Study
- Area Project site

Geology

- Simpang Granite Pluton (BTsp)
- Kranji Formation (Kkf)
- Tekong Formation (Ktf)
- Jalan Besar Formation (Kjbf)
- Water

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	TYL	Final Report	SAG	JAG
-	JUL 2024	TYL	Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Geological map of the Project site and its surroundings

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
TYL	SAG	JAG	6.3.1	1	1 of 1
	Drawn TYL	Date AUG 2024	CAD File Name : NA		A3

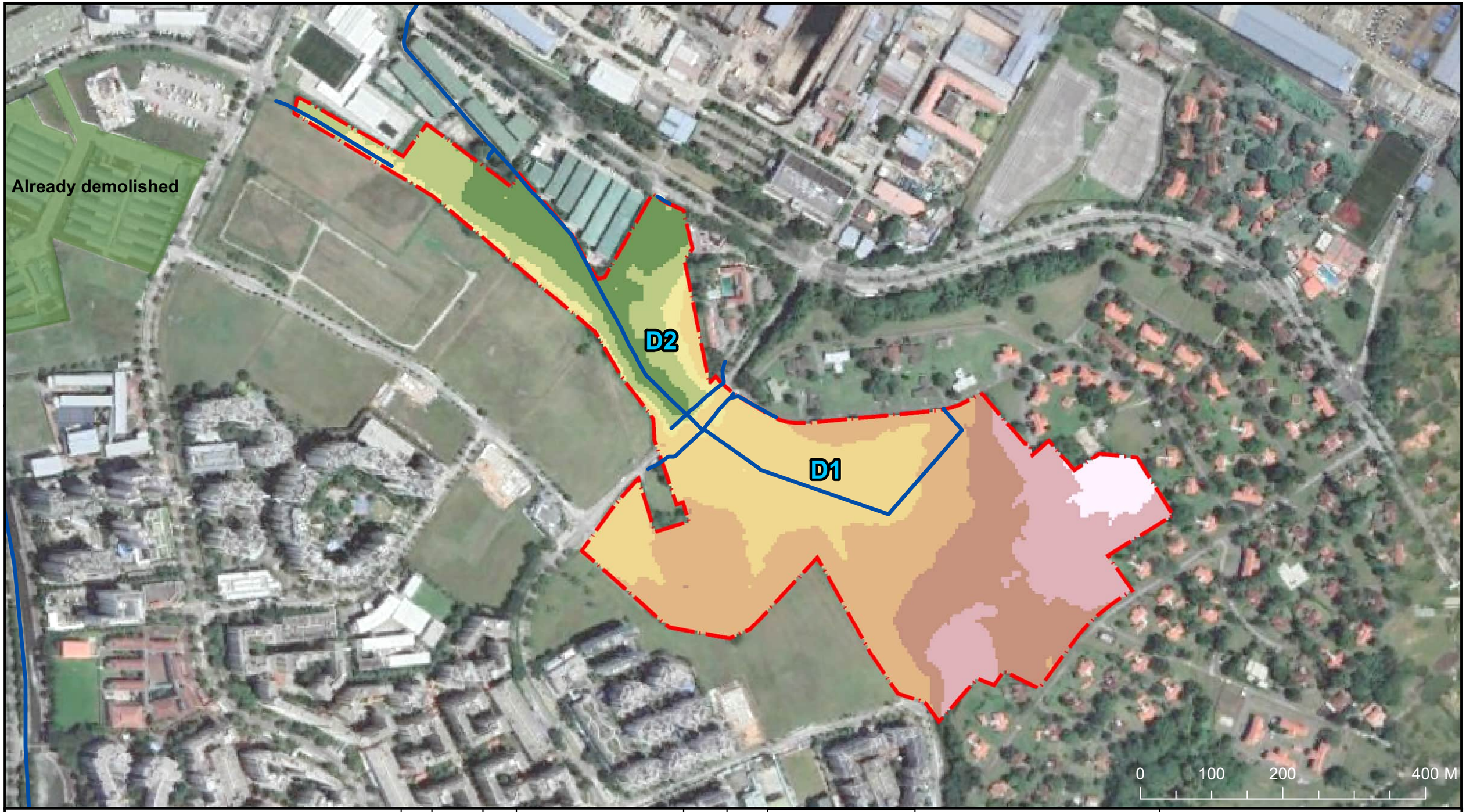
Note: Source of basemap - Google Earth Map

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6.3.2 Topography of the Forested Area

AECOM engaged a topography surveyor to determine the different elevations within the N4 and N5 Forested Area. Based on the review of the topography survey data and observations from the site visits, it was noted that the general topography of forested areas is generally hilly, with elevations ranging from 2.73 mRL to 31.89 mRL.

Within N5 Forested Area, higher elevations can be observed at the eastern portion of the site, with the elevation gradually decreasing towards the western and central portions of the area. Within N4 Forested Area elevations are generally lower compared to N5 Forested Area, with elevations decreasing towards the semi-naturalised drain in central portions.



Legend

- Watercourse within Forested Area
- Demolished Buildings
- Forested Area/ Biodiversity Study Area

Elevation (mRL)

- <5
- 5 - 8
- 8 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- >30

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	TYL	Final Report	SAG	JAG
-	JUL 2024	TYL	Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Elevation map with watercourses within N4 and N5 Forested Areas

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
JOL	SAG	JAG	6.3.2	1	1 of 1
	Drawn TYL	Date AUG 2024	CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

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6.3.3 Regional Climate

6.3.3.1 Rainfall

Singapore is situated near the equator and has typically tropical climate. Singapore's year-to-year rainfall is highly variable. Based on the 30-years long-term climate information (1981 – 2010) by the Meteorological Service Singapore (MSS), it rained an average of 167 days of the year [W-5]. The long-term mean annual rainfall total is 2165.9 millimetres (mm) when averaged across island-wide stations with long-term records [W-6]. Based on the findings from MSS, the annual rainfall total has increased at an average rate of 75.2 mm per decade, and hourly rainfall increased at the rate of 0.8 days per decade for heavy rain (>40 mm) and 0.2 days per decade for very heavy rain (>70 mm) from Year 1980 to 2019 (refer to Figure 6.3.3)].

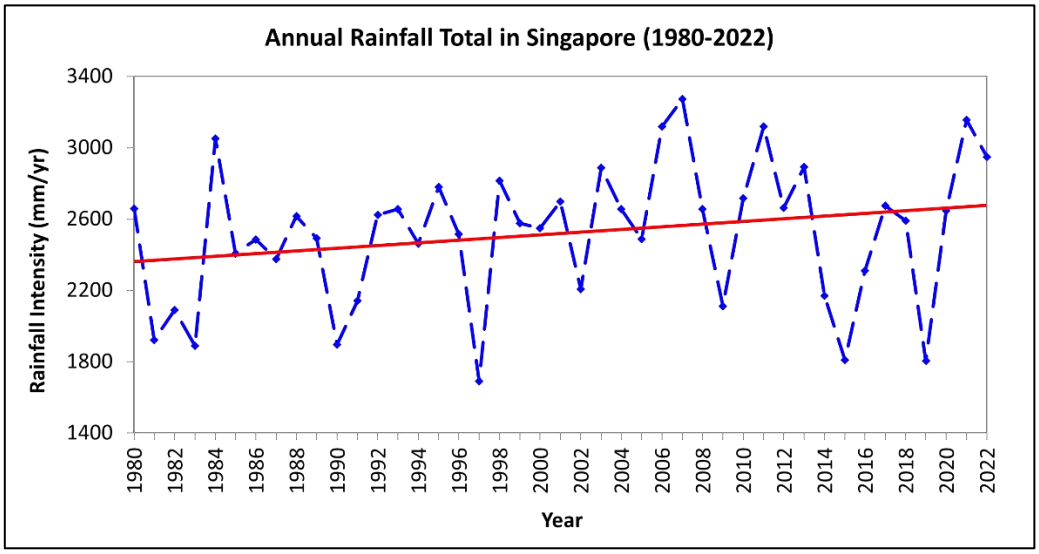


Figure 6.3.3 Annual rainfall total in Singapore from 1980 to 2022 (Source: Meteorological Service Singapore [MSS] [W-7])

In terms of spatial distribution, rainfall is higher over the northern and western parts of Singapore and decreases towards the eastern part of the island (Figure 6.3.4) [W-5]. The figure also shows that the Central Catchment possibly receives the maximum rainfall in Singapore. The annual average rainfall in the Project site is anticipated to be approximately 2,200 mm to 2,400 mm. Furthermore, the recent findings from MSS had shown an overall upward trend in total annual rainfall at increased average rates ranging from 0.3 mm/ year to 15.3 mm/year, during the period from 1980 to 2022 (refer to Figure 6.3.5) if compared to the 30-years long-term basis, except for the areas near Queenstown climate stations at the south of Singapore [W-7].

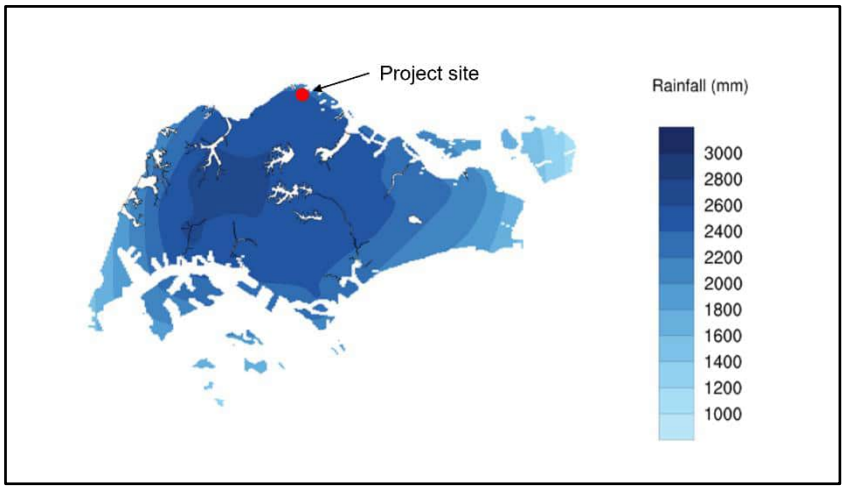


Figure 6.3.4 Annual average rainfall spatial distribution (1981 - 2010) (Source: MSS [W-5])

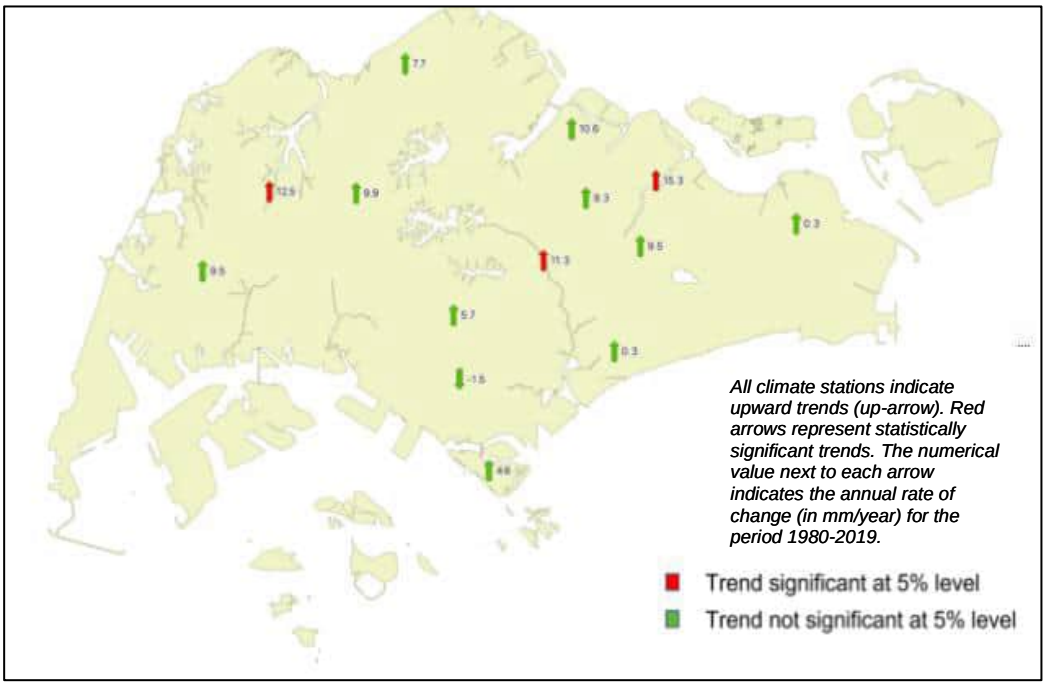


Figure 6.3.5 Past trends of annual rainfall total at indicative stations (1980-2022) [W-7]

Singapore has two monsoon seasons separated by inter-monsoonal periods, where the Northeast Monsoon occurs from December to early March and the Southwest Monsoon from June to September. It also has abundant rainfall all the year round with relatively higher mean rainy days (more than thirteen [13] days) and mean rainfall amount (more than 220 mm) from November to January every year (refer to Figure 6.3.6). The average rainfall in Singapore is approximately 220 mm and 180 mm during Northeast and Southwest Monsoon, respectively. Most months in 2022 had rainfall that was above average (refer to Figure 6.3.6).

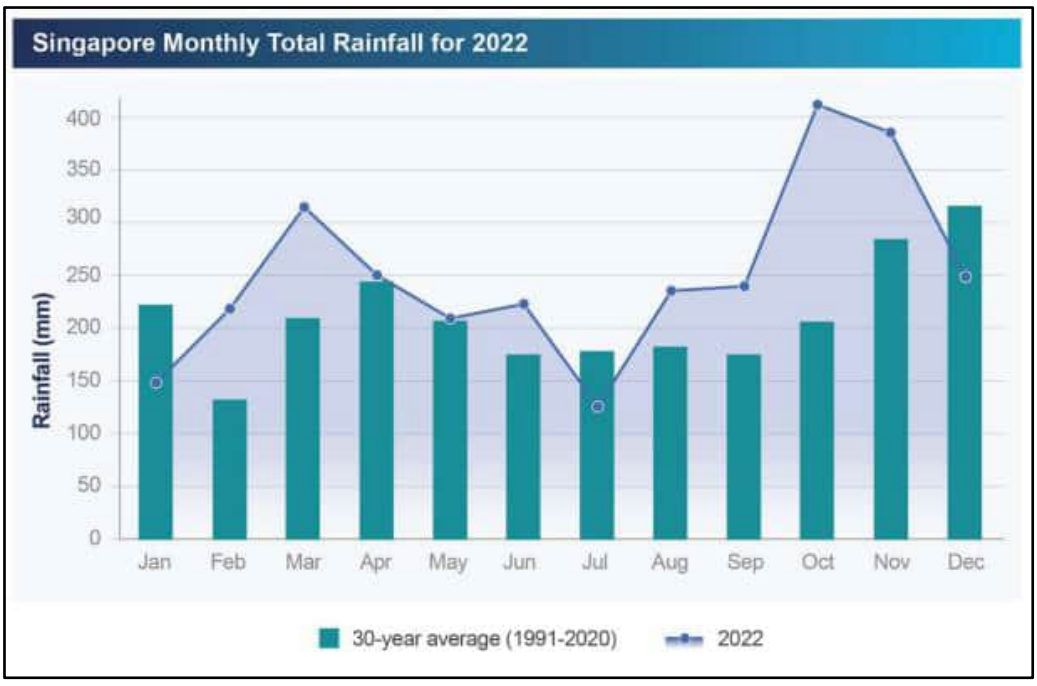


Figure 6.3.6 Monthly total rainfall in Singapore for 30-year average over island-wide stations with long-term records (bars, 1991 – 2020) compared to 2022 (solid line) (Source: MSS [W-6])

6.3.3.2 Temperature

Singapore's continuous temperature records since 1948 show that the island has warmed by an average of 0.25°C per decade, with a visible and sudden rapid increase after the mid-1970s (see Figure 6.3.7). This may have been due to the rapid economic development and urbanisation that took place after Singapore's political reformation, as well as due to the influence of anthropogenic global warming effects. Eight (8) out of the ten (10) warmest years recorded in Singapore have occurred in the 21st century and all ten (10) occurred after 1997. This increasing trend has led to an increase in warm days and warm nights, and a decrease in cool days and cool nights.

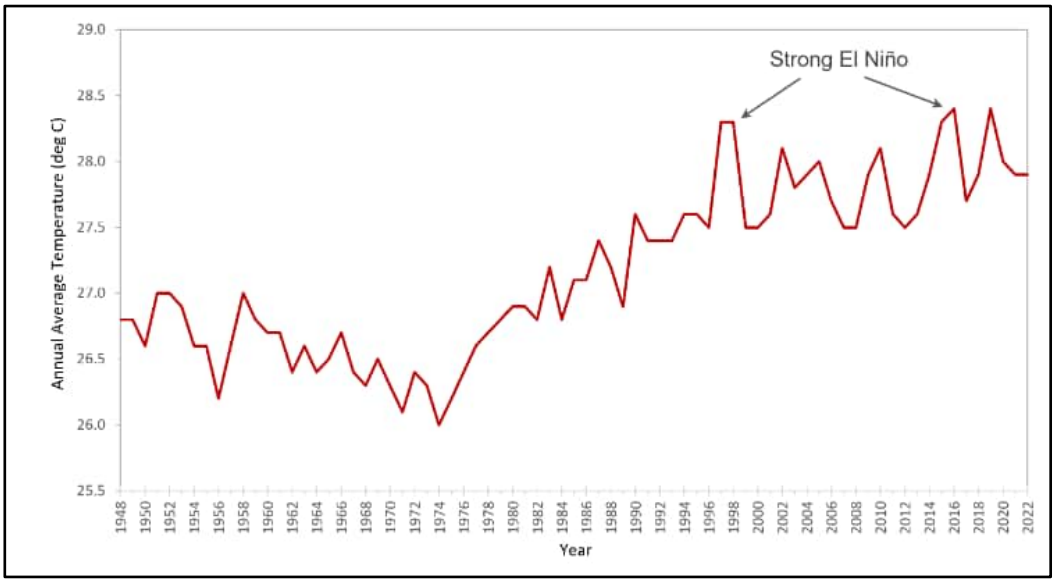


Figure 6.3.7 Annual mean temperature in Singapore from 1948 to 2022 (Source: MSS [W-7])

Generally, the temperature variation throughout the year is relatively small as compared to the mid-latitude regions [W-8]. The mean temperature from 2013 to 2022 was 28.01°C, which is 0.04°C higher than the previous record of 27.97°C for the decade from 2010 to 2021. In Year 2022, the annual mean temperature was 27.9°C, with May 2022 being the warmest month at 29.2°C and December 2022 being the coolest month at 26.7°C. Overall, the annual mean temperature of Year 2022 is 0.1°C above the long-term average of 27.8°C. Monthly mean temperatures in January (27.4°C) and May (29.2°C) were both 0.6°C warmer than their respective long-term monthly mean temperatures and monthly mean temperatures in June (27.9°C) and October (27.5°C), were 0.6°C and 0.3°C cooler than their respective long-term monthly mean temperatures, making them the coolest June and October in the past 10 years [W-6], as shown in the figure below.

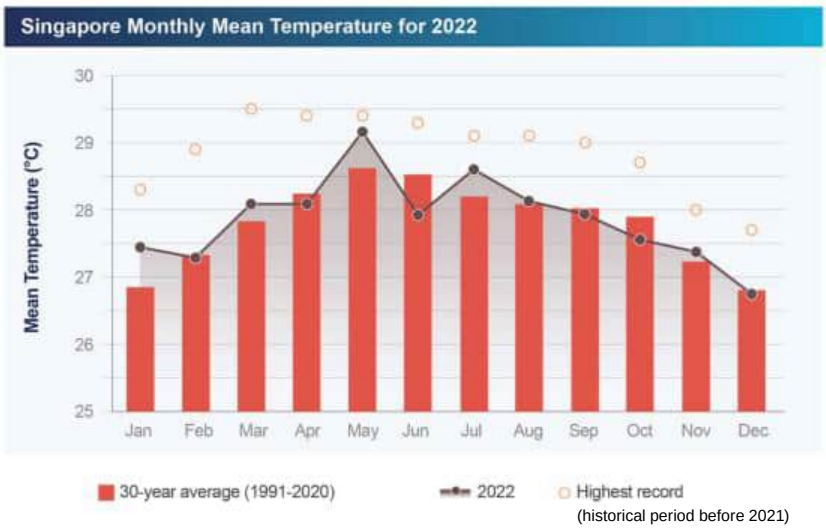


Figure 6.3.8 Singapore monthly mean temperature for 30-years average from Changi Climate Station with comparison to Year 2022 monthly mean temperature [W-6]

Although there is no distinct borderline between “urban” and “rural” areas in Singapore, maximum temperature difference of 4.01°C was observed between well-planted area, such as Lim Chu Kang area, and the Central Business District (CBD) area [P-18]. This shows the presence of an Urban Heat Island (UHI) effect in Singapore. Green areas in cities have been considered as potential measure in mitigating the UHI effect. This finding is also supported by a study conducted by Jusuf et al (2007), which shows different daytime temperature at different type of land use areas in Singapore. As observed in Figure 6.3.9, the daytime temperature in park areas is considerably lower compared to other type of land use areas [P-19].

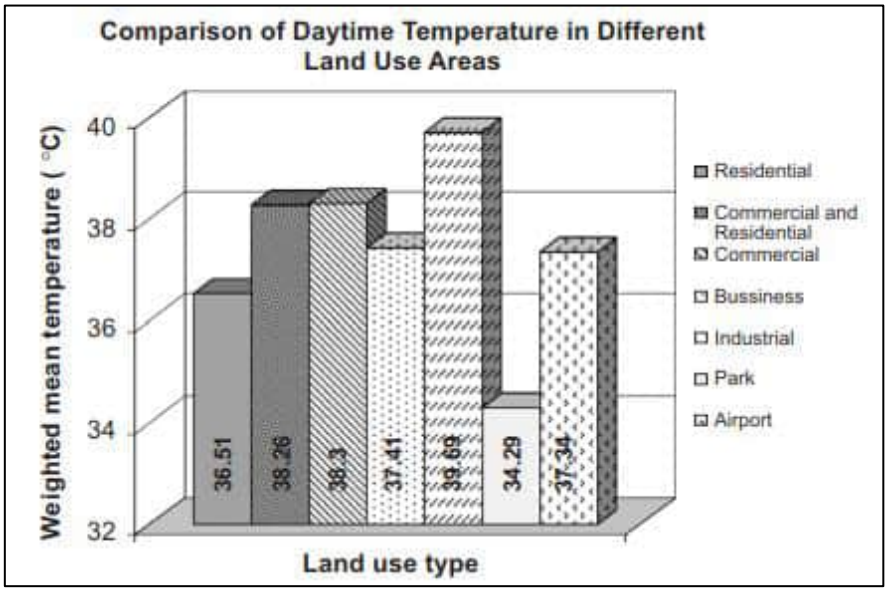


Figure 6.3.9 Comparison of daytime and night time temperature in different land use areas [P-19]

6.3.3.3 Relative Humidity

Relative humidity shows a fairly uniform pattern throughout the year and does not vary much from month to month (refer to Figure 6.3.10). Its daily variation is more marked, varying from more than 90% before sunrise to around 60% in the mid-afternoon on days when there is no rain. While the mean annual relative humidity is 83.9%, the relative humidity frequency reaches 100% during prolongated periods of rain.

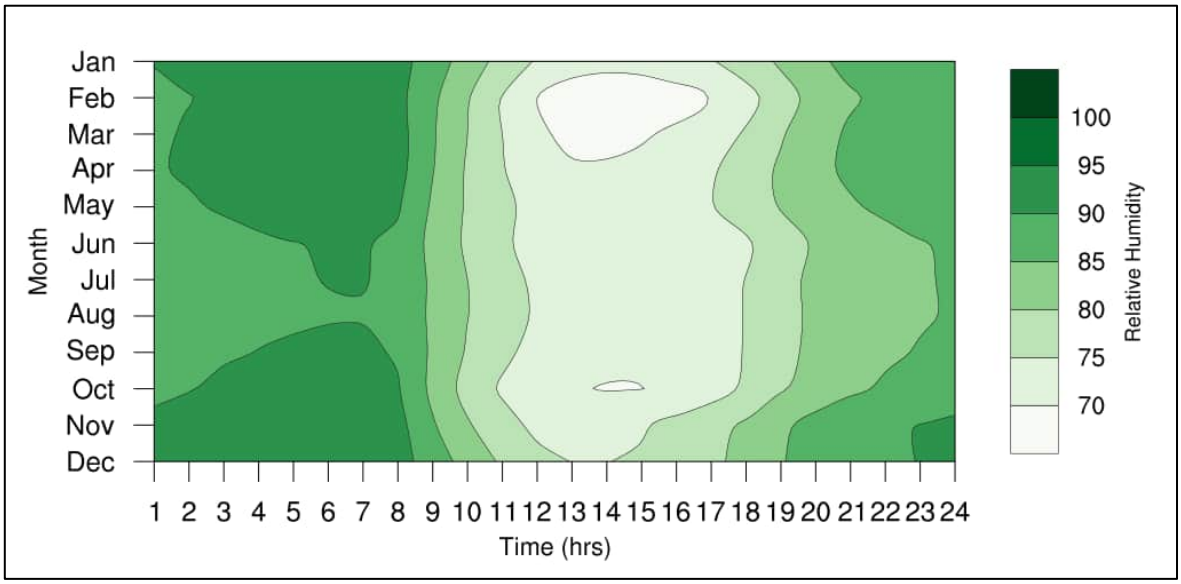


Figure 6.3.10 Hourly variation of relative humidity for each month from 1981 to 2010 (Source: MSS [W-5])

6.3.3.4 Surface Wind

Winds in Singapore are generally light, with the mean surface wind speed normally less than 2.5 m/s. An exception to this is during the presence of a Northeast Monsoon surge, where mean speeds of 10 m/s or more have been observed. Strong winds also occur during thunderstorms. Surface wind gusts are produced from thunderstorm downdrafts and from the passage of Sumatra Squall Lines. As shown in Figure 6.3.11, the most prominent winds in Singapore are from northeast and the south, occuring during the Northeast and Southwest Monsoon, respectively. The mean monthly wind speeds ranges from 1.5 m/s to 3 m/s [W-5].

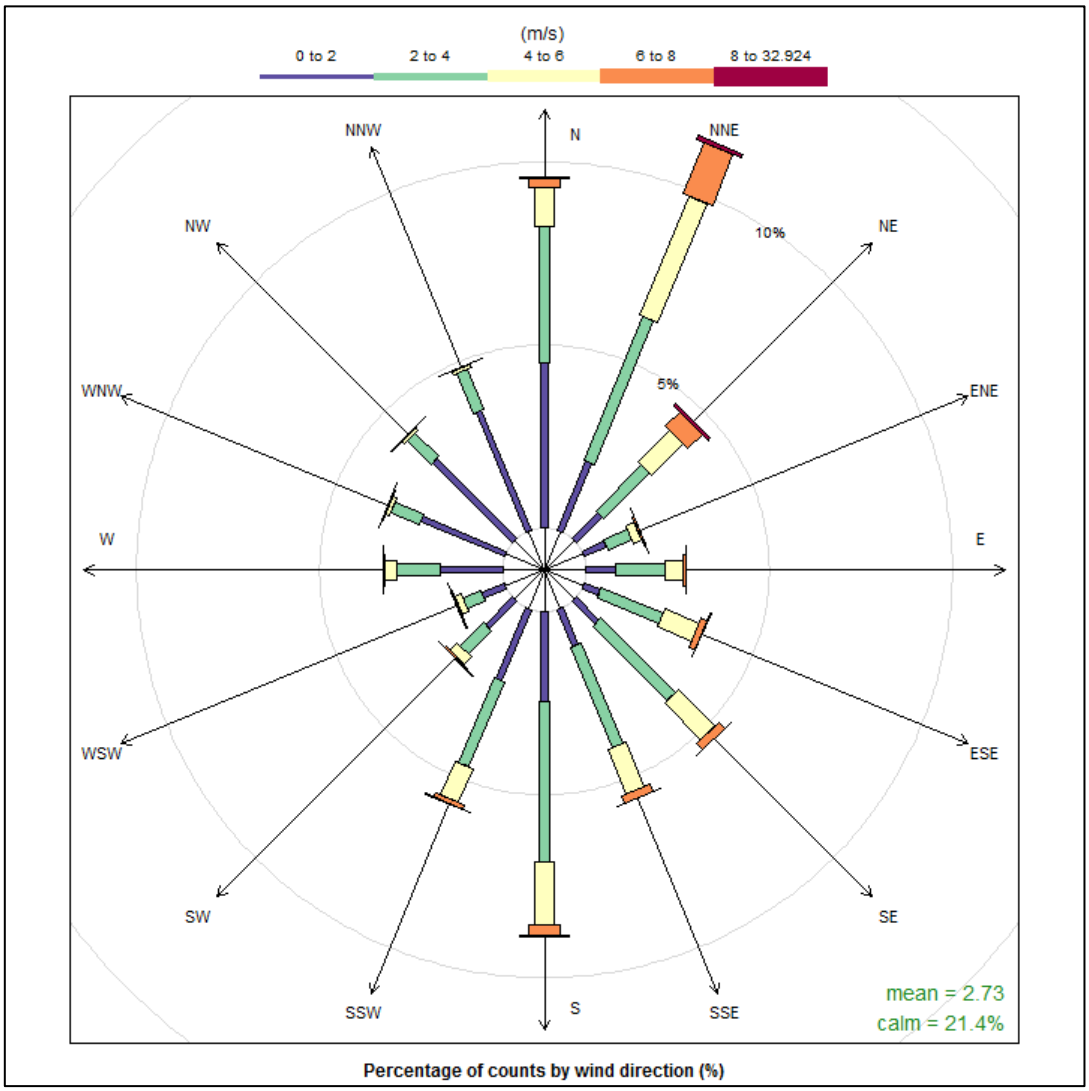


Figure 6.3.11 Annual wind rose of Singapore (1981-2010) (Source: MSS [W-5])

6.4 Biodiversity

6.4.1 Floristic Baseline Conditions

6.4.1.1 Habitat Description

Across the biodiversity Study Area (i.e., N4 and N5 Forested Areas), the dominant vegetation type identified was exotic-dominated secondary forest, which made up about a third (33.5%) of the Study Area. This reflects the land use history of Sembawang, which comprised mostly of cleared lands in the mid-20th century [W-3]. The cleared land was eventually overrun by tall grasses in the late-20th century that subsequently regenerated into exotic-dominated secondary forests as seen today [W-3]. Grassland that has regenerated to scrubland makes up 29.5% of the Study Area. Other spontaneous vegetation types found include abandoned-land forest (27.7%) which are remnant sundry cultivation from late-20th century [W-3], and grassland (5.1%). Other habitat types recorded is urban vegetation (2.5%) and semi-naturalised drain (0.2%). The remaining area is occupied by roads (0.9%) and construction storage facility (0.6%). The area occupied by each habitat/ vegetation type is tabulated in Table 6.2 and visualised in Figure 6.4.1.

Table 6.2 Absolute (ha) and relative (%) sizes of each habitat and vegetation type in the biodiversity Study Area

Habitat Type	Absolute N4 Forested size (ha)	Relative N4 Forested size (%)	Absolute N5 Forested size (ha)	Relative N5 Forested size (%)	Total absolute size (ha)	Total relative size (%)
Abandoned-land forest*	-	-	7.85	36.2	**7.85**	**27.7**
Scrubland*	1.73	25.9	6.62	30.6	**8.35**	**29.5**
Exotic-dominated Secondary Forest*	4.22	63.1	5.28	24.4	**9.5**	**33.5**
Grassland*	0.69	10.3	0.74	3.4	**1.42**	**5.1**
Urban Vegetation (Turf)	-	-	0.72	3.3	**0.72**	**2.5**
Semi-naturalised drain	0.05	0.7	-	-	**0.054**	**0.2**
Others (Infrastructure)	-	-	0.45	2.1	**0.45**	**1.5**
Others (Road)	-	-	0.25	1.1	**0.25**	**0.9**
Others (Construction storage facility)	-	-	0.20	0.9	**0.2**	**0.6**
Total	**6.69**	**100**	**21.66**	**100**	**28.34**	**100**
Note: *Habitats are considered as spontaneous vegetation						

N4 Forested Area

N4 Forested Area consists of four different habitat types (as summarised in Table 6.2, and shown in Figure 6.4.1). From the most dominant to the least dominant habitat, N4 Forested Area consists of exotic-dominated secondary forest, scrubland, grassland and semi-naturalised drain.

N5 Forested Area

N5 Forested Area consists of five different habitats (as summarised in Table 6.2, and shown in Figure 6.4.1). From the most dominant habitat to the least dominant habitat, N5 Forested Area consists of abandoned-land forest, scrubland, exotic-dominated secondary forest, grassland and urban vegetation. Altogether, spontaneous vegetation takes up approximately 94.6% (20.49 ha) of this area.



Legend

Habitat Mapping

- Abandoned-land forest
- Exotic-dominated secondary forest
- Scrubland
- Grassland
- Urban vegetation (Turf)
- Semi-naturalised drain
- Infrastructure
- Drain
- Project site
- Biodiversity Study Area

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	IT	Final Report	SAG	JAG
-	JUL 2024	IT	Final Report	SAG	JAG
1	JUN 2024	IT	Draft Final Report	SAG	JAG
-	MAY 2024	KRT	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Habitat mapping in biodiversity Study Area of Sembawang N4

Designed	Checked	Approved
KRT	SAG	JAG
	Drawn: KRT	Date: AUG 2024

Figure No. : 6.4.1 | Rev. : 1 | Sheet : 1 of 1

CAD File Name : NA | A3

Note: Source of basemap - Google Earth Map

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6.4.1.1.1 Abandoned-land Forest

N4 Forested Area

This habitat type is not present in N4 Forested Area.

N5 Forested Area

Abandoned-land forest occupies about a third of N5 Forested Area (refer to Figure 6.4.1). This habitat type is dominated by African tulip (*Spathodea campanulata*; Figure 6.4.2A) and cultivated trees, such as wild cinnamon (*Cinnamomum iners*), earleaf acacia (*Acacia auriculiformis*), rambutan (*Nephelium lappaceum var. lappaceum*), and oil palm (*Elaeis guineensis*). The undergrowth is dominated by saplings of Macarthur palm (*Ptychosperma macarthurii*; Figure 6.4.2D), which is typical of an abandoned-land forest habitat. However, recruitment of native species of conservation significance was also observed in the understorey, of which, most of the specimens were the nationally Vulnerable tree species, *Lindera lucida* (Figure 6.4.2B) and nationally Endangered climber species, *Adenia cordifolia* (Figure 6.4.2C). Other saplings of native species include common species such as ketapang (*Terminalia catappa*) and *Cinnamomum iners*

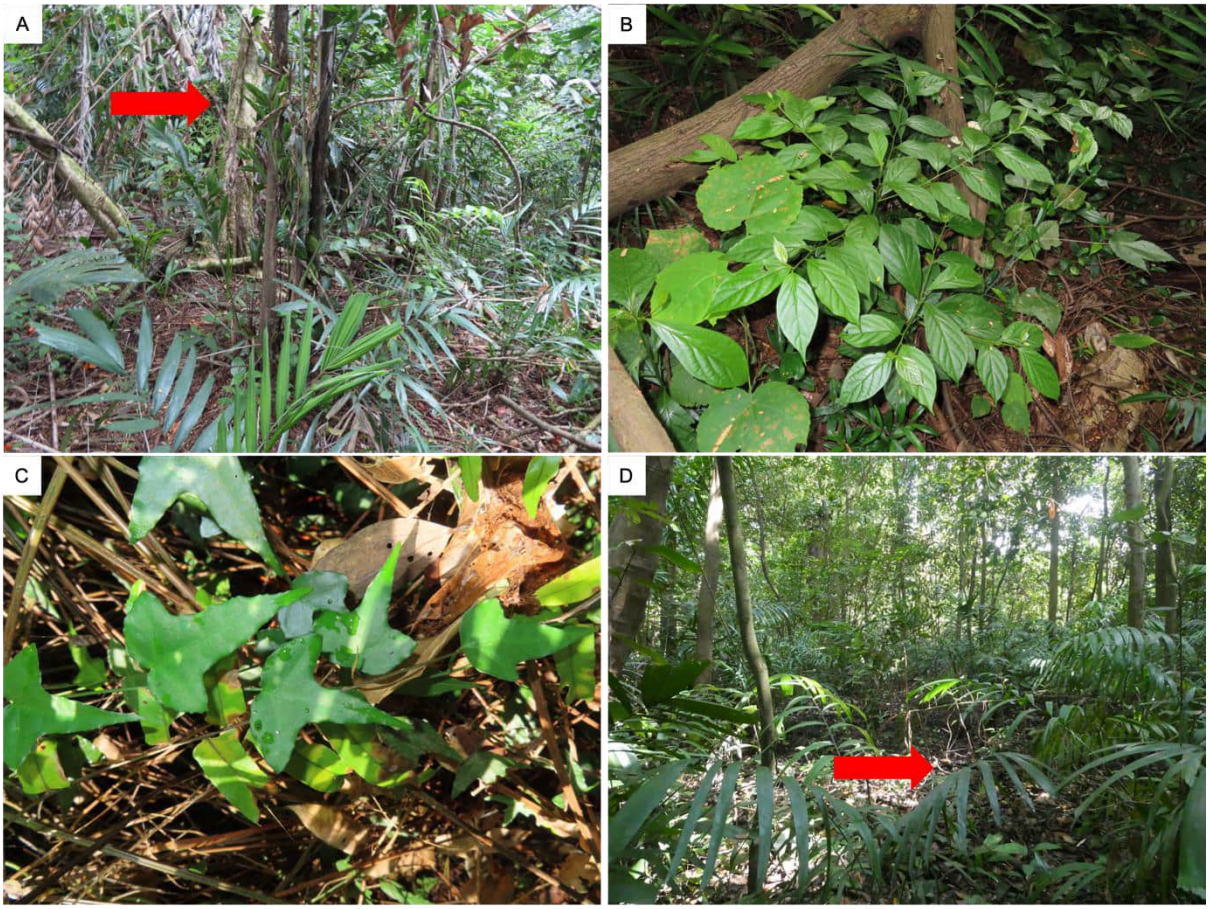


Figure 6.4.2 Abandoned-land forest in N5 Forested Area. (A) African tulip (*Spathodea campanulata*) dominates the canopy (red arrow); (B) sapling of nationally Vulnerable *Lindera lucida* that was frequently recorded in the understorey and undergrowth; (C) Nationally Endangered climber *Adenia cordifolia* that was frequently recorded in the undergrowth; (D) saplings of Macarthur palm (*Ptychosperma macarthurii*) often seen in the undergrowth (red arrow)

6.4.1.1.2 Exotic-dominated Secondary Forest

N4 Forested Area

The exotic-dominated secondary forest is the predominant habitat type in N4 Forested Area (refer to Table 6.2 for more details), dominated by albizia (*Falcataria falcata*; Figure 6.4.3A) and African tulip (*Spathodea campanulata*). Furthermore, the understorey and undergrowth are dominated by saplings of Macarthur palm (*Ptychosperma macarthurii*), fishtail palm (*Caryota mitis*) and wild cinnamon (*Cinnamomum iners*; Figure 6.4.3B). A few species

of conservation significance were also recorded within this habitat type, notably the sizeable penaga laut (*Calophyllum inophyllum*) found in the western forest patch (Figure 6.4.3C). On the western-most side of N4 Forested Area, the exotic-dominated secondary forest is dominated by *river tamarind (Leucaena leucocephala)* (Figure 6.4.3D).



Figure 6.4.3 Exotic-dominated secondary forest in N4 Forested Area. (A) albizia (*Falcataria falcata*) dominates the canopy (red arrow); (B) saplings of Macarthur palm (*Ptychosperma macarthurii*), fishtail palm (*Caryota mitis*) and wild cinnamon (*Cinnamomum iners*) that was frequently recorded in the understorey and undergrowth; (C) penaga laut (*Calophyllum inophyllum*) tree with a sizeable girth (red arrow); (D) forest edge of *River tamarind (Leucaena leucocephala)* dominated forest

N5 Forested Area

Exotic-dominated secondary forest occupies approximately a quarter of the N5 Forested Area (for more details, refer to Table 6.2). It is dominated by albizia (*Falcataria falcata*; Figure 6.4.4A) and African tulip (*Spathodea campanulata*). The understorey and undergrowth are dominated by saplings of Macarthur palm (*Ptychosperma macarthurii*), arrowhead vine (*Syngonium angustatum*), betel vine (*Piper betle*) and golden pothos (*Epipremnum aureum*; Figure 6.4.4B). The exotic-dominated secondary forest patch in the southwest of N5 Forested Area is dominated by ambay pumpwood (*Cecropia pachystachya*; Figure 6.4.4F). However, a few species of conservation significance were also recorded within this habitat type, notably the nationally Critically Endangered *Horsfieldia crassifolia* (Figure 6.4.4D), and nationally Vulnerable belalang puak (*Pittosporum ridleyi*; Figure 6.4.4C) and *Cnestis palala* (Figure 6.4.4E).



Figure 6.4.4 Exotic-dominated secondary forest in N5 Forested Area. (a) albizia (*Falcataria falcata*) dominates the canopy (red arrow); (b) saplings of Macarthur palm (*Ptychosperma macarthurii*), arrowhead vine (*Syngonium angustatum*), betel vine (*Piper betle*) and golden pothos (*Epipremnum aureum*) found in the undergrowth and understorey; (c) leaves and flowers of belalang puak tree (*Pittosporum ridleyi*); (d) leaves of *Horsfieldia crassifolia*; (e) *Cnestis palala* climber; (f) ambay pumpwood (*Cecropia pachystachya*) dominates the canopy of western-most exotic-dominated secondary forest patch

6.4.1.1.3 Scrubland

N4 Forested Area

The scrubland habitat occurs in the eastern portion of N4 Forested Area (refer to Figure 6.4.1). It generally occurs along the fringes of exotic-dominated secondary forest, and it contains clusters of shrubs and herbs (Figure 6.4.5A). Two species of conservation significance were recorded within this habitat type, mainly the nationally Vulnerable trees mahang bulan (*Macaranga griffithiana*; Figure 6.4.5E) and poison peach (*Trema tomentosum*; Figure 6.4.5F). Fern species such as broad sword fern (*Nephrolepis biserrata*; Figure 6.4.5B), resam (*Dicranopteris linearis*), and swamp shield-fern (*Cyclosorus interruptus*) were also recorded, In addition, shrub species (*Mallotus paniculatus*; Figure 6.4.5C) and herb species *Heliconia* 'Golden Torch Sunshine' (Figure 6.4.5D) were observed in N4 Forested Area.



Figure 6.4.5 Scrubland in N4 Forested Area. (A) mix of shrubs and herbs occur within the habitat; (B) broad sword fern (*Nephrolepis biserrata*) dominates scrubland patch; (C) shrub species *Mallotus paniculatus* (red arrow); (D) herb species *Heliconia* 'Golden Torch Sunshine' (red arrow); (E) glaucous stem of mahang bulan (*Macaranga griffithiana*); (F) leaf underside and fruits of poison peach (*Trema tomentosum*)

N5 Forested Area

The scrubland habitat occupies about a third of the N5 Forested Area (for more details, please refer to Table 6.2). Generally, each scrubland parcel was dominated by a different species of shrub or herbs.

In the western scrubland patch, shrub species simpoh air (*Dillenia suffruticosa*) was found to be a dominating one (Figure 6.4.6A). A few species of conservation significance such as the nationally Endangered climber *Adenia cordifolia* (Figure 6.4.6B) and tree *Melicope lunu-ankenda* (Figure 6.4.6C) were found within this patch. Fern species broad sword fern (*Nephrolepis biserrata*) was the dominating species within the southern scrubland patch (Figure 6.4.6D). Within this patch, only one individual of conservation significance, nationally Vulnerable shrub capal (*Callicarpa longifolia*) was found (Figure 6.4.6E).

Dense clusters of herb species tapioca (*Manihot esculenta*) dominate the central scrubland patch within N5 Forested Area (Figure 6.4.6F). There are no species of conservation significance occurring within this patch.



Figure 6.4.6 Scrubland in N5 Forested Area. (A) simpoh air (*Dillenia suffruticosa*) found within the western scrubland patch; (B) Nationally Endangered climber Adenia cordifolia found within scrublands and abandoned-land forests; (C) Nationally Endangered Tree *Melicope lunu-ankenda*; (D) broad sword fern (*Nephrolepis biserrata*) dominated scrubland patch; (E) Nationally Vulnerable shrub capal (*Callicarpa longifolia*); (F) dense clusters of tapioca (*Manihot esculenta*) within the central scrubland patch

6.4.1.1.4 Grassland

N4 Forested Area

The grassland habitat occurs is both the eastern and western part of N4 Forested Area (refer to Figure 6.4.1). It is mainly dominated by a single plant species, elephant grass (*Cenchrus purpureus*; Figure 6.4.7A). The grassland patch occurring in the centre of N4 Forested Area (Figure 6.4.1) is mainly dominated by *Scleria oblata* (Figure 6.4.7B).

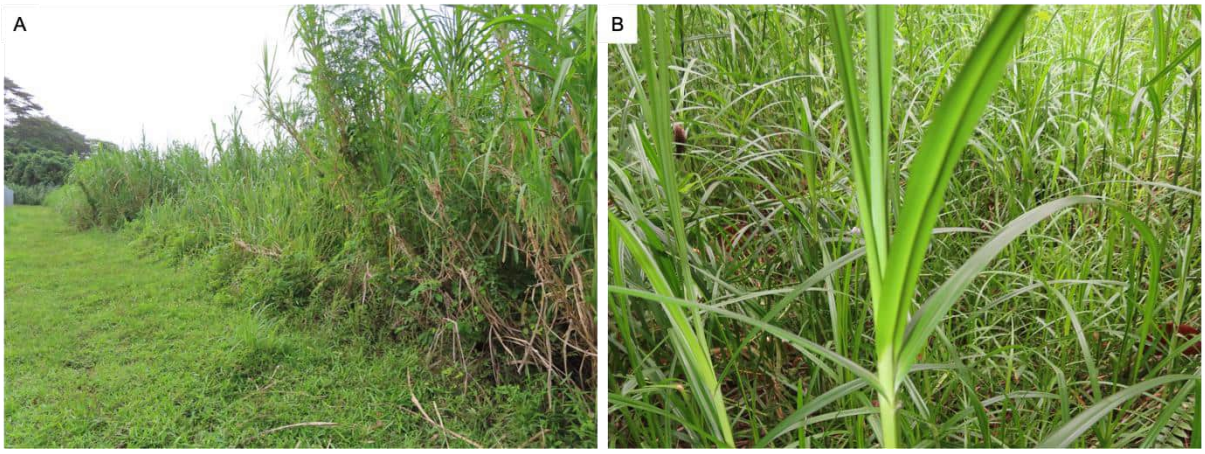


Figure 6.4.7 Grassland in N4 Forested Area. (A) elephant grass (*Cenchrus purpureus*) found within the western grassland patch; (B) *Scleria oblata* found within the western grassland patch

N5 Forested Area

Grassland habitat occurs along the forest fringes in both western and northern parts of N5 Forested Area (refer to Figure 6.4.1). It is mainly dominated by grass species, Guinea grass (*Urochloa maxima*; Figure 6.4.8A) and *Urochloa mutica* (Figure 6.4.8B).

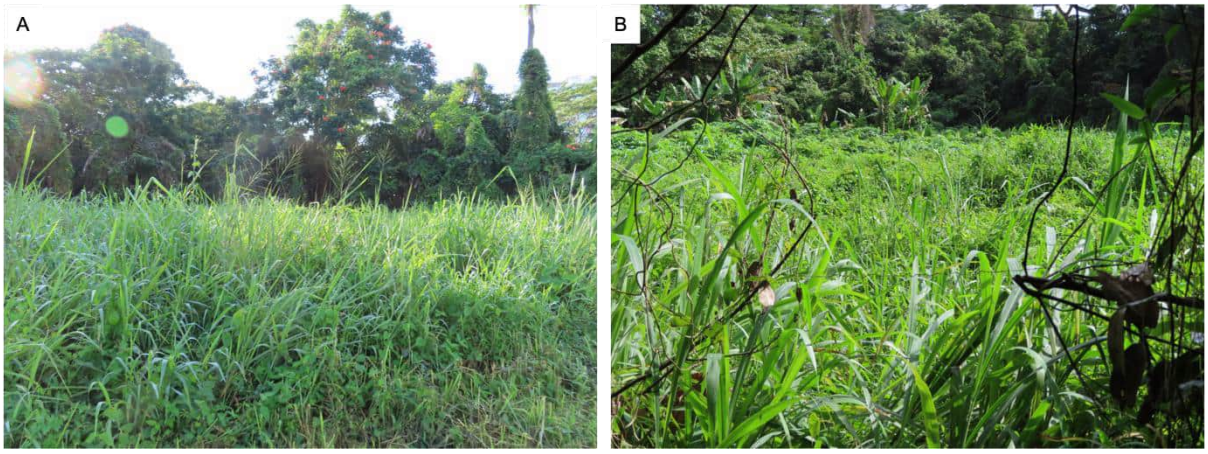


Figure 6.4.8 Grassland in N5 Forested Area. (A) guinea grass (*Urochloa maxima*) found within grassland patch; (B) *Urochloa mutica* found within grassland patch

6.4.1.1.5 Urban Vegetation (Turf)

N5 Forested Area

Urban vegetation makes up a small portion of N5 Forested Area (as summarised in Table 6.2, and shown in Figure 6.4.1). This vegetation type largely consists of managed turf along the western part of the N5 Forested Area (refer to Figure 6.4.9). It is mainly dominated by cow grass (*Axonopus compressus*).



Figure 6.4.9 Turf in N5 Forested Area. (A) section of turf in proximity to St John's Rd; (B) section of turf in proximity to Canada Rd

6.4.1.1.6 Others (Infrastructure)

N5 Forested Area

Infrastructure was only found within the western portion of N5 Forested Area. A section of a discontinued asphalt road can be found at the junction in proximity to Assyafaah Mosque (Figure 6.4.10A). Other infrastructure within N5 Forested Area includes a storage facility for a construction site along Canberra Road (Figure 6.4.10B).



Figure 6.4.10 Infrastructure in N5 Forested Area. (A) section of a discontinued asphalt road; (B) storage facility for a construction site along Canberra Road

6.4.1.1.7 Watercourses

N4 Forested Area

A semi-naturalised drain is present within N4 Forested Area. The drain flows west from Canberra Road, through the N4 Forested Area, before flowing north-west towards Admiralty Road West. The upstream section of the concrete drain banks is shaded by moderately dense canopy of vegetation on both sides (as shown in Figure 6.4.11A). In the downstream sections, there were scrublands on one side of the bank and a steep turf on the other (as shown in Figure 6.4.11B). No stream-related species are found along the drain banks.

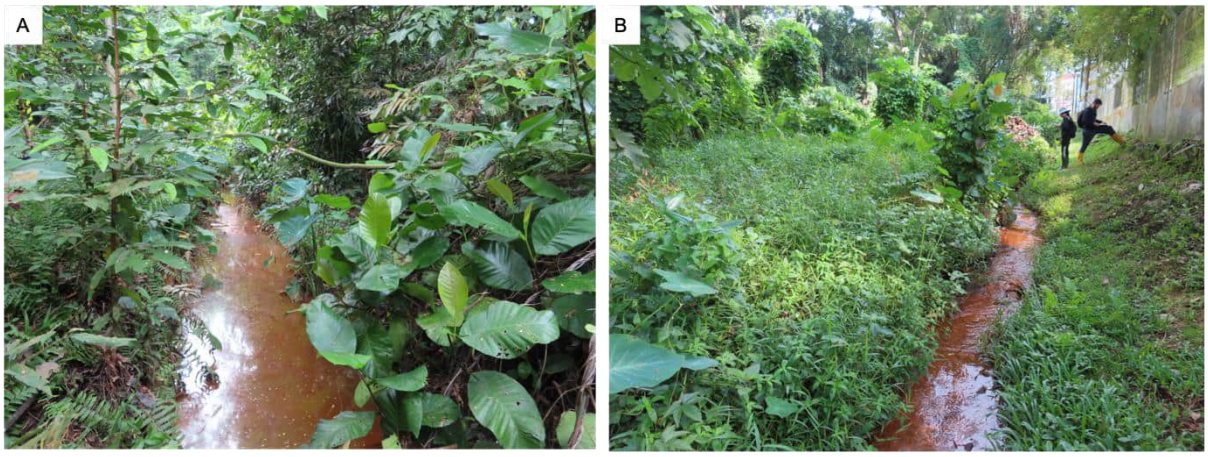


Figure 6.4.11 Semi-naturalised drain in N4 Forested Area. (A) section of drain south of Ottawa Road with vegetation on both banks; (B) section of drain leading to Admiralty Road W with scrubland on one side of the bank

N5 Forested Area

A concrete drain is present within N5 Forested Area. The drain flows south from Ottawa Road (Figure 6.4.12A), through the Study Area, before flowing west towards Canberra Road (Figure 6.4.12B). Generally, the concrete drain is shaded by a dense canopy of vegetation on both banks.



Figure 6.4.12 Concrete drain in N5 Forested Area. (A) section of drain south of Ottawa Road with vegetation on both banks; (B) section of drain leading towards Canberra Road with vegetation on both banks

6.4.1.2 Overall

The origins and statuses were tabulated for the species in each of the forested areas (refer to Table 6.3). This includes for native threatened species—species that have been accorded the following statuses: Vulnerable, Endangered, Critically Endangered or Presumed Extinct (as detailed in Appendix D). Distinction was made to decipher if threatened species are from native wild populations or cultivated locally and/ or are relics from past cultivation. Species belonging to the latter category are not of conservation significance even though they have been accorded with a threatened status.

A total of 249 species and two species groups (i.e., plants that could not be identified to species level with certainty) belonging to 82 families were identified in the Study Area (refer to Table 6.3). In N4 Forested Area, 128 species were present and in N5 Forested Area, 198 species were present. The species groups consist of *Lepistemon cf binectarifer* and *Tectaria cf semipinnata*. The identification of *Tectaria cf semipinnata* could not be confirmed as no fertile fronds were present. Overall, there were 29 species which are listed as nationally threatened.

N4 Forested Area

Of the 129 species recorded within the N4 Forested Area, 66 species are exotic (51.6%), 57 species are native (44.5%) and five (3.9%) are cryptogenic (i.e., species that has unknown or uncertain origins). The plant species belonging to each status category are summarised in Table 6.3.

Of the 57 native species recorded, nine species are considered as threatened species (i.e., species with statuses of Vulnerable, Endangered, and Critically Endangered).

N5 Forested Area

Of the 198 species recorded within the N5 Forested Area, 95 species are exotic (48%), 98 species are native (49.5%) and five (2.5%) are cryptogenic (i.e., species that has unknown or uncertain origins). The plant species belonging to each status category are summarised in Table 6.3.

Of the 98 native species recorded, 22 species are considered as threatened species (i.e., species with statuses of Vulnerable, Endangered, and Critically Endangered), which is twice the number of threatened species in N4 Forested Area.

Table 6.3 Number and percentage (%) of species belonging to each status category in the forested areas

Origin Status	Number of Species within N4 Forested Area	Percentage (%)	Number of Species within N5 Forested Area	Percentage (%)	Number of Species within Biodiversity Study Area	Percentage (%)
Native	**57**	**44.5**	**98**	**49.5**	**112**	**45**
Common	45	35.2	74	37.4	81	32.5
Vulnerable	4	3.1	12	6.1	15	6
Endangered	2	1.6	4	2	5	2
Critically Endangered	3	2.3	6	3	8	3.2
Data deficient	3	2.3	2	1	3	1.2
Exotic	**66**	**51.6**	**95**	**48**	**129**	**51.8**
Cultivated Only	6	4.7	13	6.6	18	7.2
Casual	14	10.9	33	16.7	38	15.3
Naturalised	42	32.8	45	22.7	65	26.1
Not Assessed	4	3.1	4	2	8	3.2
Cryptogenic	**5**	**3.9**	**5**	**2.5**	**8**	**3.2**
Total	**128**	**100**	**198**	**100**	**249**	**100**

6.4.1.3 Species of Conservation Significance

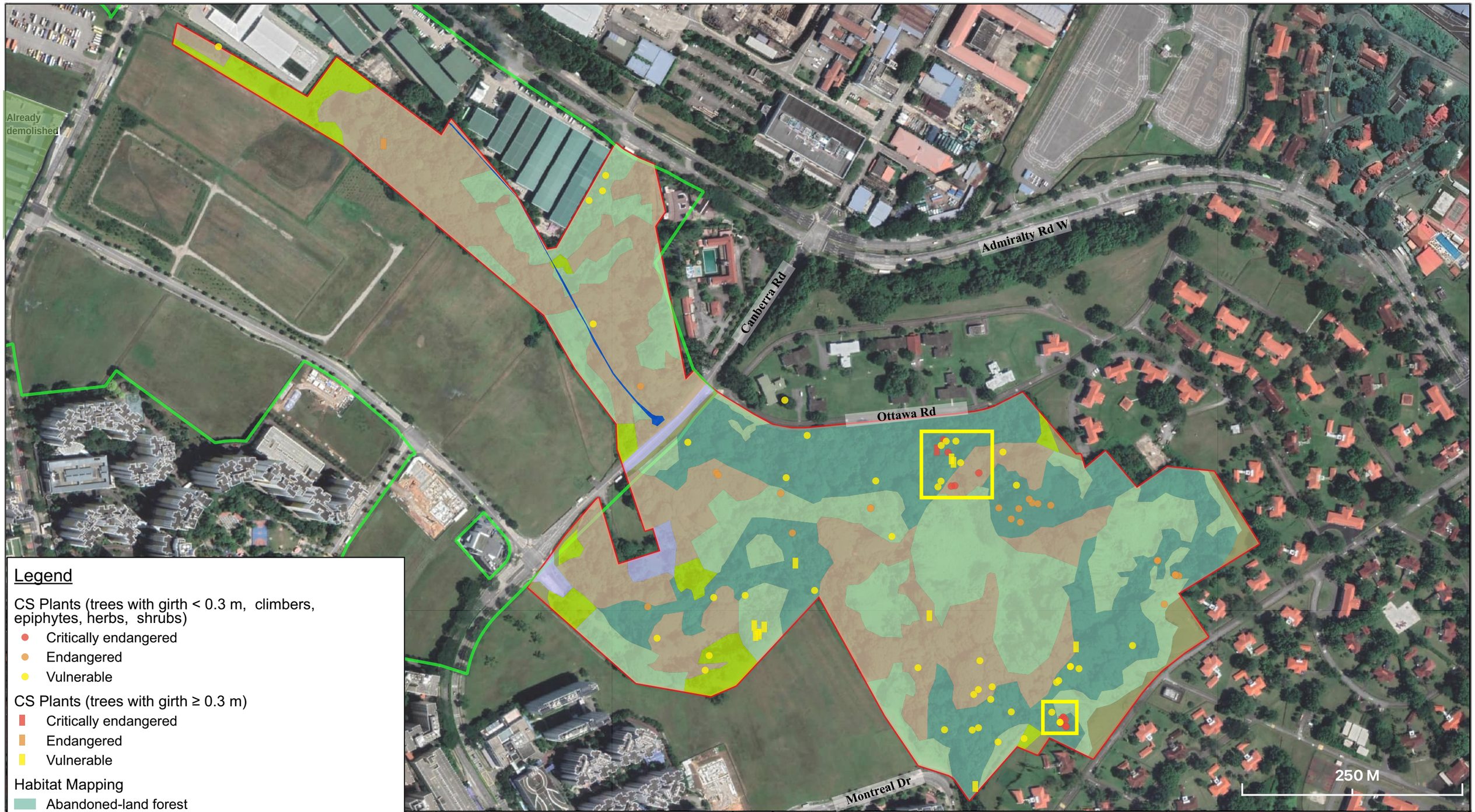
N4 Forested Area

Five species were considered to be of conservation significance (Figure 6.4.13; Table 6.4). The number of specimens and/ or clusters of specimens of these threatened species are summarised in Table 6.5 and detailed in Appendix E.

A total of nine plant species are initially considered as threatened species and were found scattered across N4 Forested Area. According to the historical land use of N4 Forested Area (Section), four species — *Mangifera odorata* and *Syzygium pycnanthum* — are most likely relics that had persisted from the past sundry cultivation rather than local provenance and are not considered as species of conservation significance. Additionally, *Neolitsea cassia* and *Syzygium myrtifolium* are also not considered as species of conservation significance since they are commonly planted as roadside trees which can act as a dispersal source.

A nationally Endangered penaga laut (*Calophyllum inophyllum*; Figure 6.4.14A) tree with 2.3 m girth was found within the exotic-dominated secondary forest. Typically, penaga laut are slow growing coastal forest species and its presence suggest that it may have been dispersed from coastal forests patches present in the area. Other species found within this habitat type are the nationally Vulnerable mahang bulan (*Macaranga griffithiana;* Figure 6.4.14B) and *Tectaria cf semipinnata* (Figure 6.4.14C).

Mahang bulan (*Macaranga griffithiana*) also occurred in scrubland of the N4 Forested Area, along with poison peach (*Trema tomentosum*; Figure 6.4.14D). As pioneer species, they usually occur in early stages of forest regeneration such as scrubland or degraded forest habitats.



Legend

CS Plants (trees with girth < 0.3 m, climbers, epiphytes, herbs, shrubs)
- Critically endangered
- Endangered
- Vulnerable

CS Plants (trees with girth ≥ 0.3 m)
- Critically endangered
- Endangered
- Vulnerable

Habitat Mapping
- Abandoned-land forest
- Exotic-dominated secondary forest
- Grassland
- Infrastructure
- Semi-naturalised drain
- Scrubland
- Urban vegetation (Turf)

Others
- Recent colonisation by Swamp Forest species
- Biodiversity Study Area
- Project site

Note: Source of basemap - Google Earth Map

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	IT	Final Report	SAG	JAG
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1	JUN 2024	IT	Draft Final Report	SAG	JAG
	MAY 2024		Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client : HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Distribution of plant specimens of conservation significance in biodiversity Study Area of Sembawang N4

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Figure 6.4.14 Plant species of conservation significance found in N4 Forested Area. (A) *Calophyllum inophyllum* tree; (B) lobbed leaves of *Macaranga griffithiana*; (C) a frond of *Tectaria* cf *semipinnata*; (D) leaves and fruits of *Trema tomentosum*

Table 6.4 Number of plant species of conservation significance in N4 Forested Area

Species Conservation Status*	VU	EN	CR	Total
Non-Cultivated Threatened Species	3	2	-	**5**
Cultivated Threatened Species	1	-	3	**4**
Note: VU – Vulnerable; EN – Endangered; CR – Critically Endangered				

Table 6.5 Breakdown of plant species of conservation significance in N4 Forested Area

Habitat	Number of Individuals and Clusters				Number of Species			
	VU	EN	CR	Total	VU	EN	CR	Total
Exotic-dominated Secondary Forest	1	2	-	**3**	1	2	-	**3**
Scrubland	3	-	-	**3**	2	-	-	**2**
Grassland	-	-	-	**-**	-	-	-	**-**
Note: VU – Vulnerable; EN – Endangered; CR – Critically Endangered								

N5 Forested Area

A total of 17 species were considered to be of conservation significance (Figure 6.4.13; Table 6.6). The number of specimens and/or clusters of specimens of these threatened species are summarised in Table 6.7.

There are 22 plant species that were initially considered as threatened species and were found scattered across N5 Forested Area. According to the historical land use of N5 Forested Area, five species out of the 22 threatened species — *Baccaurea motleyana*, *Oncosperma tigillarium*, *Peltophorum pterocarpum*, *Sterculia parviflora*, *Syzygium myrtifolium* — are most likely relics that had persisted from the past cultivation rather than local provenance, and hence were not considered as species of conservation significance.

Within the N5 abandoned-land forest patches, 13 species of conservation significance were found, of which, two are nationally Critically Endangered, four are nationally Endangered, and seven are nationally Vulnerable (Table 6.7). The two nationally Critically Endangered species are *Horsfieldia crassifolia* (Figure 6.4.15B) and *Neoscortechinia sumatrensis* (Figure 6.4.15D). These species, along with nationally Vulnerable *Horsfieldia polyspherula* var. *polyspherula* (Figure 6.4.15G) and *Santiria laevigata* (Figure 6.4.15H), occur within freshwater swamp forests and were previously recorded along Sungei Seletar, now Seletar Reservoir (Dempsey and Chew, 2011; Ang et al., 2010). Given the proximity of the Study Area to Seletar Reservoir, this would suggest that the specimens found within N5 Forested Area could have been dispersed from nearby remnant freshwater swamp forests in Seletar, or across the sea from Johor (Malaysia). The four nationally Endangered species are *Adenia cordifolia* (Figure 6.4.15A), *Calophyllum inophyllum*, *Melicope lunu-ankenda* and *Uncaria cordata* (Figure 6.4.15 E). *Adenia cordifolia* is a climber typically associated with dense, secondary forest growth whereas *Calophyllum inophyllum* is a coastal forest species. *Melicope lunu-ankenda* (Figure 6.4.15F) and *Uncaria cordata*, along with nationally Vulnerable *Macaranga griffithiana*, are typically found in disturbed forests and forest fringes. Within the abandoned-land forest patches, these specimens are generally found along the forest edges. Other nationally Vulnerable species such as *Goniophlebium percussum*, *Lindera lucida*, *Litsea umbellata*, and *Microlepia speluncae* usually occur in mature secondary forests.

Nationally Vulnerable *Cnestis palala* and *Pittosporum ridleyi*, are found within the N5 exotic-dominated secondary forest patches. These species are typically associated with mature secondary forest. Other species found within this habitat type are *Horsfieldia crassifolia*, *Lindera lucida*, *Litsea umbellata*, *Macaranga griffithiana* and *Uncaria cordata*.

Other nationally Vulnerable species such as *Callicarpa longifolia* and *Cissus repens* can be found within the scrublands. These species are able to occur in forest fringe habitats, such as scrublands. Other species found within this habitat type are *Adenia cordifolia*, *Macaranga griffithiana*, *Melicope lunu-ankenda* and *Uncaria cordata*. Specimens of *Lindera lucida* and *Macaranga griffithiana* were recorded within the grassland habitat.



Figure 6.4.15 Plant species of conservation significance found in N5 Forested Area. (A) *Adenia cordifolia* Climber; (B) *Horsfieldia crassifolia* sapling; (C) *Melicope lunu-ankenda* tri-foliate leaves; (D) *Neoscortechinia sumatrensis* sapling; (E) *Uncaria cordata* climber; (F) compound leaves of *Melicope lunu-ankenda*; (G) *Horsfieldia polyspherula var. polyspherula* leaves; (H) *Santiria laevigata* leaves

Table 6.6 Number of plant species of conservation significance in N5 Forested Area

Species Conservation Status*	VU	EN	CR	Total
Non-Cultivated Threatened Species	11	4	2	17
Cultivated Threatened Species	1	-	4	5

Note: VU – Vulnerable; EN – Endangered; CR – Critically Endangered.

Table 6.7 Breakdown of plant species of conservation significance in N5 Forested Area

Habitat	Number of Individuals and Clusters				Number of Species			
	VU	EN	CR	Total	VU	EN	CR	Total
Abandoned-land Forest	31	15	7	**53**	7	4	2	**13**
Exotic-dominated Secondary Forest	10	2	3	**15**	5	1	1	**7**
Scrubland	8	4	2	**14**	1	3	3	**7**
Grassland	2	-	-	**2**	2	-	-	**2**

Note: VU – Vulnerable; EN – Endangered; CR – Critically Endangered.

6.4.1.4 Large Specimens

N4 Forested Area

There were 28 large plant specimens of ≥ 3 m recorded within N4 Forested Area (refer to Table 6.8 and Appendix F), of which 20 individuals are large trees with girth sizes that range from 3 m – 4 m girth, belonging to two species and two families. All of these specimens are exotic tree species. The remaining eight specimens are stranglers with a spread that ranges from 3 m – 20 m. The largest tree specimen recorded was albizia (*Falcataria falcata*; Figure 6.4.16A) of 4 m girth. As for stranglers, a specimen of Malayan banyan (*Ficus fore*; Figure 6.4.16B) was recorded with spread of 20 m.



Figure 6.4.16 Large specimens recorded in the N4 Forested Area. (A) albizia (*Falcataria falcata*) tree with 4 m girth; (B) Malayan banyan (*Ficus microcarpa*) strangler with spread of 20 m

Already demolished

Admiralty Rd W

Canberra Rd

Ottawa Rd

Montreal Dr

250 M

Legend

Large Specimens
- Shrub (Bamboo)
- Strangler (Keystone)
- Tree

Habitat Mapping
- Abandoned-land forest
- Exotic-dominated secondary forest
- Scrubland
- Grassland
- Urban vegetation (Turf)
- Semi-naturalised drain
- Infrastructure
- Project site
- Biodiversity Study Area

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-	JUL 2024	IT	Final Report	SAG	JAG
1	JUN 2024	IT	Draft Final Report	SAG	JAG
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Figure Title :

Distribution of large specimens in biodiversity Study Area of Sembawang N4

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Table 6.8 Number of large specimens recorded in N4 Forested Area

Habit	Origin	Species	No. Of Specimens
Tree	Exotic	*Falcataria falcata*	16
		Spathodea campanulata	4
Strangler	Cryptogenic	*Ficus benjamina*	1
	Native	*Ficus microcarpa*	7
Total			**28**

N5 Forested Area

There were 112 large plant specimens of ≥ 3 m recorded within N5 Forested Area (refer to Table 6.9 and Appendix F), of which 92 individuals are large trees with girth sizes that range from 3 m – 7 m girth, belonging to 12 species and 8 families. Most of these specimens are exotic tree species. There were 15 strangler specimens with a spread that ranges from 3 m – 20 m. The remaining five specimens are bamboo clusters with a spread that ranges from 8 m – 25 m. The largest tree specimen recorded was Albizia (*Falcataria falcata*; Figure 6.4.17A of 7 m girth. As for stranglers, a specimen of Malayan banyan (*Ficus microcarpa*; Figure 6.4.17B) was recorded with spread of 20 m. The largest bamboo cluster recorded was a specimen of golden bamboo (*Bambusa vulgaris*; Figure 6.4.17C) with a spread of 25 m.

Table 6.9 Number of large specimens recorded in N5 Forested Area

Habit	Origin	Species	No. Of Specimens
Tree	Exotic	*Falcataria falcata*	61
		Spathodea campanulata	10
		Adenanthera pavonina	5
		Samanea saman	5
		Cecropia pachystachya	1
		Pterocarpus indicus	1
	Native	*Cyrtophyllum fragrans*	4
		Cinnamomum iners	1
		Peltophorum pterocarpum	1
		Syzygium grande	1
		Terminalia catappa	1
	Cryptogenic	*Nephelium lappaceum*	1
Strangler	Cryptogenic	*Ficus benjamina*	3
	Native	*Ficus microcarpa*	12
Shrub (Bamboo)	Exotic	*Bambusa vulgaris*	4
		Bambusa cf heterostachya	1
Total			**112**

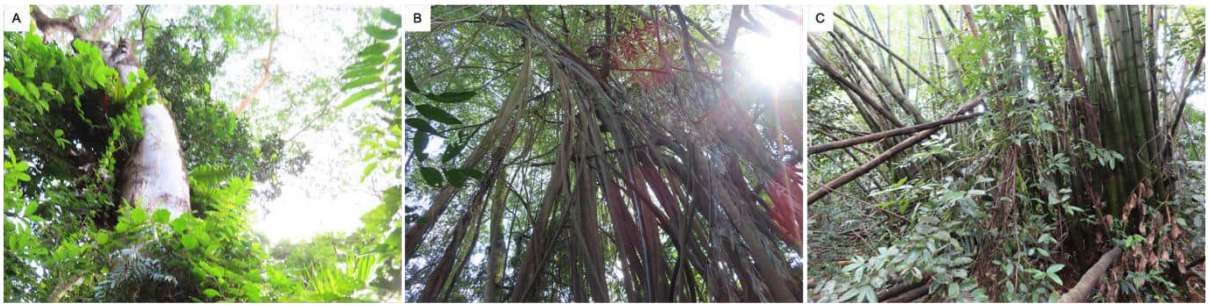
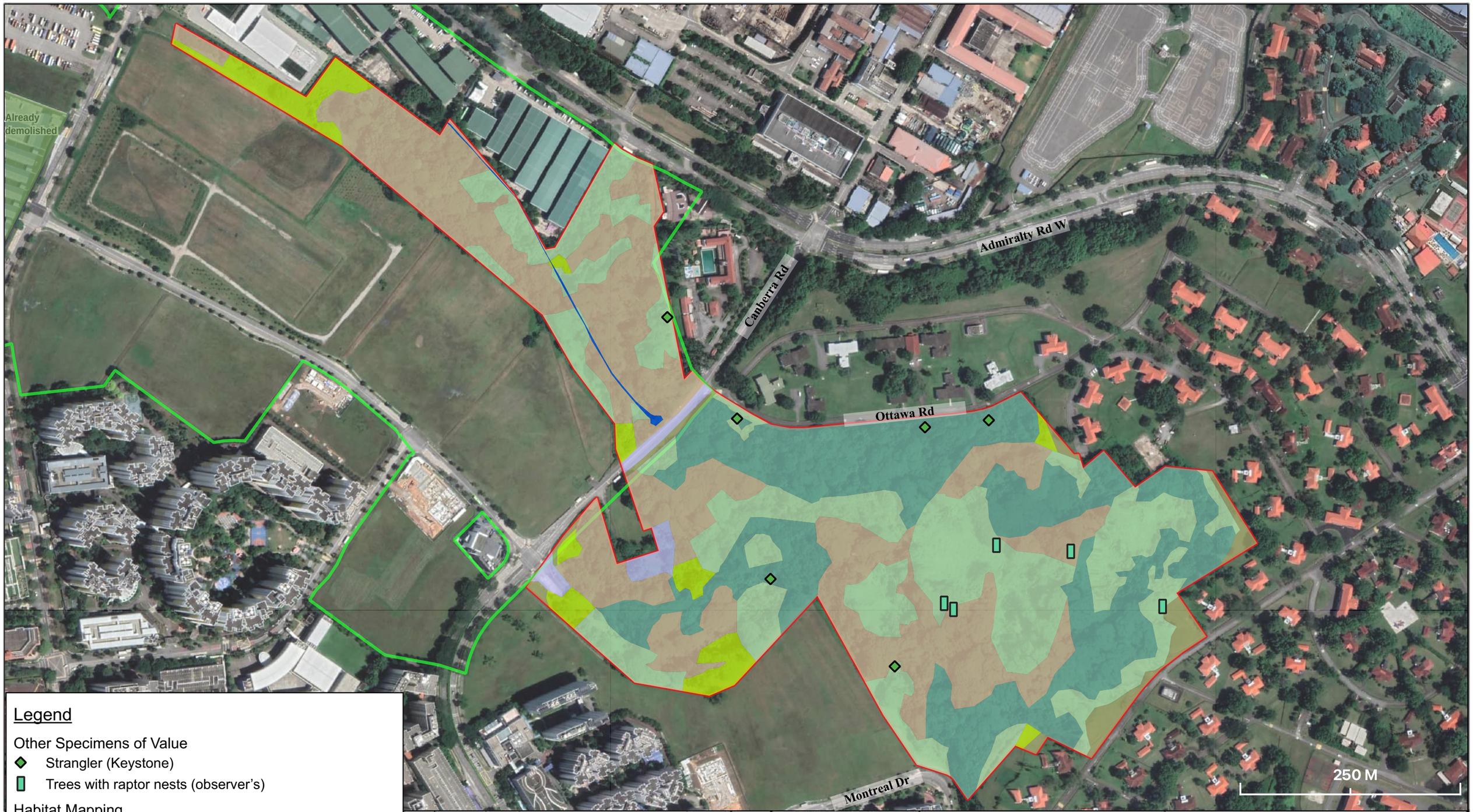


Figure 6.4.18 Large specimens recorded in the N5 Forested Area. (A) albizia (*Falcataria falcata*) tree with 7 m girth; (B) Malayan banyan (*Ficus microcarpa*) strangler with spread of 20 m; (C) golden bamboo (*Bambusa vulgaris*) with a spread of 25 m

6.4.1.5 Other Specimens of Value

Other plant specimens of value recorded include trees with raptor nests, keystone species (*Ficus* spp.), and bamboo clusters that are potential roosting sites for nationally threatened bamboo bats (*Tylonycteris* spp.). It should be noted that keystone species that are of conservation significance and large keystone/ bamboo specimens (i.e., girth/spread of 3.0 m and above) are excluded in this Section as they have been represented in Section 6.4.1.3 and 6.4.1.4.



Legend

Other Specimens of Value
- Strangler (Keystone)
- Trees with raptor nests (observer's)

Habitat Mapping
- Abandoned-land forest
- Exotic-dominated secondary forest
- Grassland
- Infrastructure
- Semi-naturalised drain
- Scrubland
- Urban vegetation (Turf)

Others
- Biodiversity Study Area
- Project site

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Figure Title :

Distribution of other specimens of value in biodiversity Study Area of Sembawang N4

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N4 Forested Area

A single record of small Malayan banyan (*Ficus microcarpa*) was found on the eastern side of N4 Forested Area (Table 6.10; Figure 6.4.20). This 1 m girth strangler was growing within a scrubland (Figure 6.4.19).

Table 6.10 Number of other specimens of value recorded in N4 Forested Area

Habit	Origin	Species	No. Of Specimens
Strangler	Native	*Ficus microcarpa*	1
Total			**1**



Figure 6.4.20 Malayan banyan (*Ficus microcarpa*) recorded in N4 Forested Area.

N5 Forested Area

A total of 11 other plant specimens of value were recorded in N5 Forested Area (Table 6.11; Figure 6.4.19). These specimens consist of five albizia (*Falcataria falcata*) tree with raptor's nest (Figure 6.4.21A), three weeping fig (*Ficus benjamina*; Figure 6.4.21B) stranglers, two Malayan banyan (*Ficus microcarpa*; Figure 6.4.21C), and a cluster of golden bamboo (*Bambusa vulgaris*; Figure 6.4.21D).

Majority of the *Ficus* specimens and the bamboo cluster were recorded within the abandoned-land forest in N5 Forested Area, while the Albizia (*Falcataria falcata*) tree with raptor's nest was found within the exotic-dominated secondary forest (Section 6.4.2.10).

Table 6.11 Number of other specimens of value recorded in N5 Forested Area

Habit	Origin	Species	No. Of Specimens
Tree	Exotic	*Falcataria falcata*	5
Strangler	Cryptogenic	*Ficus benjamina*	3
	Native	*Ficus microcarpa*	2
Shrub (Bamboo)	Exotic	*Bambusa vulgaris*	1
Total			**11**



Figure 6.4.21 Other specimens recorded in N5 Forested Area. (A) raptor's nest on albizia (*Falcataria falcata*); (B) a weeping fig (*Ficus benjamina*) strangler; (C) a Malayan banyan (*Ficus microcarpa*) strangler; (D) a golden bamboo (*Bambusa vulgaris*) cluster

6.4.1.6 Tree Mapping Findings

In total, 1370 tree specimens of ⩾ 1 m and tree specimens with conservation significance of ⩾ 0.3 m girth belonging to 48 species and 21 families were tagged and recorded (as summarised in Table 6.12). The majority are exotic species, of which, albizia (*Falcataria falcata*; 390 specimens) and African tulip (*Spathodea campanulata*; 244 specimens) collectively made up close to half (46.3%) of the tree specimens mapped in the biodiversity Study Area, with a girth range of 1 m – 7 m and 1 m – 4.2 m respectively.

Table 6.12 Number and percentage (%) of tree species mapped belonging to each status category in the biodiversity Study Area

Origin	Status	Number of Species within N4 Forested Area	Percentage (%)	Number of Species within N5 Forested Area	Percentage (%)	Number of Species within Biodiversity Study Area	Percentage (%)
Native		**102**	**28.9**	**297**	**29.1**	**399**	**29.1**
Common		100	28.4	283	27.7	383	27.9
Vulnerable		-	-	10	1	10	0.7
Endangered		1	0.3	-	-	1	0.1
Critically Endangered		1	0.3	4	0.4	5	0.4
Exotic		**249**	**70.7**	**695**	**68.2**	**944**	**68.9**
Cultivated Only		-	-	8	0.8	8	0.6
Casual		8	2.3	70	6.9	78	5.7
Naturalised		241	68.4	617	60.6	858	62.6
Cryptogenic		**1**	**0.3**	**26**	**2.6**	**27**	**2**
Total		**352**	**100**	**1018**	**100**	**1370**	**100**

6.4.1.7 Stream Mapping Findings

The descriptions of the waterbodies in the sections below are results from mapping and characterisation at 20 m intervals where possible, alongside other observations in the field.

N4 Forested Area

Within N4 Forested Area, there is one stream (i.e. semi-naturalised drain). The stream flows from east to northwest and is separated by a dense scrubland area that is periodically waterlogged during wet weather season. A comprehensive list of plant species is detailed in Appendix G.

The stream of approximately 423 m in length is a slow-flowing stream. The partially closed-canopy forest stream has a concrete-lined bank upstream and silty-clay substrate downstream. In the upstream portions, the stream flows through exotic-dominated secondary forest (Figure 6.4.22A) before flowing adjacent to scrubland (Figure 6.4.22B). Most species occurring on stream banks were exotic species such as *Colocasia esculanta* and *Sphagneticola trilobata*. Native species commonly found along the stream are *Ottochloa nodosa* and *Christella dentata*. One nationally critically endangered *Syzygium myrtifolium* specimen was found along the stream at stream points SM02, SM15, SM16 and SM17 (Figure 6.4.23). However, this species is not considered as a species of conservation significance as it may have escaped from nearby cultivated roadside trees.

Table 6.13 Number and percentage (%) of species mapped along the stream in N4 Forested Area

Origin	Status	Number of Species within N4 Forested Area Stream	Percentage (%)
Native		**27**	**35.5**
Common		25	32.9
Critically Endangered		1	1.3

Origin	Status	Number of Species within N4 Forested Area Stream	Percentage (%)
Data Deficient		1	1.3
Exotic		**46**	**60.5**
Cultivated Only		3	3.9
Casual		14	18.4
Naturalised		29	38.2
Cryptogenic		**3**	**3.9**
Total		**76**	**100**

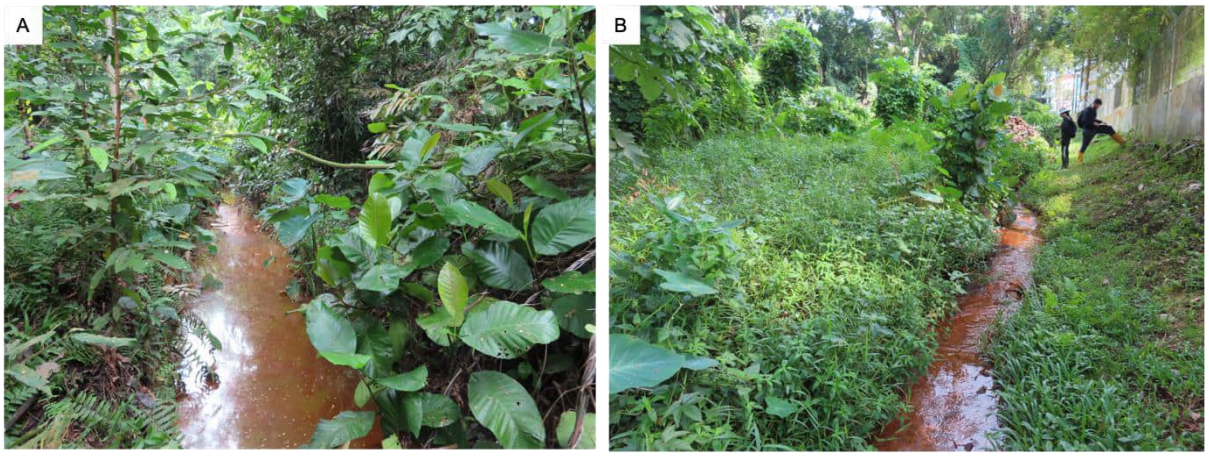


Figure 6.4.22 Stream in N4 Forested Area. (A) stream flowing through exotic-dominated secondary forest; (B) stream flowing through scrubland



Legend

Stream Mapping Points

- Stream Mapping Point

Habitat Mapping

- Abandoned-land forest
- Exotic-dominated secondary forest
- Scrubland
- Grassland
- Urban vegetation (Turf)
- Semi-naturalised drain
- Infrastructure
- Project site
- Biodiversity Study Area

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Figure Title :

Stream mapping points in Sembawang N4 Forested Area

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6.4.2 Faunistic Baseline Conditions

6.4.2.1 Overall

The field assessment thus far recorded a total of 220 faunal species, with birds (71 species) and butterflies (52 species) making up more than half the species assemblage (as summarised in Table 6.14; and detailed in Appendix I). Species of conservation significance of birds (ten species) and mammals (four species) were recorded, while no other species of conservation significance were observed in other taxa.

Table 6.14 Final summary of recorded faunal species and species of conservation significance

Faunal Group	No. of Recorded Faunal Species	
	All Species	**Species of Conservation Significance**
Odonates	**21**	0
Dragonflies	18	0
Damselflies	3	0
Aculeate hymenopterans	**29**	0
Bees	13	0
Stinging wasps	16	0
Butterflies	**52**	0
Freshwater fish	**4**	0
Decapod Crustaceans	**1**	0
Molluscs	**3**	0
Herpetofauna	**22**	0
Amphibians	8	0
Reptiles	14	0
Birds	**71**	**10**
Mammals	**17**	**4**
Non-volant mammals	9	3
Bats	8	1
Total	**220**	**14**

6.4.2.2 Species of Conservation Significance

Of the 14 species of conservation significance recorded, 10 are birds, three are non-volant mammals and one is a bat as listed in Table 6.15. Species of conservation significance were recorded across the entire biodiversity Study Area (Figure 6.4.24).

Faunal species of conservation significance were recorded mainly in exotic-dominated secondary forest and abandoned-land forest, while some records are found in the urban vegetation (Figure 6.4.24). While bird species of conservation significance recorded within both N4 and N5 Forested Areas, mammal and bat species of conservation significance were only recorded in N5 Forested Area. In addition, nesting sites of species of conservation significance such as bamboo clusters, raptors' nests, and baya weavers' nests were found in N5 Forested Area only. There were no records of species of conservation significance in aquatic fauna groups, which comprised of mainly non-native fauna and common fauna species typical of disturbed habitats. These are discussed in detail in their respective sections below.



Legend

Highest Threatened Status
- Critically Endangered
- Endangered
- Vulnerable

Fauna of Conservation Significance
- Bird
- Mammal
- Mammal (bats)

Habitat Mapping
- Abandoned-land forest
- Exotic-dominated secondary forest
- Grassland
- Infrastructure
- Semi-naturalised drain
- Scrubland
- Urban vegetation (Turf)

Others
- Fauna transect
- Biodiversity Study Area
- Project site

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Figure Title :

Location of faunal species of conservation significance in biodiversity Study Area of Sembawang N4

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Table 6.15 Species of conservation significance observed in biodiversity Study Area of Sembawang N4

Taxon	Scientific Name	Common Name	National Status	Global Status
Bird	*Collocalia affinis*	Plume-toed swiftlet	Vulnerable	Least Concern
Bird	*Copsychus saularis*	Oriental magpie-robin	Vulnerable	Least Concern
Bird	*Corvus macrorhynchos*	Large-billed crow	Vulnerable	Least Concern
Bird	*Ketupa ketupu*	Buffy fish owl	Vulnerable	Least Concern
Bird	*Nycticorax nycticorax*	Black-crowned night heron	Endangered	Least Concern
Bird	*Nishaetus cirrhatus*	Changeable hawk-eagle	Vulnerable	Least Concern
Bird	*Ploceus philippnus*	Baya weaver	Vulnerable	Least Concern
Bird	*Psittacula longicauda*	Long-tailed parakeet	Near Threatened	Vulnerable
Bird	*Pycnonotus zeylanicus*	Straw-headed bulbul	Endangered	Critically Endangered
Bird	*Zosterops simplex*	Swinhoe's white-eye	Vulnerable	Least Concern
Mammal (Non-volant)	*Macaca fascicularis*	Long-tailed macaque	Least Concern	Endangered
Mammal (Non-volant)	*Manis javanicus*	Sunda pangolin	Critically Endangered	Critically Endangered
Mammal (Non-volant)	*Lutrogale perspicillata*[1]	Smooth-coated otter	Vulnerable	Endangered
Bat	*Tylonycteris spp.*[2]	Bamboo bat	Vulnerable	Not Applicable

[1]While the otter record was not identified to species-level, it is presumed to be the smooth-coated otter.

[2]Both bamboo bat species are nationally Vulnerable.

6.4.2.3 Taxon Sampling Curves

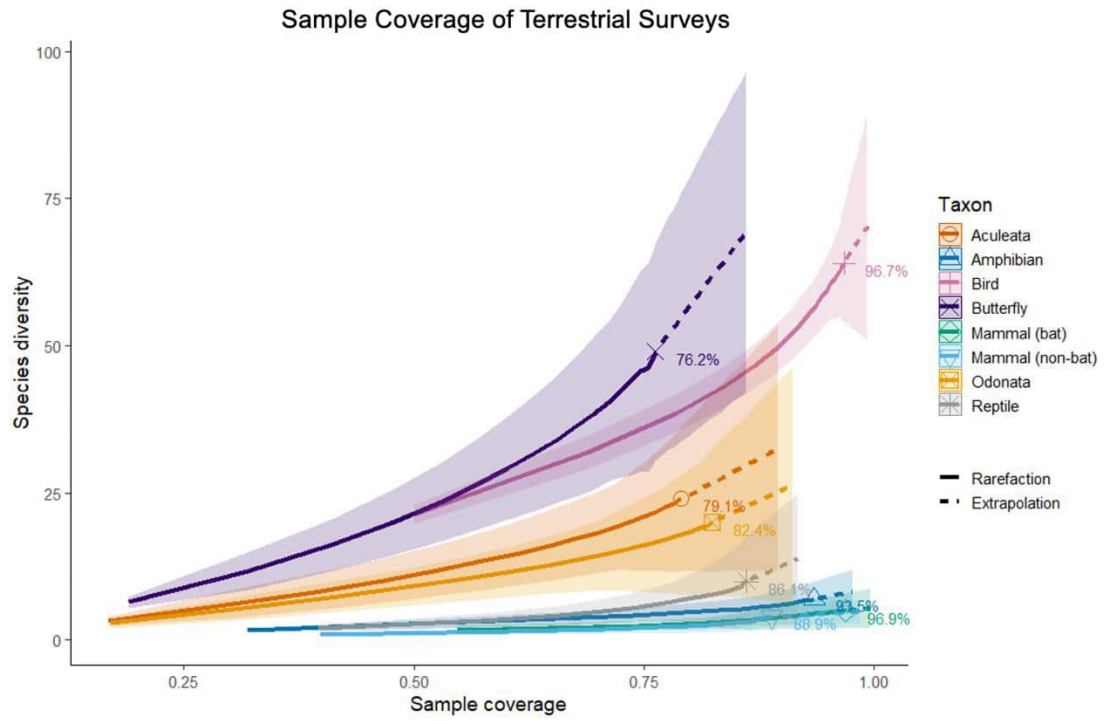
For transect surveys, sample coverage was generated for the following taxa: (1) odonates (2), aculeate hymenopterans, (3) butterflies, (4) amphibians, (5) reptiles, (6) birds, (7) non-volant mammals, and (8) bats. For camera trapping, sample coverage was generated for non-volant mammals only. For aquatic point counts, sample coverage was generated for the following taxa: (1) amphibians, (2) fish, (3) molluscs and (4) odonates. Sample coverage was not generated for the following faunal groups for aquatic surveys as the number of species collected were too low: (1) reptiles and (2) decapod crustaceans.

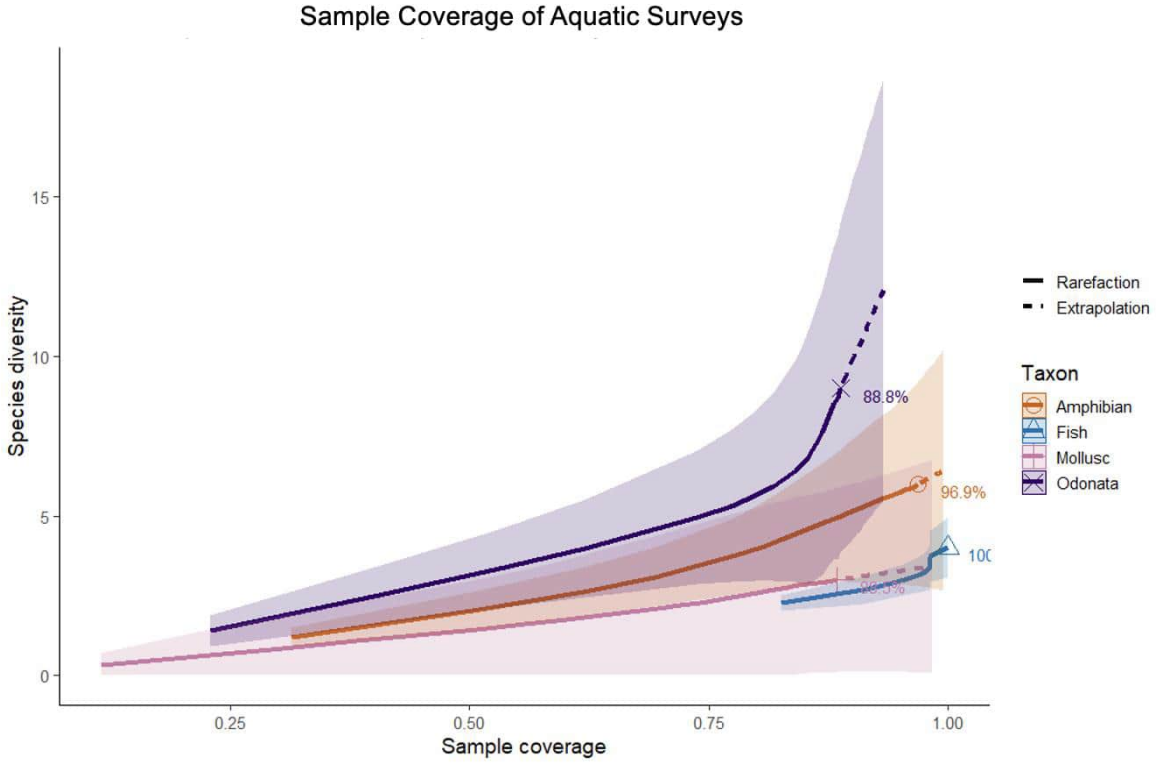
Apart from aculeate hymenopterans and butterflies ranging above 70%, all other faunal groups achieved sample coverages of above 82% for transect surveys. For camera trapping, the sampling coverage achieved was 94.7%.

For aquatic surveys, the sample coverage was above 88% for all faunal groups. A summary of the taxon sampling analysis is shown in Table 6.15 and the sample coverage curves are shown in Figure 6.4.25.

Table 6.16 Result summary of the taxon sampling analysis

Taxon	Sample coverage (%)	Observed Richness	Estimated Richness ± S.E.	95% Confidence Interval
Terrestrial Transect Surveys				
Aculeata hymenopterans	79	24	41 ± 13.6	28.3 - 91.4
Amphibian	93.5	7	9 ± 3.5	7.2 - 27.9
Bird	96.7	64	72 ± 5.8	66.2 - 92.6
Butterfly	76.2	49	98 ± 27.3	66.7 - 185
Mammal (bat)	96.9	5	5 ± 1.3	5 - 13
Mammal (non-bat)	88.9	4	5 ± 2.1	4.1 - 16.6
Odonates	82.4	20	33 ± 11.8	22.7 - 79.4
Reptile	86.2	10	19 ± 9.6	11.8 - 59.2
Camera Trap Surveys				
Mammals	94.7	8	14 ± 6.8	8.9 - 44.2
Aquatic Surveys				
Amphibian	96.9	6	6 ± 1.3	6 - 14.2
Fish	100	4	4 ± 0.5	4 - 5.4
Mollusc	88.5	3	3 ± 1.3	3 - 11.2
Odonates	88.8	9	17 ± 11.2	9.9 - 71.3


Sample Coverage of Terrestrial Surveys
Species diversity
Sample coverage
100
75
50
25
0
0.25
0.50
0.75
1.00
76.2%
96.7%
79.1%
82.4%
86.1%
88.9%
96.9%
Taxon
Aculeata
Amphibian
Bird
Butterfly
Mammal (bat)
Mammal (non-bat)
Odonata
Reptile
Rarefaction
Extrapolation


Sample Coverage of Aquatic Surveys
Species diversity
Sample coverage
15
10
5
0
0.25
0.50
0.75
1.00
88.8%
96.9%
Rarefaction
Extrapolation
Taxon
Amphibian
Fish
Mollusc
Odonata

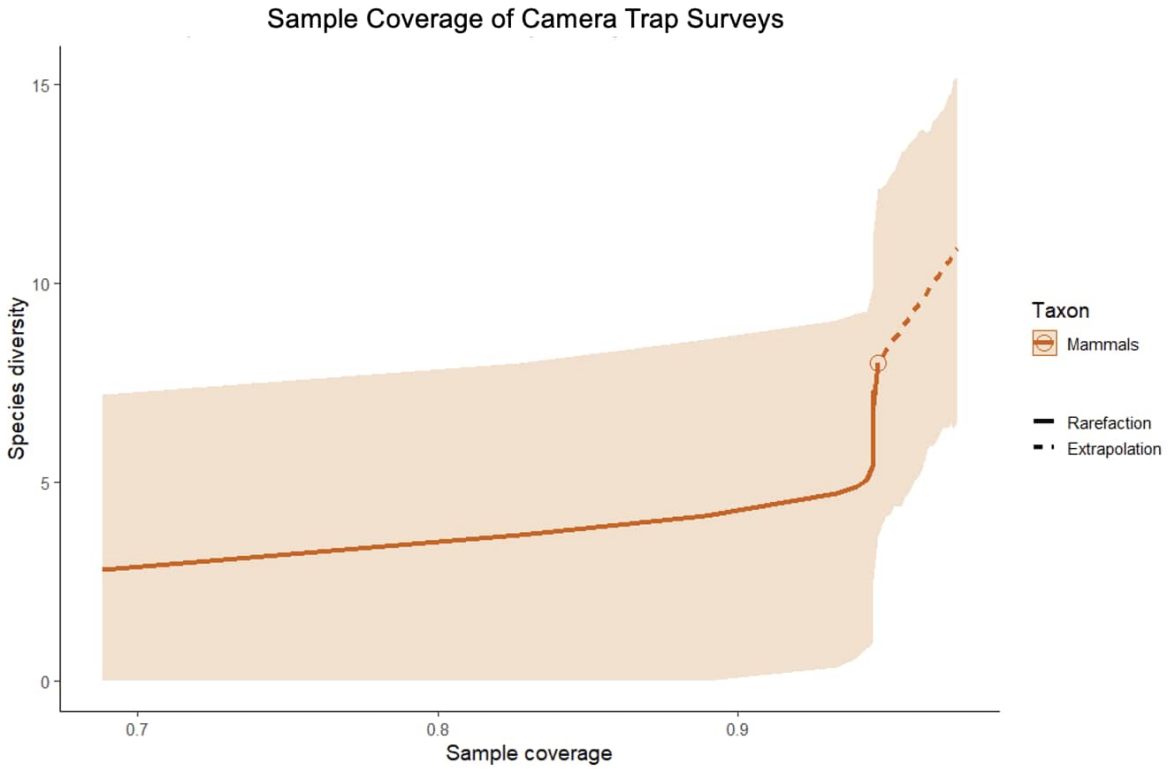


Figure 6.4.25 Taxon sampling curves for terrestrial transect surveys, aquatic surveys and camera trap survey

6.4.2.4 Odonates

A total of 21 species of odonates —18 species of dragonflies and three species of damselflies— were recorded during field assessments. While there are no species of conservation significance, two odonate species were considered to be interesting findings, mainly because of their habitat preference. Though widespread, common and often found near slow-flowing streams [P-39], violet sprite (*Archibasis viola*) was found in N5 Forested Area where a natural stream is absent. Since the violet sprite depends on streams and not ephemeral bodies, it is likely that this species flew over from N4 Forested Area (Ngiam pers. comm.). Another interesting observation is the bronze flutterer (*Rhyothemis obsolescens*) (Figure 6.4.26) which is widespread but uncommon and found in swampy forest and marshy habitats [P-39]. This finding is more likely to have been a transient occurrence and it is plausible that the individual sighted flew in from a nearby swamp forest in Seletar or Simpang (Ngiam pers. comm.).



Figure 6.4.26 Bronze flutterer (*Rhyothemis obsolescens*)

6.4.2.5 Aculeate Hymenopterans

A total of 29 species of aculeate hymenopterans: 16 species of wasps and 13 species of bees were recorded during field assessments. There are no species of conservation significance. However, three species of hover wasps *Liostenogaster nitidipennis* and *Liostenogaster varipicta* and the lesser paper wasp (*Parapolybia varia)* are nationally Near Threatened. Both *Liostenogaster nitidipennis* and *Liostenogaster varipicta* were found in both N4 and N5 Forested Area while the Lesser Paper Wasp (*Parapolybia varia*) was found only in N4 Forested Area. Apart from functioning as hydration sources to the wasps, naturalised drain in N4 Forested Area and ephemeral waterbodies present in N5 Forested Area are important water sources to these species, as the process of nest making requires water to make the nest more malleable (Lee JXQ pers. comm., 2023). Additionally, the lesser paper wasp (*Parapolybia varia)* is an uncommon species in Singapore that are often observed to nest in mangrove areas and in proximity to the open seas (Lee JXQ pers. comm., 2023).



Figure 6.4.27 (A) Active giant honeybee's (*Apis dorsata*) nest and (B) active Sumatran paper wasp's (*Ropalidia sumatrae*) nest (C) abandoned lesser banded hornet's (*Vespa affinis)*

Nests (Figure 6.4.27) belonging to the giant honeybee (*Apis dorsata*), *Parischnogaster melly bothi, Liostenogaster nitidipennis* and one species of unidentified *Crabronidae* wasp were recorded in N5 Forested Area while lesser banded hornet's (*Vespa affinis) and* Sumatran paper wasp's (*Ropalidia* sumatrae) nests were found in N4 Forested Area, indicating the suitability of the forests as a nesting and breeding ground.

6.4.2.6 Butterflies

A total of 52 species of butterflies were recorded across both the N4 and N5 Forested Areas. Though there are no records of conservation significance species for this taxon, two species are nationally Near Threatened, namely tawny palmfly (*Elymnias panthera panthera)* and long brand bush brown (*Mycalesis visala phamis*) (Figure 6.4.28). The caterpillar host plants for tawny palmfly (e.g., *Caryota mitis, Licuala spinosa and Ptychosperma macarthurii*) and host plant for long brand bush brown (e.g. *Ottochloa nodosa*) are widespread

and common throughout N4 and N5 Forested Area, with the exception of *Licuala spinosa* occurring only in N5 Forested Area (Appendix D).



Figure 6.4.28 Long brand bush brown (*Mycalesis visala phamis*)

6.4.2.7 Freshwater Fauna

A total of eight species of freshwater fauna; four species of fish, one species of freshwater shrimp and three species of molluscs were recorded. Among the freshwater fauna, all species are non-native to Singapore and no species of conservation significance were found. The mosquitofish (*Gambusa affinis*) (Figure 6.4.29A), which is associated with highly disturbed waterbodies, is the dominant species recorded at all aquatic sampling points (Figure 5.2.7).

A single record of the barcheek goby (*Rhinogobius similis*) and a shrimp from the *Palaemonidae* family (*Macrobrachium sp.*) were noted during the diurnal point count survey at sampling point A2 (Figure 5.2.7). The non-native barcheek goby has successfully populated many waterbodies in Singapore [P-40].

Native Macrobrahcium species are typically acid water specialists or require conditions that are present in natural forest streams. They are largely found within the confines of nature reserves and are not transported around urban/semi-urban waterways. Considering the habitat preference and range of native species, the specimen found in the semi-naturalised stream is likely to be of non-native origin (Nyanasengeran pers. comm., 2023).

Three species of freshwater molluscs *Melanoides tuberculata*, *Physa acuta* and *Radix rubiginosa* were also recorded. *Melanoides tuberculata* (Figure 6.4.29B), a species native to Southeast Asia [P-54], was recorded at A2, A3 and A4 (Figure 5.2.7). This species has the ability to thrive in wide range of habitats and is capable of tolerating disturbed and lower quality streams [P-42].

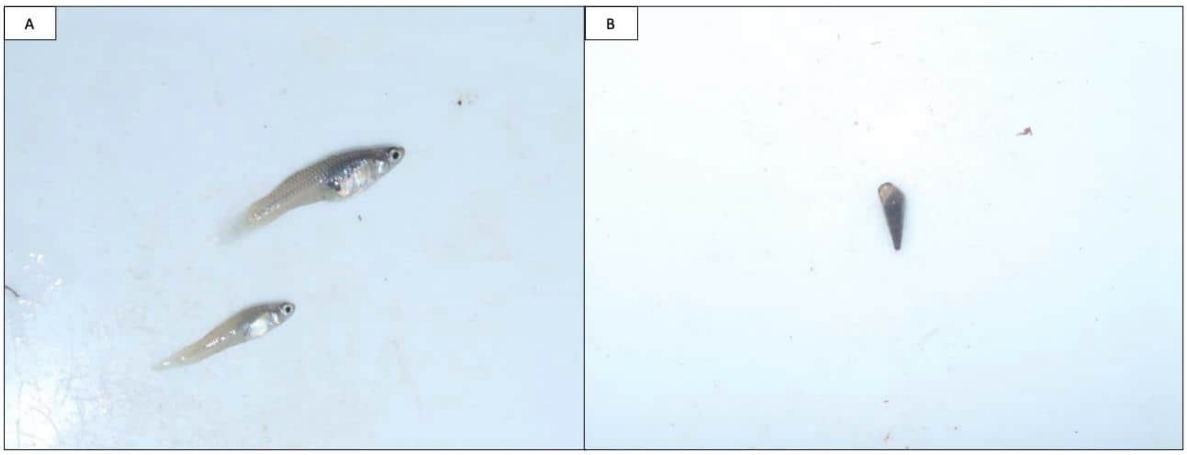


Figure 6.4.29 Mosquitofish (*Gambusa affinis*) (B) *Melanoides tuberculata*

6.4.2.8 Amphibians

A total of eight species of amphibians were recorded across N4 and N5 Forested Areas and no species of conservation significance were found. Of the eight recorded species, five are native to Singapore. Species with

the highest number of records across both forested areas include the native dark-sided chorus frog (*Microhyla heymonsi*) and the highly tolerant, introduced greenhouse frog (*Eleutherodactylus planirostris*).

Three out of the four known chorus frogs in Singapore, including the East Asian ornate chorus frog (*Microhyla mukhlesuri*) were recorded in N4 (Figure 6.4.30). Tadpoles of the native Malayan giant frog (*Limnonectes blythii*) were also recorded during diurnal and nocturnal aquatic point count surveys indicating signs of population establishment. One record of the banded bull frog (*Kaloula pulchra*) was noted in N5. Despite being an introduced species, the banded bull frog does not appear to have any obvious impact on native fauna since its appearance in the 1880s [P-41].

6.4.2.9 Reptiles

Field assessments across both N4 and N5 Forested Areas yielded 14 reptile species. Of which, eleven species are native to Singapore and no species of conservation significance were recorded.

Two bronzeback species, namely the painted bronzeback (*Dendrelaphis* pictus) and striped bronzeback *(Dendrelaphis caudolineatus*) were recorded across both forested areas. Snake species that were recorded in N5 Forested Area only, includes the equatorial spitting viper (*Naja sumatrana*), reticulated python (*Malayopython reticulatus*) and paradise gliding snake (*Chrysopelea paradisi*). Both the native green crested lizard (*Bronchocela cristella*) (Figure 6.4.30) and non-native changeable lizard (*Calotes versicolor*) were found in both forested areas. A single record of the Malayan water monitor (*Varanus salvator*) was found in N4 Forested Area during the nocturnal aquatic point count survey.

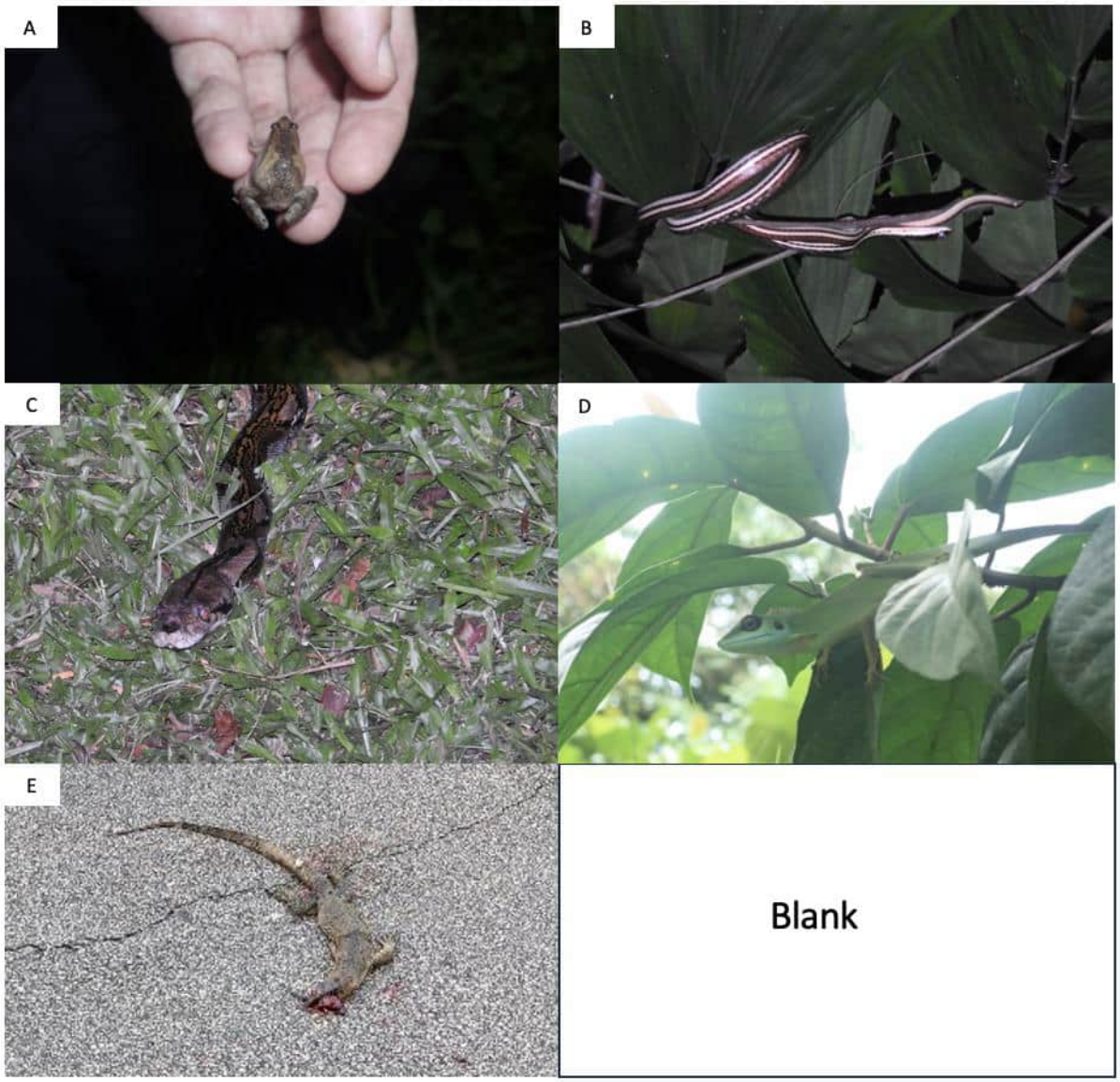


Figure 6.4.30 Amphibian and reptile species found in Sembawang N4; (A) East Asian ornate chorus frog (*Microhyla mukhlesuri*), (B) Painted Bronzeback (*Dendrelaphis pictus*), (C) Reticulated python (*Malayopython reticulatus*), (D) Green-crested Lizard (*Bronchocela cristella*), and (E) Malayan water monitor (*Varanus* salvator)



Legend

- Varanus salvator (roadkill)

Habitat Mapping

- Abandoned-land forest
- Exotic-dominated secondary forest
- Grassland
- Infrastructure
- Semi-naturalised drain
- Scrubland
- Urban vegetation (Turf)

Others

- Fauna transect
- Biodiversity Study Area
- Project site

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	IT	Final Report	SAG	JAG
-	JUL 2024	IT	Final Report	SAG	JAG
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-	MAY 2024	IT	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Location of roadkill incident of Malayan water monitor (Varanus salvator) on Canberra Rd at Sembawang N4

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IT	SAG	JAG
	Drawn: IT	Date: AUG 2024

Figure No. : 6.4.31 | Rev. 1 | Sheet 1 of 1

CAD File Name : NA | A3

Note: Source of basemap - Google Earth Map

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6.4.2.10 Birds

A total of 71 species of birds — 60 resident species (52 native and eight introduced) and 11 migrant/visitor species were recorded during field assessment, 10 of which are species of conservation significance. This includes the globally Critically Endangered straw-headed bulbul (*Pycnonotus zeylanicus*), nationally Endangered black-crowned night heron (*Nycticorax nycticorax*), globally Vulnerable long-tailed parakeet (*Psittacula longicauda*) and nationally Vulnerable buffy fish owl (*Ketupa ketupu*), changeable hawk-eagle (*Nisaetus cirrhatus*), large-billed crow (*Corvus macrorhynchos*), Swinhoe's white-eye (*Zosterops simplex*), oriental magpie-robin (*Copsychus saularis*), plume-toed swiftlet (*Collocalia affinis*) and baya weaver (*Ploceus philippinus*) (Figure 6.4.32).

Forest-associated species such as the dark-necked tailorbird (*Orthotomus atrogularis*) and rufous-tailed tailorbird (*Orthotomus sericeus*) were also recorded. Furthermore, a myriad of bird species including, but not limited to, the barbets, sunbirds, doves, pigeons, munias, flowerpecker, woodpeckers, bulbuls, kingfishers, and shrike were found in the biodiversity Study Area. In addition, nesting structures of baya weaver and raptor species were observed in N5 Forested Area (Figure 6.4.32).

Records of the straw-headed bulbul were concentrated in the central section of the N4 Forested Area, as well as south-western part of N5 Forested Area (Figure 6.4.33). They were seen and/or head frequently during surveys. The straw-headed bulbul is heavily threatened by the songbird trade and loss of forest habitats. Its global status was uplisted from Endangered to Critically Endangered as populations worldwide experience rapid decline (W-20). A recent study by Chiok et al., 2020 revealed the importance of Singapore as a stronghold with local population estimates ranging from 22.9-57.3% of the species in southeast Asia. In contrast with the global populations, local populations are less susceptible, but not completely unexposed to poaching pressures.

The long-tailed parakeet (*Psittacula longicauda*) is a globally Vulnerable and nationally Near Threatened species, although it is common within Singapore. Its global status is attributed to poaching and habitat loss (W-24). This species was frequently recorded flying over the N5 Forested Area and Canberra Road, in flocks of up to eight individuals during the transect surveys.

The nationally Endangered black-crowned night heron (*Nycticorax nycticorax*) is associated with freshwater and mangrove habitats, with only one known colony surviving to date at Jurong Lake area (W-21). This species requires an extensive area for nesting due to their colonial nesting behaviour and is known to fly long distances to forage at dusk (W-21). One individual was recorded feeding at the edge of the semi-naturalised drain in N4 Forested Area (Figure 6.4.33). Large feeding and nesting sites are crucial for the survival of this heron species as there is a decreasing trend in numbers (P-60).

The nationally Vulnerable buffy fish owl (*Ketupa ketupu*) is an uncommon resident breeder. One individual was seen at dusk within the exotic-dominated secondary forest approximately 50 m away from the semi-naturalised drain in N4 Forested Area. This species can utilise both urban and natural waterways for foraging activity (W-22). However, it seems unlikely using the semi-naturalised drain within N4 Forested Area for foraging, as the drain lacks larger fish prey that the owl usually prefers.

Amongst the nationally Vulnerable species, the changeable hawk eagle (*Nisaetus cirrhatus*) and baya weaver (*Ploceus philippinus*) (Figure 6.4.32) exhibit clear preferences in choice of nesting locations. The former nests in albizia trees of native-dominated secondary forests (P-66) while the latter nest colonially (P-67) in open habitats such as grasslands with low trees (W-23). Both species are threatened by habitat loss. Five raptor nests were observed on albizia trees in the N5 Forested Area (Figure 6.4.33). Raptors are typically territorial and often reuse nest structures (P-62; P-5). While no activity was observed at the nests, frequent records of the nationally Vulnerable changeable-hawk eagle (*Nishaetus cirrhatus*), white-bellied sea eagle (*Halieetus leucogaster*) and a juvenile Brahminy kite (*Haliastur indus*) in the vicinity of the nests suggest possible usage. Similarly, a baya weaver was observed with nesting material in its beak near a half-constructed nest and the presence of fully constructed nests (Figure 6.4.32D) confirm breeding evidence of this species within the N5 Forested Area.

The Swinhoe's white-eye (*Zosterops simplex*) and oriental magpie robin (*Copsychus saularis*) are commonly traded songbird species, with the latter almost being driven to extinction by poaching in the 1980s prompting a species reintroduction program (P-61). Within Singapore, both species are able to utilise a variety of habitats including forests and urban parkland (W-18; W-19), as shown by their records within the biodiversity Study Area (Figure 6.4.33). The national status of the Swinhoe's white-eye (*Zosterops simplex*) was recently raised to vulnerable (NParks, 2023) because the local population of the naturally-occurring native *erwini* subspecies appears to be confined to Pulau Ubin (P-73). On the main island of Singapore, the white-eye population is mostly

composed of the non-native *simplex* or hybrid *simplex-erwini* gene pools believed to be established from escaped individuals from the pet trade. Although the individuals recorded in this assessment are most likely of introduced origin and unlikely to be of true conservation significance, there is still a possibility that they are of the native gene pool established from natural range expansion. Hence, it is still conservatively regarded as a species of conservation significance in this study.



Figure 6.4.32 Birds and nest observed in N5 Forested Area (A) juvenile Brahminy kite (*Haliastur indus*), (B) baya weaver (*Ploceus philippinus*), (C) raptor's nest and (D) baya weaver's nest

Both the large-billed crow (*Corvus macrorhynchos*) and plume-toed swiftlet (*Collocalia affinis*) are uncommon resident breeders. Both species are prone to habitat loss and destruction, accounting for their nationally Vulnerable status. The large-billed crow nests in open forests and woodlands and is less adapted to urban environments compared to the widespread and common house crow (*Corvus splendens*) (W-17). This is apparent from the records within the biodiversity Study Area as the species was more frequently encountered along the forest fringes instead of along the roads where the synanthropic house crow is usually spotted (Figure 6.4.33). Breeding activity of the plume-toed swiftlet was only first recorded in 2017, with breeding colonies making use of culverts to build nests (P-59). These nests are prone to destruction from inundation and water damage when the culverts flood during the monsoon season. Two aerial records were noted— one in the grassland habitat of N4 Forested Area and one at the edge of N5 Forested Area along Ottawa Rd (Figure 6.4.33).



Legend

Birds of Conservation Significance
- Collocalia affinis (VU)
- Copsychus saularis (VU)
- Corvus macrorhynchos (VU)
- Ketupa ketupu (VU)
- Nisaetus cirrhatus (VU)
- Nycticorax nycticorax (EN)
- Ploceus philippinus (VU)
- Psittacula longicauda (VU)
- Pycnonotus zeylanicus (CR)
- Zosterops simplex (VU)

Habitat Mapping
- Abandoned-land forest
- Exotic-dominated secondary forest
- Grassland
- Infrastructure
- Semi-naturalised drain
- Scrubland
- Urban vegetation (Turf)

Others
- Trees with raptor nests (observer's)
- Biodiversity Study Area
- Project site

Note: Source of basemap - Google Earth Map

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	IT	Final Report	SAG	JAG
-	JUL 2024	IT	Final Report	SAG	JAG
1	JUN 2024	IT	Draft Final Report	SAG	JAG
-	MAY 2024	IT	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Birds of conservation significance in biodiversity Study Area of Sembawang N4

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6.4.2.11 Mammals (Non-Volant)

From the data analysed for the Draft Final Report, there are a total of nine non-volant mammals. Three of which are species of conservation significance, and all were observed in N5 Forested Area (Figure 6.4.35), namely the Sunda pangolin (*Manis javanica)*, globally Endangered long-tailed macaque (*Macaca fascicularis*) and Otter spp. (unidentified *Mustelidae*). The Sunda pangolin was recorded in the camera trap while the long-tailed macaques and otters were recorded incidentally or during transect surveys. The highest number of long-tailed macaques observed is five individuals during a diurnal transect survey. A compilation of camera trap data is further detailed in Appendix J and Appendix K.

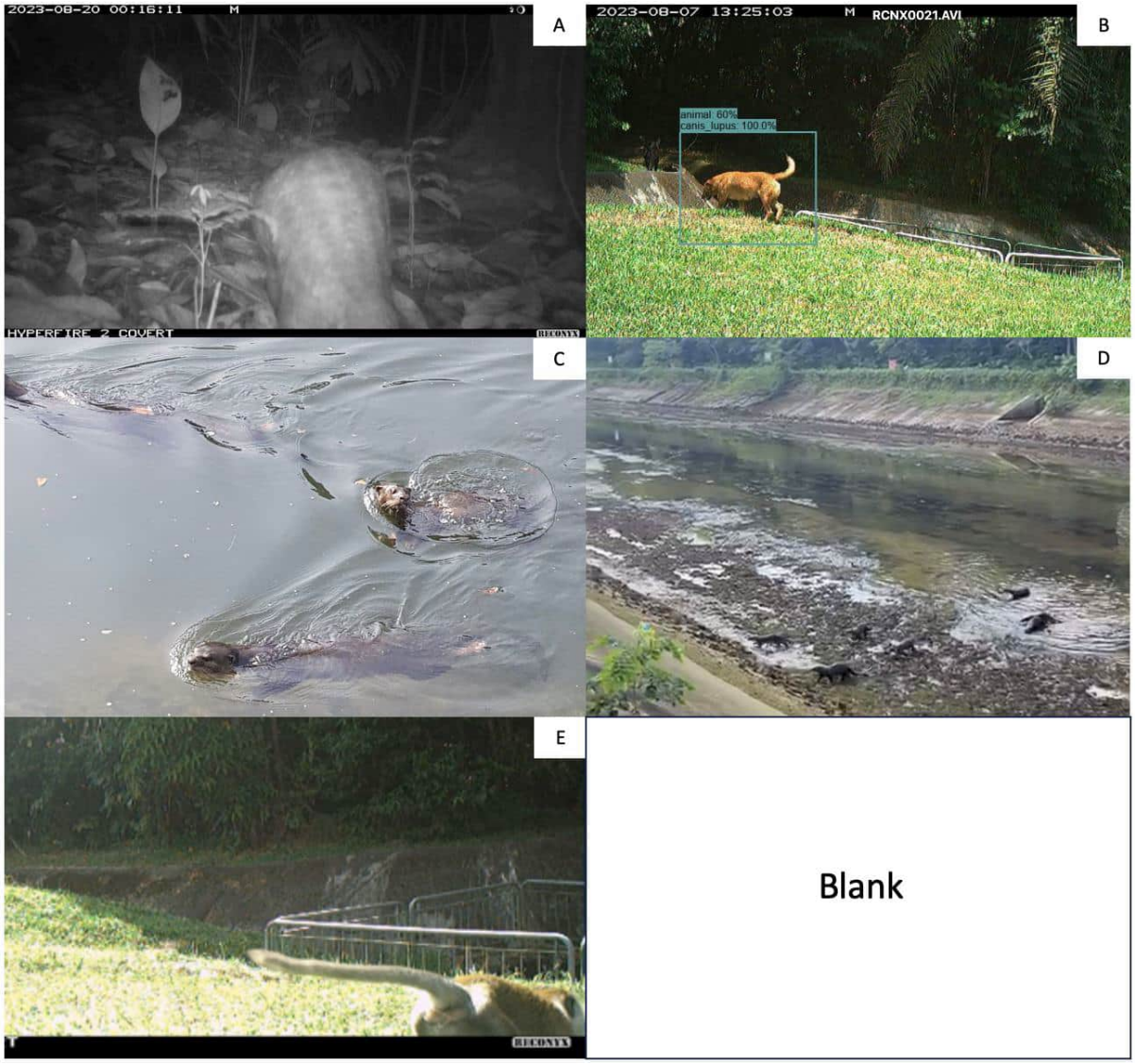


Figure 6.4.34 (A) Sunda pangolin (*Manis javanica*) at N5.24, (B) Feral dogs (*Canis lupus familiaris*) entering N5 Forested Area, (C & D) Anecdotal sightings of smooth otters (*Lutrogale perspicillata)* at Simpang Kiri River (source: Isabelle Tan), and (E) long-tailed macaque (*Macaca fascicularis*) likely crossing Canberra Road to enter N5 Forested Area

One record of Sunda pangolin (*Manis javanica*) was detected at camera trap station N5.24, located northeast of N5 Forested Area (Figure 5.2.3; Figure 6.4.35). This species depends on well-connected wooded habitats for dispersal especially for the sub-adult males venturing out to into the urban matrix in search for a home range (Nash, 2018).). A significant threat to this species is the fragmentation of habitats rendering them highly susceptible to roadkill (Lim & Ng, 2007). Furthermore, they depend on mature forest to reproduce because the females use large trees (> 50 cm diameter at breast height) as natal dens [P-45]. Aside from the single record of Sunda pangolin in N5 Forested Area, the Singapore Pangolin Working Group collated records of sightings, roadkills, and rescues from 2010 to 2021 showing two records of rescue and one sighting in the urban matrix outside of the biodiversity Study Area (precise locations are not shown here due to confidentiality).



Legend

Non-volant Mammals of Conservation SIgnificance

- Macaca fascicularis (EN)
- Manis javanica (CR)
- Unidentified Mustelidae

Habitat Mapping

- Abandoned-land forest
- Exotic-dominated secondary forest
- Grassland
- Infrastructure
- Semi-naturalised drain
- Scrubland
- Urban vegetation (Turf)

Others

- Biodiversity Study Area
- Project site

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1	AUG 2024	IT	Final Report	SAG	JAG
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1	JUN 2024	IT	Draft Final Report	SAG	JAG
-	MAY 2024	IT	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Non-volant mammals of conservation significance at biodiversity Study Area of Sembawang N4

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Five individuals of otters spp. (unidentified *Mustelidae*) were encountered incidentally in N5 Forested Area during a flora survey as shown in Figure 6.4.35. Anecdotal sightings of otter spp. have been observed by members of public, approximately less than 1km east and west of N5 Forested Area, in Sembawang River and Simpang Kiri River, respectively. Among the otters species, the more common smooth-coated otters are known to utilise canals and reservoirs for foraging or as means of traversing (P-46).

A single footage of a long-tailed macaque (*Macaca fascicularis*) was recorded at camera trap station E1 which was deployed along Canberra Road facing the western fringe of N5 Forested Area. On other occasions, up to five individuals of long-tailed macaques were observed during diurnal surveys along the northern and eastern forest edges of N5 (Figure 6.4.35). This species' core population occurs in Western Catchment, Bukit Timah, Central Catchment Nature Reserves and Mandai (P-57; P-58). Though commonly associated with human-wildlife conflict, a census-wide survey conducted by Riley et al., (2015) found no evidence of overpopulation, and the native populations are more associated with wild populations than synanthropic populations, when compared to the same species occurring in South East Asia. Hence, the long-tailed macaques that are typically deemed as nuisance are actually wild populations that requires mitigation measures against human-wildlife conflict such as monkey guarding (Jane Goodall institute Singapore 2019) and educating members of public especially residents living close to a forested area.

In addition to the non-volant mammals of conservation significance, the independent detections and occurrence at camera trap stations of other non-volant mammals are illustrated in Table 6.17. The forest-edge camera traps were deployed to recorded species moving out of Forested Area N5. From the records thus far, only Feral dog (*Canis lupus familiaris*) have been seen leaving and entering the forest-edge of N5 Forested Area (Figure 6.4.34).

Table 6.17 Non-volant mammals detected at camera trap stations and number of independent detections

Scientific name	Common name	No. of independent detections	Camera Trap Stations																										
			E1	E2	N4.3	N4.4	N4.5	N4.6	N4.7	N4.8	N4.9	N4.10	N5.11	N5.13	N5.14	N5.15	N5.16	N5.17	N5.18	N5.19	N5.20	N5.21	N5.22	N5.23	N5.24	N5.25	N5.26	N5.27	N5.28
Canis lupus familiaris	Feral dog	531	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Callosciurus notatus	Plantain squirrel	113				✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
Tupaia glis	Common treeshrew	73							✓	✓	✓			✓			✓				✓	✓		✓	✓	✓	✓		✓
Rattus tanezumi	Asian house rat	43				✓				✓		✓					✓		✓			✓	✓	✓	✓	✓	✓		✓
Felis catus	Feral cat	1							✓																				
Macaca fascicularis	Long-tailed macaque	1	✓																										
Manis javanica	Sunda pangolin	1																							✓				
Rattus tiomanicus	Malaysian wood rat	1																											✓

6.4.2.12 Mammals (Bats)

Eight bat species were recorded acoustically during nocturnal transect and roost emergence surveys. This includes Lesser short-nosed fruit bat (*Cynopterus brachyotis*), lesser Asian house bat (*Scotophilus kuhlii*), black-bearded tomb bat (*Taphozous melanopogon*), Horsfield's myotis (*Myotis horsfieldii*), Javan pipistrelle (*Pipistrellus javanicus*), pouch tomb bat (*Saccolaimus saccolaimus*), whiskered myotis (*Myotis muricola*) and bamboo bat sp. (*Tylonycteris* sp.) (Figure 6.4.36). Harp trapping and mist netting were conducted in both N4 and N5 Forested Area but yielded no catch.

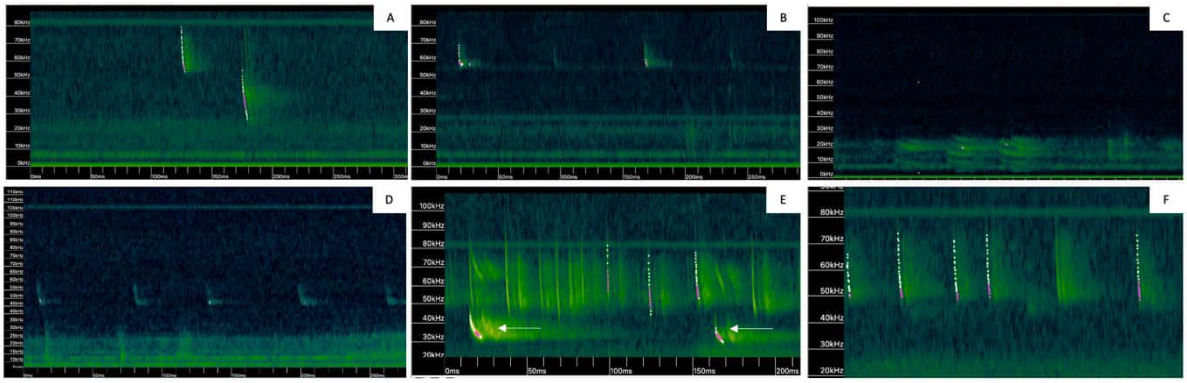


Figure 6.4.36 Spectrogram of (A) Horsfield's myotis (*Myotis horsfieldii*), (B) whiskered myotis (*Myotis muricola*), (C) pouch tomb bat (*Saccolaimus saccolaimus*), (D) Javan pipistrelle (*Pipistrellus javanicus*), (E) black-bearded tomb bat (*Taphozous melanopogon*) and (F) bamboo bat sp. (*Tylonycteris* sp.). Spectrogram of lesser Asian house bat (*Scotophilus kuhlii*) not shown here

All species recorded are not of conservation significance with the exception of the locally Vulnerable bamboo bat sp. which were detected in acoustic recordings during roost emergence survey at BAM_3 (Figure 5.2.6). Adapted with a dorsoventrally flattened skull, this species enter the internode of a bamboo through a small slit constructed by long-horned beetles [P-47; P-48; P-49]. Bats detected were likely foraging in the vicinity of BAM_3 since no active roost were found during the survey. This does not indicate the absence of an active roost; it is possible that the active roost is higher up in the canopy and out of surveyor's sight.

Roosting of bamboo bats was not confirmed for any of the clusters five bamboo clusters surveyed in N5 Forested Area. However, bamboo bats were detected acoustically in four clusters (BAM_2, BAM_3, BAM_4 and BAM_5) (Figure 5.2.6; Figure 6.4.37). Even though acoustic records and roosting evidence were not found at BAM_1 the cluster is still considered as potential roosting sites.

The Horsfield's myotis (*Myotis horsfieldii*) recorded in N5 Forested Area was only recently recorded in Upper Pierce Reservoir west and Punggol [P-50; P-51]. Previous records of this species were incorrectly identified as *Myotis adversus* — presence of *Myotis adversus* here in Singapore is disputable at present [P-52].



Legend

Bambooo cluster surveyed

Priority Classification

- 1- Bamboo bat roosting confirmed
- 2- Bamboo bat acoustically recorded, roosting not confirmed
- 3- No visual/acoustic records; potential roosting site

Habitat Mapping

- Abandoned-land forest
- Exotic-dominated secondary forest
- Grassland
- Infrastructure
- Semi-naturalised drain
- Scrubland
- Urban vegetation (Turf)

Others

- Biodiversity Study Area
- Project site

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-	MAY 2024	IT	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Location of bamboo bat sp. (Tylonycteris sp.) detected at bamboo clusters in Sembawang N5 Forested Area

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IT	SAG	JAG	6.3.37	1	1 of 1
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6.4.3 Ecological Significance and Connectivity

In a developing country where land-use changes are frequent, faunal species are forced to shift outside their primary habitat and traverse the highly human-modified landscape. Stepping-stone habitats serves an important function to prevent further isolation of species and to sustain crucial dispersal events [P-34]. Stepping-stone habitats should also be of sufficient quality that is usually indicated by the presence of habitat resources [P-34].

Spontaneous Forest Vegetation

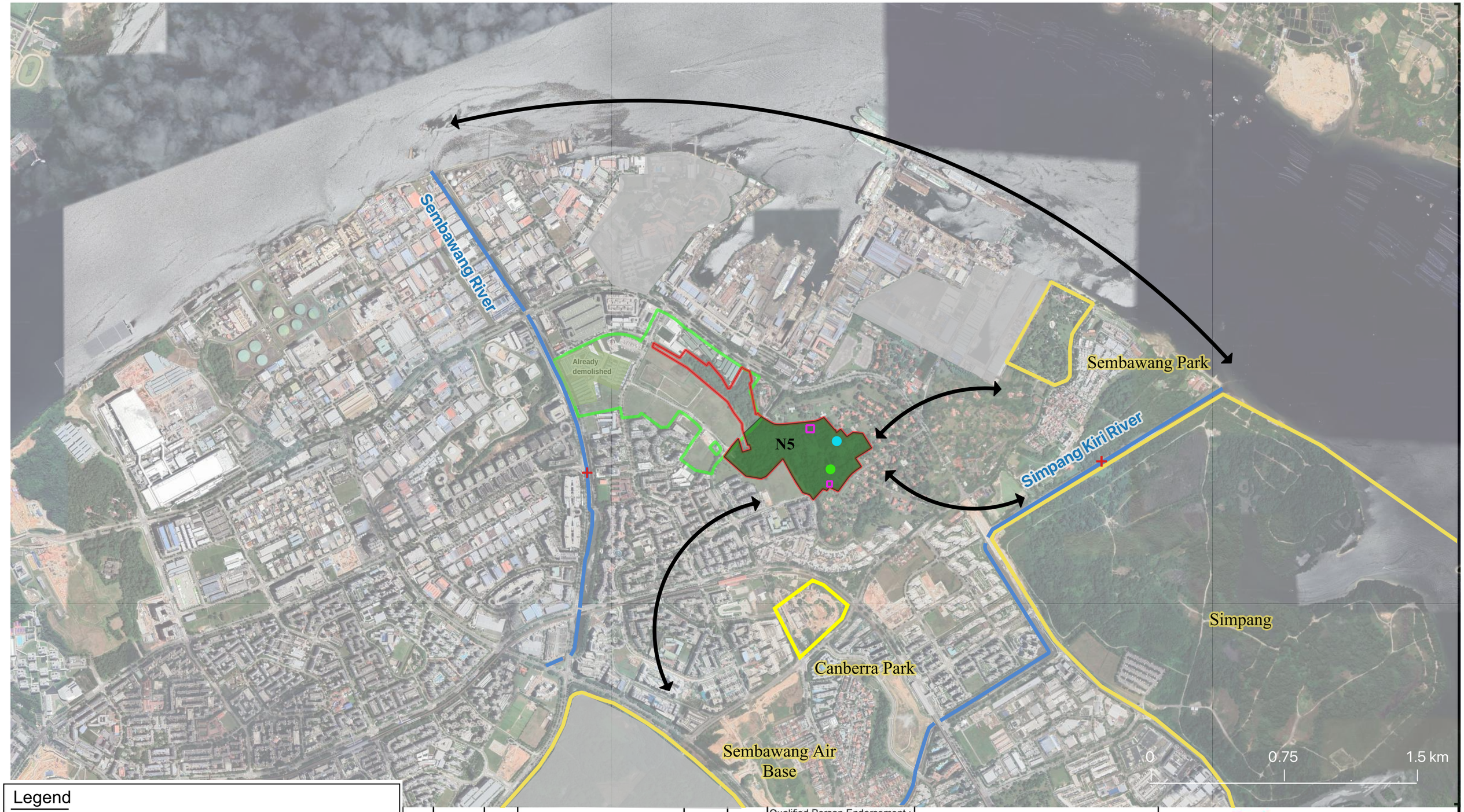
The biodiversity Study Area, which comprises of N4 and N5 Forested Areas, is one of a few remaining large and continuous vegetated patches in the urban matrix of Sembawang region. The larger size and position of N5 Forested Area makes this forest patch a much more effective stepping-stone habitat than the adjacent non-continuous remnant vegetation e.g., Canberra Park. In comparison to the N4 Forested Area, the N5 Forested Area has a higher proportion of native species recruitment with an understorey growth of largely abandoned-land forest species. The understorey of N4 Forested Area comprises of common native and exotic species. Furthermore, N5 Forested Area has a disproportionately larger number of species of conservation significance (Figure 6.4.13) and a higher number of other specimens of value such as bamboo clusters, keystone species and trees with raptor's nests (Figure 6.4.17).

Recent colonisation of freshwater swamp species in urban matrix

Opportunities recruitment of freshwater swamp species observed in the north and south of N5 Forested Area suggests that dispersal events from a Freshwater swamp forest source has taken place. It is likely that the source of dispersal is from the remnant freshwater swamp forest patches in Sungei Seletar Catchment as species such as *Horsfieldia crassifolia* (Critically Endangered), *Santiria laevigata* (Vulnerable), *Neoscortechinia sumatrensis* (Critically Endangered) and *Horsfieldia polyspherula var. polyspherula* (Vulnerable) occurring in N5 Forested Area have also been found in Seletar [P-53]. Much like the influence from the nearby swamp forests i.e. Simpang or Seletar, a dragonfly species found in swamp forest and marsh habitats — Bronze flutterer (*Rhyothemis obsolescens*) — was found N5 Forested Area and deemed as a transient occurrence.

Stepping-stone for fauna between Simpang and Central Catchment Nature Reserve

The faunal assessments in this EIA study also underscore the function of N5 Forested Area as a stepping-stone habitat in assisting movement of species from the forested areas of (Simpang) and Central Catchment Nature Reserve via Sembawang Air Base (Figure 6.4.38). The presence of trees > 50 cm diameter at breast height [P-45] in N5 Forested Area makes it a feasible option for natal dens for the Sunda pangolins (*Manis javanica*). Aside from the single record of Sunda pangolin in N5 Forested Area, the Singapore Pangolin Working Group collated records of sightings, roadkill, and rescues from 2010 to 2021 showing two records of rescue and one sighting in the urban matrix outside of the biodiversity Study Area (precise locations are not shown here due to confidentiality). These records further highlight the importance of N5 Forested Area as a means of connectivity to other source populations. Semi-aquatic mammals like the smooth-coated otter (*Lutrogale* perspicillata) utilise the waterway systems as a travel path and may sometimes venture into the urban matrix. In order to traverse between the canals (Sembawang River and Simpang Kiri River) where they were anecdotally observed, otters will have to either swim along the coastline or traverse through the urban matrix using N5 Forested Area as a stepping stone and refuge. This is corroborated by the species' occurrence in the forest as detailed in Section 6.4.2.11.



Legend

- Manis javanica (CR)
- Lutrogale perspicillata (EN)
- Unidentified Mustelidae (anecdotal sightings)
- Freshwater swamp species
- Ecological connectivity pathway
- Large drain
- N5 Forested Area
- Boundaries (green area)
- Biodiversity Study Area
- Project site

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Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Ecological significance of Sembawang N5 Forested Area

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6.4.4 Assessment of Ecological Value

6.4.4.1 Habitats

The ecological value of five terrestrial habitats and one aquatic habitat within the biodiversity Study Area were assessed according to the criteria detailed in Section 5.1.2.

There are no habitats that were assessed to be of high ecological value (Priority 1). Three terrestrial habitats (i.e., abandoned-land forest, exotic-dominated secondary forest and grassland) were assessed to have overall medium ecological value (Priority 2). Two terrestrial habitats (i.e., scrubland and urban vegetation) and aquatic habitat (i.e., were assessed to have overall low ecological value (Priority 3). A summary of the assessment of ecological value is detailed in the respective paragraphs below and summarised in Table 6.18.

Table 6.18 National assessment of ecological value of each habitat type in the biodiversity Study Area

Criterion	Terrestrial habitat					Aquatic habitat
	Abandoned-land Forest	Exotic-dominated Secondary Forest	Grassland	Scrubland	Urban vegetation	Semi-naturalised drain
Flora and fauna species richness	2	2	1	1	1	2
Irreplaceability	1	1	1	1	1	1
National rarity of habitat	2	2	2	2	1	1
Unique flora and fauna species	1	1	3	0	1	1
Total score	**6**	**6**	**7**	**4**	**4**	**5**
Ecological value	**Medium (Priority 2)**	**Medium (Priority 2)**	**Medium (Priority 2)**	**Low (Priority 3)**	**Low (Priority 3)**	**Low (Priority 3)**

I. Abandoned-land Forest (Medium Ecological Value; Priority 2)

Abandoned-land forests are regrowth forests developed from abandoned villages, orchards, or plantations, usually dominated by cultivated fruit trees and crops, or ornamental plants. In N5 Forested Area, this forest is dominated by African tulip (*Spathodea campanulata*) and cultivated fruit trees such as wild cinnamon (*Cinnamomum iners*) and rambutan (*Nephelium lappaceum*). Abandoned-land forests generally have moderate flora and fauna species richness (Score 2), supporting few unique flora and fauna species (Score 1). Even though it is possible to recreate and replace this habitat type by means of human intervention, natural or accelerated succession, rendering it a low score in irreplaceability (Score 1), this habitat type is uncommon in Singapore (Score 2) due to increasing urbanisation. With two criteria assessed to be medium (Score 2) and two criteria assessed to be low (Score 1), the overall score for the abandoned-land forest habitat is six. This translates into medium ecological value across all terrestrial habitats in Singapore.

II. Exotic-dominated Secondary Forest (Medium Ecological Value; Priority 2)

Exotic-dominated secondary forest is defined as forest patches that had arose from land clearance, including exotic tree species such as albizia (*Falcataria falcata*), earleaf acacia (*Acacia auriculiformis*), and river tamarind *(Leucaena leucocephala)*. This habitat type is present in both N4 and N5 Forested Areas. Both forested Areas were generally dominated by the storm-vulnerable albizia (*Falcataria falcata*). The understory is also interspersed with African tulip (*S. campanulata*) and cultivated fruit trees due to its proximity to the abandoned-land forest.

Similar to abandoned-land forests, this habitat generally has moderate flora and fauna species richness (Score 2), supporting few unique flora and fauna species (Score 1). It is also able to support certain species of conservation significance. For instance, in N4 Forested Area, specimen of nationally Endangered *Calophyllum inophyllum* of a notable size (2.3 m in girth and 20 m in height) was recorded. Typically associated with mature secondary forests, nationally Vulnerable *Cnestis palala* and *Pittosporum ridleyi* were also recorded in this habitat type of N5 Forested Area. It is possible to recreate and replace this habitat type by means of human intervention,

natural or accelerated succession, rendering it a low score in irreplaceability (Score 1). Nonetheless, this habitat type has been diminishing in Singapore over the recent years due to increasing urbanisation (Score 2). With two criteria assessed to be medium (Score 2) and two criteria as low (Score 1), the overall score for the abandoned-land forest habitat is six, which translates into medium ecological value across all terrestrial habitats in Singapore.

III. Grassland (Medium Ecological Value; Priority 2)

Grasslands are open, level, and continuous areas dominated by grasses (Family Poaceae) and other slow-growing plants. This habitat type was only encountered in both Study Areas along forest fringes and is mainly dominated by elephant grass (*Cenchrus purpureus*) in N4 Forested Area, and Guinea grass (*Urochloa maxima*) and *Urochloa mutic*a in N5 Forested Area. Grasslands are generally low in flora and fauna species richness (Score 1), although the species i.e., caterpillars that inhabit them are unique as described in Section 6.4.2.6, and are unlikely to be found in other terrestrial habitats (Score 3). Although they are uncommon in Singapore (Score 2), most flora species in grasslands are fast-growing, they are also easily replaced (Score 1). With one criterion assessed to be high (Score 3), one criterion medium (Score 2), and 2 criteria low (Score 1), the overall score for the grassland habitat is seven (7), which translates to medium ecological value across all terrestrial habitats in Singapore.

IV. Scrubland (Low Ecological Value; Priority 3)

Scrublands are open canopy vegetation dominated by shrubs, climbers, and/or ferns. In N4 Forested Area, it comprises mostly clusters of shrubs and herbs such as broad sword fern (*Nephrolepis biserrata*), resam (*Dicranopteris linearis*), and swamp shield-fern (*Cyclosorus interruptus*), alongside other herbaceous species. In N5 Forested Area, parts of the forest were dominated by either shrub species simpoh air (*Dillenia suffruticosa*) and broad sword fern (*N. biserrata*).

Scrublands often have low flora and fauna species richness (Score 1) and are not known to support any unique flora and fauna species (Score 0). As shrubs that make up scrublands colonise rapidly and can take over land with minimal human intervention, scrublands are easy to be recreated or replaced (Score 1). This habitat type is common in Singapore (Score 1). With three criteria assessed to be low (Score 1), the overall score for the scrubland habitat is three, which translates to low ecological value of scrubland in the biodiversity Study Area.

V. Urban Vegetation (Low Ecological Value; Priority 3)

Urban vegetation in N5 Forested Area is largely managed lawn cow grass (*Axonopus compressus*). Typically, urban vegetation has low flora and fauna species richness (Score 1), with few unique flora and fauna species recorded (Score 1). This habitat type is common nationally (Score 1) and can be easily reconstructed via means of human intervention, rendering it a low score in irreplaceability (Score 1). With four criteria assessed to be low (Score 1), the overall score for the urban vegetation habitat is four, which translates into low ecological value across all terrestrial habitats in Singapore.

VI. Stream within N4 Forested Area (Low Ecological Value; Priority 3)

Stream within N4 Forested Area is a semi-naturalised drain. This habitat type generally supports moderate flora and fauna species richness (Score 2). It is also able to supports few unique flora and fauna species (Score 1). In N4 Forested Area, mostly exotic fauna species were generally recorded, such as mosquitofish (*Gambusa affinis*), which are typically found in highly disturbed habitats. In Singapore, this habitat type is common (Score 1) and is easily re-creatable (Score 1) over a short duration (i.e., 5 years or less). With one criterion assessed to be medium (Score 2) and three criteria assessed to be low (Score 1), the overall score for the stream habitat is five, which translates into low ecological value of Stream withing N4 Forested Area.

6.4.4.2 Flora

The ecological value of 249 plant species in biodiversity Study Area was assessed. The list of species is in Appendix D.

Of the 249 species assessed for their ecological value, 20 were initially assigned with the value of Priority 1, 92 of Priority 2, and 137 of Priority 3. Four species had their ecological value raised after assessment: three from Priority 3 to Priority 1 and one from Priority 2 to Priority 1. This adds up to a total of 24 Priority 1 species.

The nationally Critically Endangered *Horsfieldia crassifolia* and *Neoscortechinia sumatrensis*, nationally Endangered *Adenia cordifolia*, *Calophyllum inophyllum*, *Melicope lunu-ankenda*, *Tectaria cf semipinnata*, *Uncaria cordata*, and nationally Vulnerable *Callicarpa longifolia*, *Cissus repens*, *Cnestis palala*, *Cyperus compressus*, *Goniophlebium percussum*, *Horsfieldia polyspherula* var. *polyspherula*, *Lindera lucida*, *Litsea umbellata*, *Macaranga griffithiana*, *Microlepia speluncae*, *Pittosporum ridleyi*, *Santiria laevigata*, *Trema tomentosum* found in the biodiversity Study Area were accorded the value of Priority 1 as they are not known to be locally cultivated and likely to be of native genetic stock.

One native fig species (i.e., *Ficus microcarpa*) that was accorded with an initial level of Priority 2, were raised to Priority 1 as it is regarded as keystone species. For the same reason, one cryptogenic fig (*Ficus benjamina*) species had their initial ecological value raised from Priority 3 to Priority 1.

The exotic *Bambusa heterostachya* and *Bambusa vulgaris* were accorded an initial ecological value of Priority 3. These bamboo clusters are known to be potential roosting sites for bamboo bats (*Tylonycteris* sp.). Hence, the ecological value of *Bambusa heterostachya* and *Bambusa vulgaris* were raised to Priority 1 after assessment.

6.4.4.3 Fauna

The ecological value of 220 faunal species in biodiversity Study Area was assessed. All 76 faunal species of conservation significance (recorded and probable) were accorded a Priority 1 sensitivity level and deemed to be of high ecological value. Sensitive receptor classification were carried out according to the criteria shown in Table 5.2.

6.5 Water Resources

The following sections describe the baseline hydrological, surface water quality and groundwater depth conditions within the Study Area.

6.5.1 Baseline Monitoring Personnel

The site surveys and assessments were conducted by the following AECOM personnel:

- Dr. Liang Liang (Water Resources Technical Lead)
- Mr. Grujica Sarenac (Water Resources Lead)
- Ms. Yi Leng Tan (Water Resources Support – Surface Water)
- Mr. William Ling (Water Resources Support – Groundwater)
- Mr. Samuel Neo (Water Resources Support – Groundwater)
- Specialist Testing and Technical Services (STATS) Asia Pacific Pte Ltd (Drilling Specialists)

6.5.2 Hydrological Baseline Conditions

The main objective of this baseline study is to characterise the existing surface water hydrological conditions and gain understanding of how the surface water likely flows within the Study Area. Subsequently, this baseline information was used to assess the potential impacts on identified sensitive receptors due to the foreseen changes in hydrological baseline conditions due to proposed developments. Stream mapping was also carried out as part of this study.

As detailed in Section 5.2.3 of this Report, the hydrological baseline information was collected from both primary and secondary sources. Data analysis and findings are detailed in the following sub-sections.

6.5.2.1 Regional Catchment Analysis

Due to the lack of extensive natural aquifers or lakes from which the water could be used for beneficial purposes, Singapore has developed a robust water supply system aiming to diversify its water sources. As part of these efforts, Singapore maximises stormwater harvesting practices. Namely, stormwater is collected through a network of rivers, canals, and drains and subsequently channelled into one of 17 reservoirs. From there, water is sent to water treatment plants for multiple-stage treatment before it is distributed to final users. As such, stormwater represents one of Singapore's main sources of drinking and industrial water.

Based on PUB's catchment map (refer to Figure 6.5.1), the Project site is not located within any of the reservoirs' catchment areas. During the Scoping Meeting with Technical Agencies on 7th March 2023, PUB further confirmed that surface water from the site eventually gets discharged into the sea.

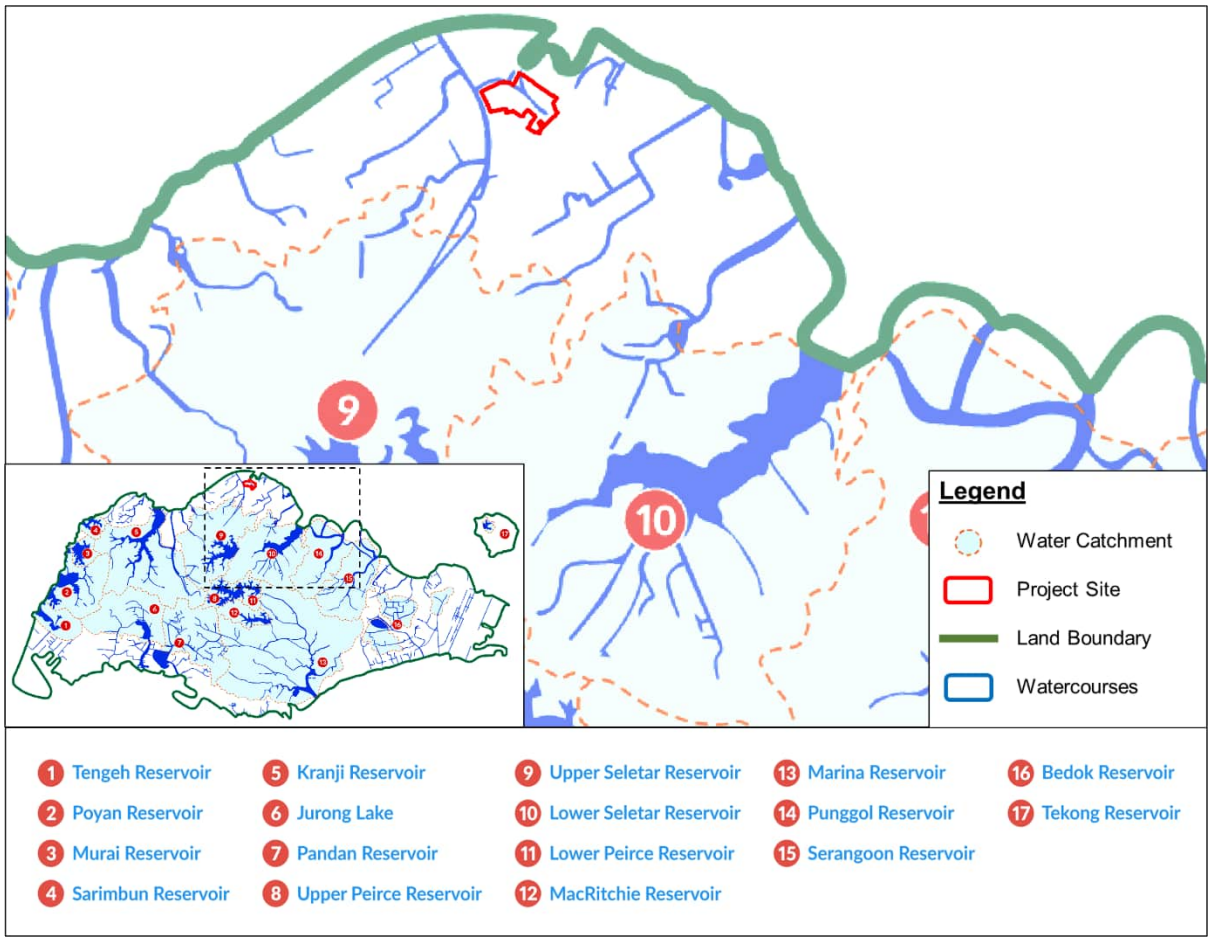


Figure 6.5.1 Singapore water catchment map and Project site (Source: PUB, 2020 [W-16])

6.5.2.2 Hydrological Conditions and Site Catchment Analysis

During the site reconnaissance, 2 watercourses with perennial flow were observed within forested areas – concrete drain D1 flowing through N5 Forested Area and semi-naturalised drain D2 flowing through N4 Forested Area. The two drains are connected via culvert located below the Canberra Road. In addition to these two watercourses, a number of watercourses with ephemeral flow were also observed within and in the vicinity of the forested areas (Figure 6.5.2). Given the proximity of Sungei Sembawang to the future development boundary, it was selected to be included in this Study. Bank features and flow conditions during dry and wet weather conditions of the drains D1 and D2 as well as Sungei Sembawang are detailed in Table 6.19. Increased flow rates during wet weather conditions were observed in both concrete drain at N5 Forested Area and semi-naturalised drain within N4 Forested Area. Almost stagnant flow conditions were observed during both dry and wet weather at the upstream of semi-naturalised drain D2 at its upstream point.

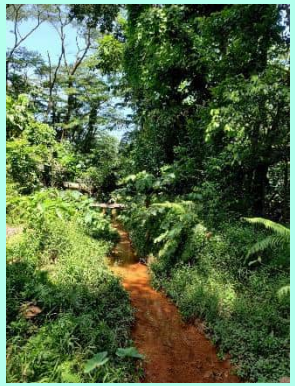
The topographic survey data was received from topographic surveyor on 18th December 2023. Elevation map overlaid with surface watercourses within N4 and N5 Forested Areas (Figure 6.5.3) was generated with the topographic survey data using ArcGIS. As shown in Figure 6.5.3 and Figure 6.5.4, the forested area can be described as hilly and undulating, with changing slopes. Highest elevations can be found at the eastern portion of N5 Forested Area, gradually decreasing towards east and Canberra Road with moderate slopes. N4 Forested Area is generally on the lower elevation compared to N5 Forested Area, with lowest elevations observed surrounding the semi-naturalised drain. Steeper slopes can be observed along the southern boundary of N4 Forested Area, towards the semi-naturalised drain (up to 48%).

Based on the elevation map, catchment delineation was carried out for both N4 and N5 Forested Area, as shown in Figure 6.5.5. Generally, N5 Forested Area was delineated into 4 sub-catchment areas, while N4 Forested Area was delineated into 3 sub-catchments. As shown in Figure 6.5.5, concrete drain D1 within N5 mainly collects the water from central sub-catchment, comprising most of the forested areas (around 18 ha). It is to be noted that based on site observations this concrete drain also partially receives water from the surrounding urbanised area

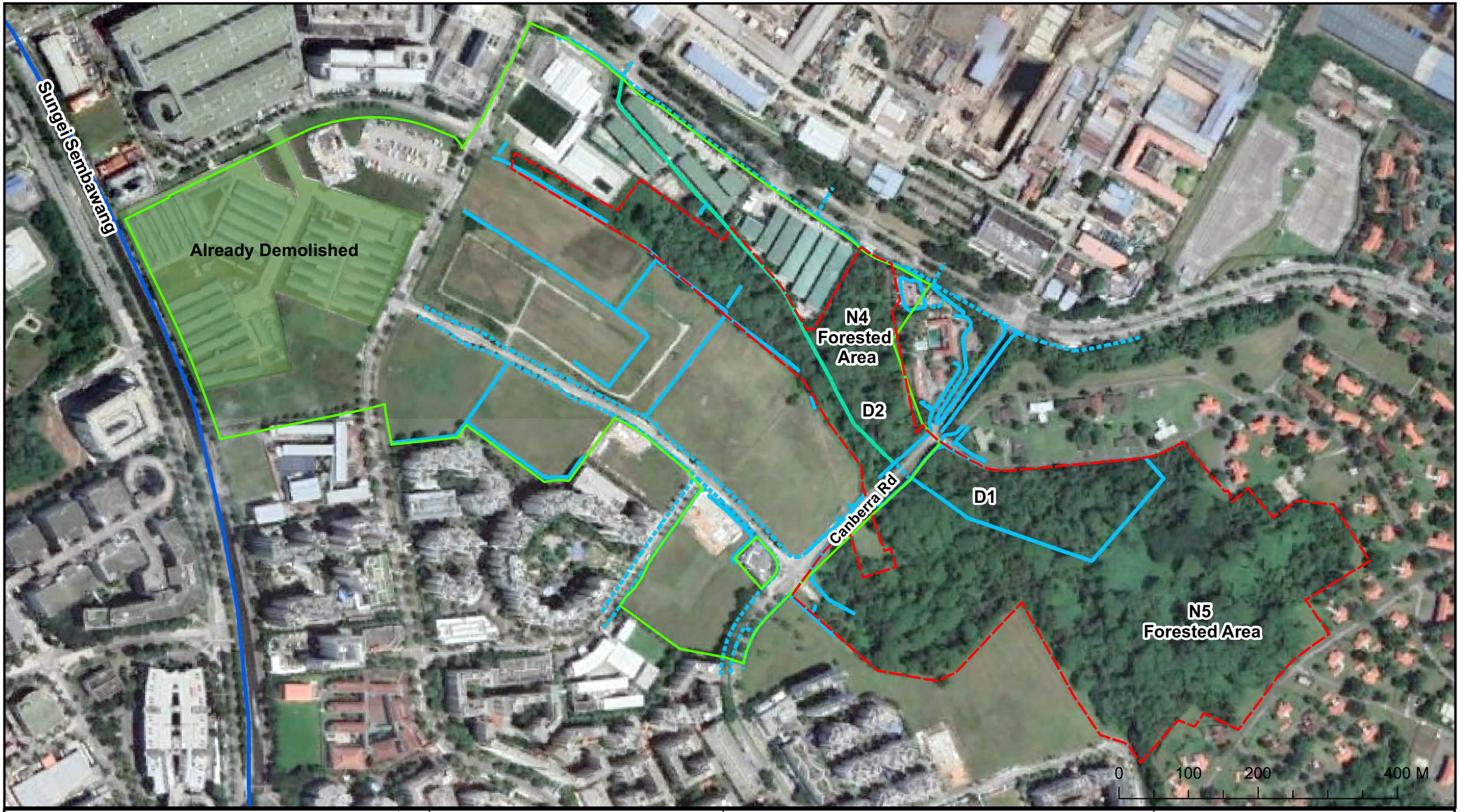
at its upstream end, via roadside drains. Semi-naturalised drain D2 within N4 Forested Area collects the water from central, and largest, sub-catchment of N4 Forested Area and also receives water discharged from D1 via underground culvert.

Table 6.19 Description of watercourses within the Study Area

Watercourses	Bank Characteristics	Water Flow Conditions	Photos	
Concrete drain D1	Concrete drain with artificial banks	• Perennial flow **Dry weather condition:** water velocity of 0.16 – 0.22 m/s with waterbody width of approximately 0.26 m and depth of 8 cm **Wet weather condition:** water velocity of 1.0 m/s with approximate waterbody width of 0.28 m and depth of 9.5 cm	During Dry Weather 	During Wet Weather 
Semi-Naturalised Drain D2	Concrete drain that has been naturalised; likely to have concrete bed covered by sediments and soil, with observed degraded concrete banks at various points along the watercourse	• Perennial flow **Dry weather condition:** • Upstream: almost stagnant, with waterbody width of approximately 4 m and depth of 0.56 m • Midstream: water velocity of 0.33-0.50 m/s with approximate waterbody width of 0.9 m and depth of 4cm • Downstream: water velocity of 0.05 m/s with approximate waterbody width of 1.1 5 m and depth of 0.15 m	**Upstream (WQ2)** During Dry Weather Conditions 	During Wet Weather Conditions 

Watercourses	Bank Characteristics	Water Flow Conditions	Photos
		Wet weather condition: • Upstream: almost stagnant, with waterbody width of approximately 5 m and depth of 0.9 m • Midstream: water velocity of 0.33-0.50 m/s with approximate waterbody width of 1.55 m and depth of 0.26 m • Downstream: water velocity of 0.16 m/s with approximate waterbody width of 1.31 m and depth of 0.42 m	**Midstream (WQ5)** During Dry Weather  During Wet Weather  **Downstream (WQ8)** During Dry Weather  During Wet Weather 

Watercourses	Bank Characteristics	Water Flow Conditions	Photos	
Sungei Sembawang	Wide concrete canal	• Perennial flow **Dry weather condition:** water velocity of 0.20 m/s with approximate waterbody width of 17 m and depth of 1.33 m **Wet weather condition:** water velocity of 0.58 m/s with approximate waterbody width of 15 m and depth 0.7 m.	During Dry weather 	During Wet weather 



Legend

- Project site
- Demolished Buildings
- Forested Area/ Biodiversity Study Area
- Open drain
- Underground drain
- Sungei Sembawang
- Semi-naturalised drain

N

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Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Watercourses of the Study Areas and its surroundings

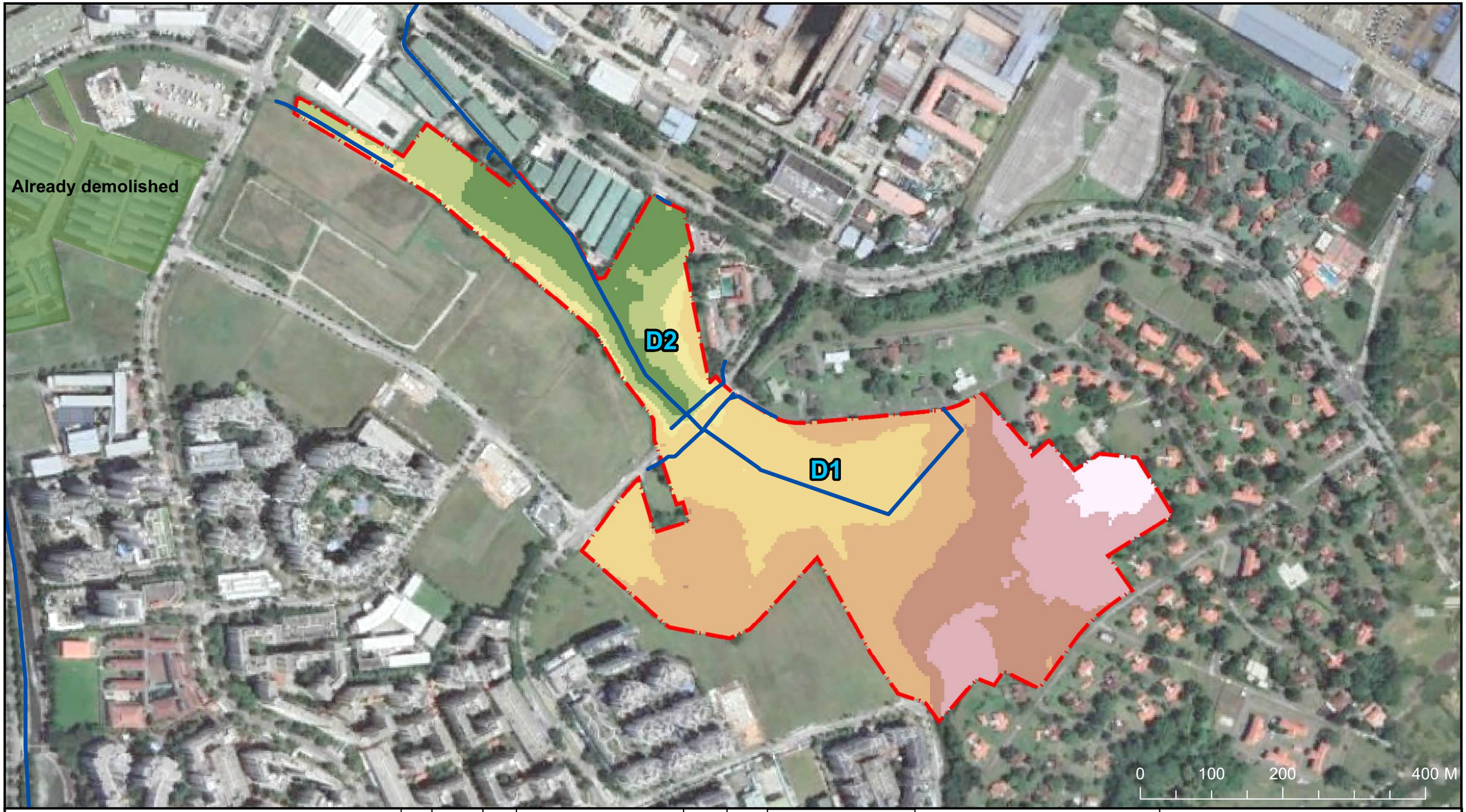
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Legend

- Watercourse within Forested Area
- Demolished Buildings
- Forested Area/ Biodiversity Study Area

Elevation (mRL)

- <5
- 5 - 8
- 8 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- >30

N

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Project Title :

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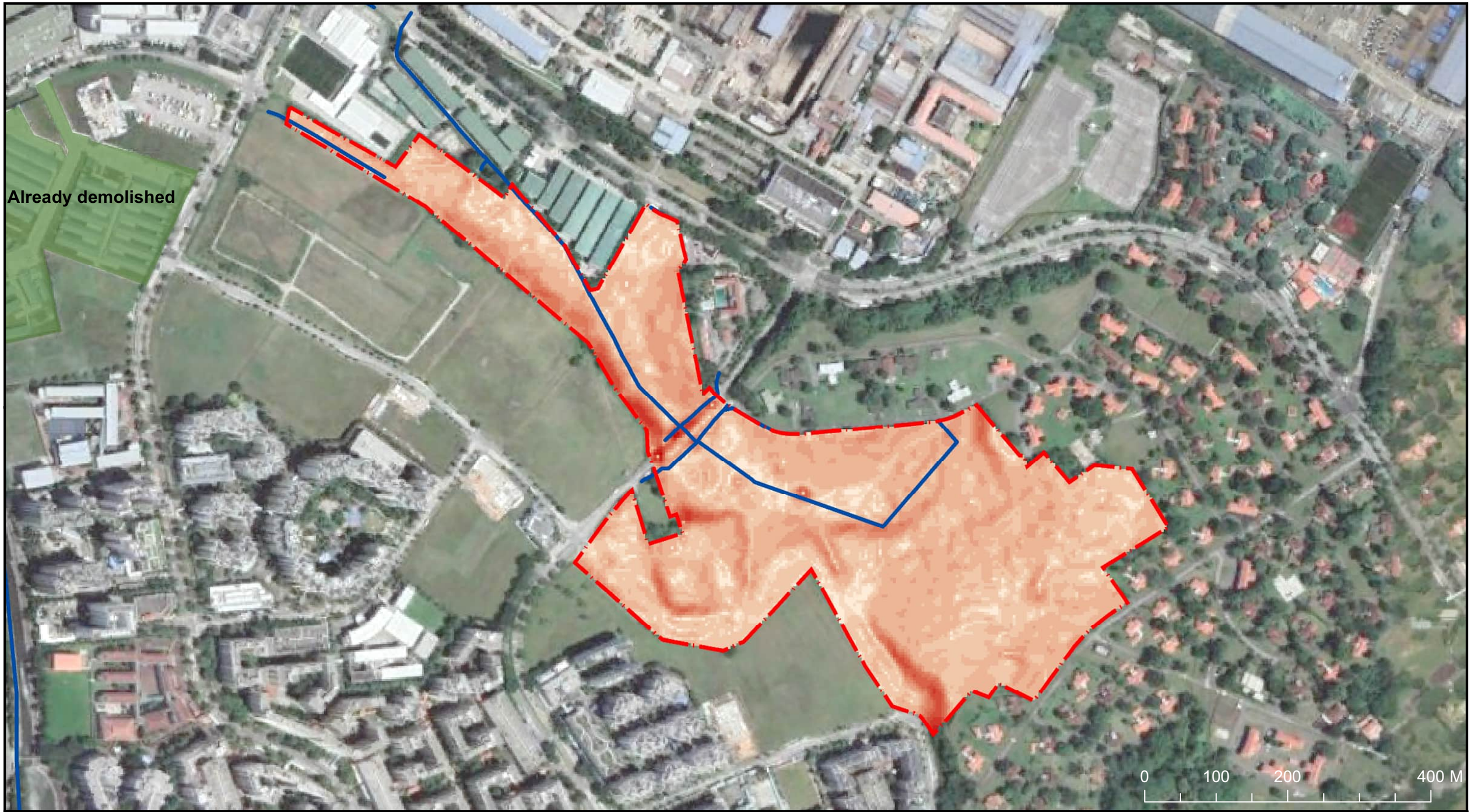
Figure Title :

Elevation map with watercourses within N4 and N5 Forested Areas

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Legend

- Forested Area/ Biodiversity Study Area
- Watercourses within Forested Areas
- Demolished Buildings

Slope (%)

- <1
- 1 - 2
- 2 -5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 48.36

N

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Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Slope map of the N4 and N5 Forested Areas

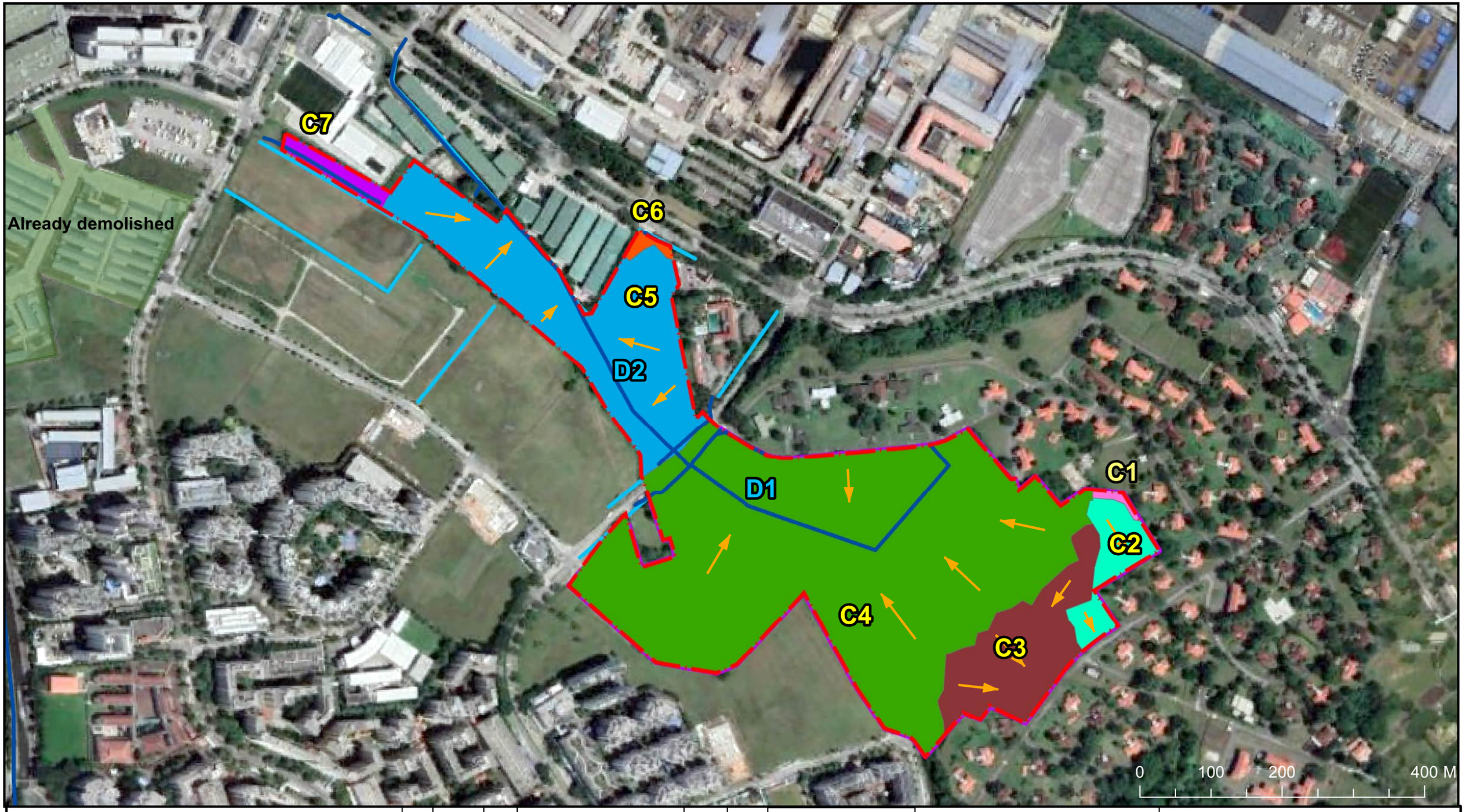
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Legend

- Biodiversity Study Area
- Demolished Buildings
- Watercourses within Forested Areas
- Surface Flow Direction

Catchment

C1, C2, C3, C4, C5, C6, C7

N

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Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Catchment map of the N4 and N5 Forested Areas

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6.5.3 Surface Water Quality Baseline Conditions

6.5.3.1 Surface Water Quality Sampling Locations

The surface water quality sampling locations (refer to detailed Table 5.10, as shown in Figure 5.2.8) were selected strategically along the identified watercourses within the Study Area based on preliminary hydrological findings during site reconnaissance. The baseline conditions of the surface water quality at the Study Area were then established at the selected water quality sampling stations by comparing the water quality results with national/ international water quality standards/ criteria relevant to ecological uses.

6.5.3.2 Water Quality Baseline Results

All water quality stations have been sampled for both in-situ and ex-situ analysis. The water sampling events were conducted on 11th July 2023, 24th July 2023 and 13th September 2023 for three (3) dry weather events and 20th July 2023 and 16th November 2023 for two (2) wet weather event in the Study Area as shown in Table 6.20.

Table 6.20 Water quality monitoring schedule

Sampling Event / Sampling Location	Dry Weather			Wet weather	
	11th July	24th July	13th September	20th July	16th November
WQ1	-	√	√	√	-
WQ2	√	√	√	√	-
WQ3	√	√	√	√	-
WQ4	√	√	√	√	-
WQ5	√	√	√	√	-
WQ6	√	√	√	√	-
WQ7	√	√	√	√	-
WQ8	-	√	√	√	-
WQ9	-	√	√	√	-
WQ10	-	√	√	-	√
WQ11	-	√	√	-	√

Note:
√ indicates that the station has been sampled
- indicates that the station was not sampled

Table 6.21 Summary of surface water quality analysis results

Parameter		WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8	WQ9	WQ10	WQ11	Average	NEA Allowable Limits [1]	Water Quality Criteria for Aquatic Life from other countries[2]
		Freshwater Sampling Locations									Marine/ Brackish Sampling Locations				
DO (mg/L)	Dry Average	6.54	5.80	4.61	4.31	4.96	4.95	4.51	3.78	3.88	6.74	7.61	5.24	-	Freshwater and Marine Water: > 4.0
	Wet	8.31	8.11	7.69	7.18	6.97	6.77	6.42	6.29	6.81	6.33	5.93	6.98		
pH	Dry Average	6.7	6.5	6.5	6.5	6.7	6.6	6.6	6.6	6.8	7.7	7.7	6.8	6 – 9	-
	Wet	7.0	7.1	7.0	6.9	8.7	8.1	7.1	7.0	7.2	7.6	7.6	7.4		
Conductivity (µS/cm)	Dry Average	196	254	251	244	252	278	284	311	1,155	36,563	39,091	7,171	-	-
	Wet	62	84	89	98	125	128	141	146	202	5,841	7,121	1,276		
Temperature (°C)	Dry Average	26.9	27.0	27.3	27.1	27.6	27.8	28.0	28.1	31.0	31.9	32.0	28.6	45	-
	Wet	25.3	25.4	25.4	25.5	25.6	25.7	25.7	25.8	25.9	28.3	28.5	26.1		
Total Dissolved Solids, TDS (mg/L)	Dry Average	123	159	157	153	156	172	175	191	673	20,968	22,404	4,121	-	Freshwater: 1,000 Marine Water: Not Applicable
	Wet	40	54	57	63	81	82	90	93	129	3,573	4,338	782		
Turbidity (NTU)	Dry Average	10.0	28.9	22.0	11.8	9.0	14.5	11.5	16.6	10.6	2.8	1.9	12.7	-	Freshwater: 200 Marine Water: 20
	Wet	33.9	34.6	29.5	28.6	58.5	37.5	24.9	23.8	23.8	17.0	18.0	30.0		
Salinity (psu)	Dry Average	0.09	0.12	0.11	0.11	0.11	0.12	0.13	0.14	0.51	20.01	21.49	3.90	-	-

Parameter		WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8	WQ9	WQ10	WQ11	Average	NEA Allowable Limits [1]	Water Quality Criteria for Aquatic Life from other countries[2]
	Wet	0.03	0.04	0.04	0.04	0.06	0.06	0.06	0.07	0.09	2.95	3.63	0.64		
Total Suspended Solids, TSS (mg/L)	Dry Average	28.93	18.18	11.49	6.96	5.61	15.35	12.58	10.90	4.88	3.60	4.20	11.15	50	Freshwater: 150 Marine Water: 80
	Wet	16.80	23.90	19.70	18.00	39.30	35.50	15.90	14.80	11.60	33.67	39.00	24.38		
Orthophosphate as Phosphorous, PO_4-P (mg/L)	Dry Average	**0.033**	**0.035**	**0.038**	**0.041**	**0.042**	**0.042**	**0.043**	**0.044**	**0.084**	**0.143**	**0.145**	0.063	1.63 (equivalent to 5 as PO_4)	Freshwater: <0.033 (equivalent to <0.1 as PO_4) Marine: 0.015
	Wet	0.031	0.030	0.028	0.030	**0.040**	**0.039**	**0.038**	**0.038**	**0.048**	**0.031**	**0.032**	0.035		
Total Phosphorous, TP (mg/L)	Dry Average	0.041	0.047	0.053	0.054	0.052	0.059	0.060	0.061	0.099	**0.156**	**0.155**	0.076	-	Freshwater: 0.1 Marine: 0.020
	Wet	0.046	0.052	0.048	0.045	0.057	0.049	0.044	0.047	0.056	**0.041**	**0.040**	0.048		
Nitrate as NO_3-N (mg/L)	Dry Average	0.057	0.115	0.154	0.130	0.142	0.148	0.142	0.145	0.080	**0.291**	**0.183**	0.144	-	Freshwater: 7 (equivalent to 44 as NO_3) Marine Water: 0.060
	Wet	1.56	0.54	0.57	0.61	0.65	0.65	0.72	0.76	0.77	**0.62**	**0.62**	0.73		
Total Nitrogen, TN (mg/L)	Dry Average	0.78	1.12	1.03	0.98	1.02	1.09	1.07	1.12	1.31	**1.18**	**1.23**	1.09	-	Freshwater: 8 Marine Water: 0.25
	Wet	3.10	1.39	1.24	1.27	1.28	1.24	1.41	1.39	1.41	**1.13**	**1.13**	1.45		

Note:
1. NEA Trade Effluent Discharge Limits are for watercourses
2. The sources of water quality criteria for aquatic life include ASEAN Marine Water Quality Criteria [R-38]United States Environmental Protection Agency [R-5], Australian & New Zealand [R-6],]Philippines [R-8], and Malaysia [R-9]
3. Red values mean data exceeding the NEA limits; Blue values mean data exceeding Aquatic Life criteria (Freshwater); Purple values mean data exceeding Aquatic Life criteria (Marine)

Generally, the existing baseline surface water quality meet the adopted criteria, as shown in Table 6.21. The detailed explanation for each of water quality parameters is provided as below. All results were compared to NEA guidelines (where applicable), stations WQ1-WQ9 (i.e. stations within concrete drain [D1] and semi-naturalised drain [D2]) were compared to adopted aquatic life criteria for freshwater, while stations WQ10 and WQ11 were compared to adopted aquatic life criteria for marine water.

As shown in Figure 6.5.6, water temperature across all water quality stations during both dry and wet weather conditions ranged from 25.3^{o}C to 32^{o}C, which is below NEA limit 45^{o}C.

The pH of the watercourses ranged from 6.5 to 7.7 during dry weather conditions and from 6.9 to 8.7 during wet weather conditions, which are within NEA criteria (i.e. 6 – 9). Generally, pH did not vary a lot during dry and wet weather conditions, with notable variations at WQ5 and WQ6 between dry and wet weather conditions, which could be due to point discharges from adjacent dormitories.

The conductivity of water is strongly dependent on the number of ions available to participate in the conduction process. This parameter is positively correlated to salinity which measures the amount of salts dissolved in water. The salinity and conductivity of the watercourses found within N4 and N5 Forested Areas were low (i.e. less than 0.5 PSU and 1,154 µS/cm). TDS within these watercourses ranged from 40 mg/L to 673 mg/L. Along Sungei Sembawang salinity (ranging from 2.95 PSU to 21.49 PSU), conductivity (ranging from 5,841 µS/cm to 39,091 µS/cm) and TDS (ranging from 3,573 mg/L to 22,404 mg/L) were notably higher. This confirms prevalence of freshwater within N4 and N5 Forested Areas, and indicates brackish water conditions within Sungei Sembawang (seawater generally has conductivity of around $3.31x10^{6}$ µS/cm [Tyler et al, 2017] and salinity of around 35 PSU [NOAA, n.d.]).

Measured Dissolved Oxygen (DO) ranged from 3.8 mg/L to 7.6 mg/L during dry weather conditions and from 5.9 mg/L to 8.3 mg/L during wet weather conditions. DO was generally within the adopted aquatic life criteria (i.e. 4 mg/L), with the exception of DO measured at WQ8 (3.78 mg/L) and WQ9 (3.88 mg/L) during dry weather conditions which are marginally below the criteria. In addition, it should be noted that previous study (Blakely, 2014) has shown that DO lower than 4 mg/L was normal in natural streams in Singapore, indicating that freshwater aquatic life may have adapted to DO that is below 4 mg/L.

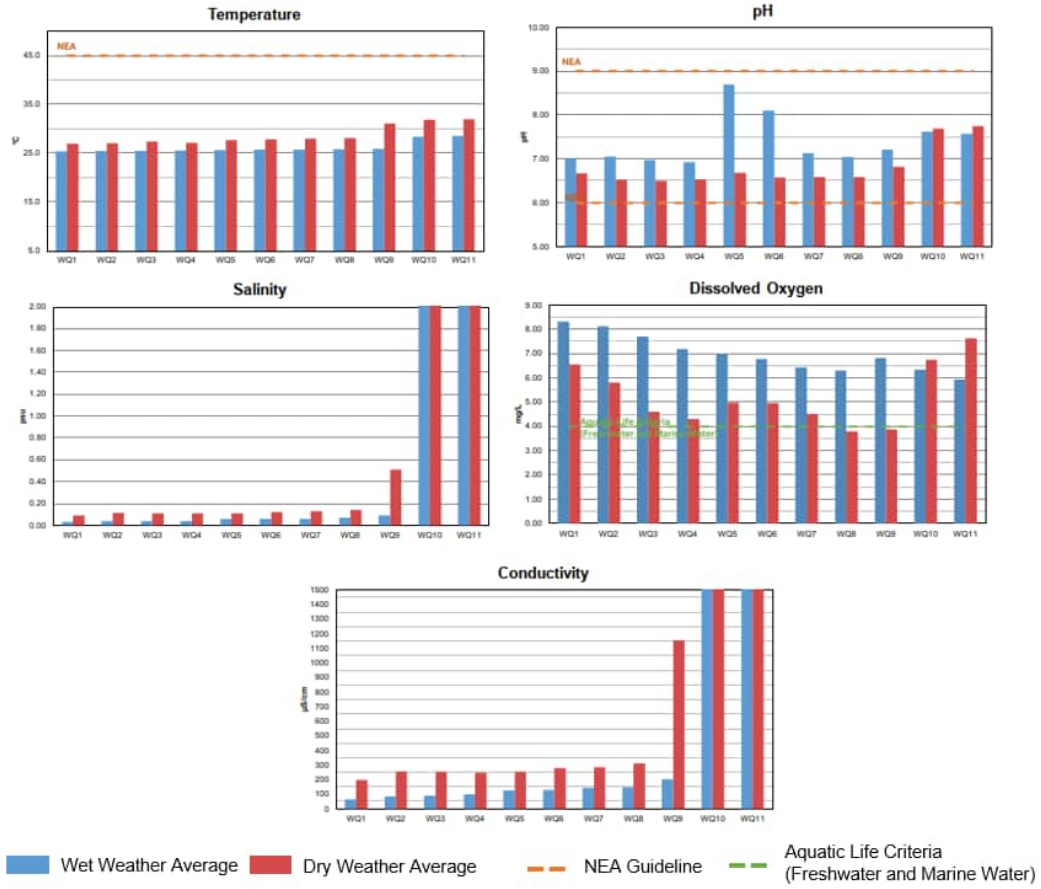


Figure 6.5.6 Average monitoring results of temperature, pH, salinity, DO and conductivity for wet and dry weather conditions

As shown in Figure 6.5.7, the turbidity along the watercourses ranged from 1.9 NTU to 58.5 NTU which is well-below selected criteria (i.e. 1,000 NTU), indicating clear water conditions. Measured concentrations of TSS ranged from 3.6 mg/L to 39.3 mg/L, which is below NEA Trade Effluent Limit (50 mg/L), freshwater criteria (150 mg/L) and marine water criteria (80 mg/L).

Generally, nutrient levels are within the adopted criteria. TN ranged from 0.8 mg/L to 3.1 mg/L, while nitrates as NO_3-N ranged from 0.1 mg/L to 1.6 mg/L. These values are within criteria in the watercourses with freshwater (i.e. concrete drain [D1] within N5 Forested Area and semi-naturalised drain [D2] within N4 Forested Area), while they exceed the criteria in watercourses with brackish/ marine water (i.e. Sungei Sembawang). TP ranged from 0.04 mg/L to 0.2 mg/L, while orthophosphates ranged from 0.03 mg/L to 0.14 mg/L. TP only exceeds criteria for marine water (i.e. within Sungei Sembawang), while orthophosphates exceed criteria for both freshwater (i.e. concrete drain and semi-naturalised drain) and marine water, with the exception of concentration of orthophosphates at WQ1 (concrete drain), WQ2, WQ3 and WQ4 (semi-naturalised drain) for wet weather conditions which are within criteria. The higher concentrations of these nutrients are potentially due to urban run-off of nutrients from the nearby urbanised areas (i.e. industrial, residential) and potentially from the natural processes such as decomposition of plants within and in the vicinity of watercourses. Water quality sampling locations and exceedances are shown in Figure 6.5.8.

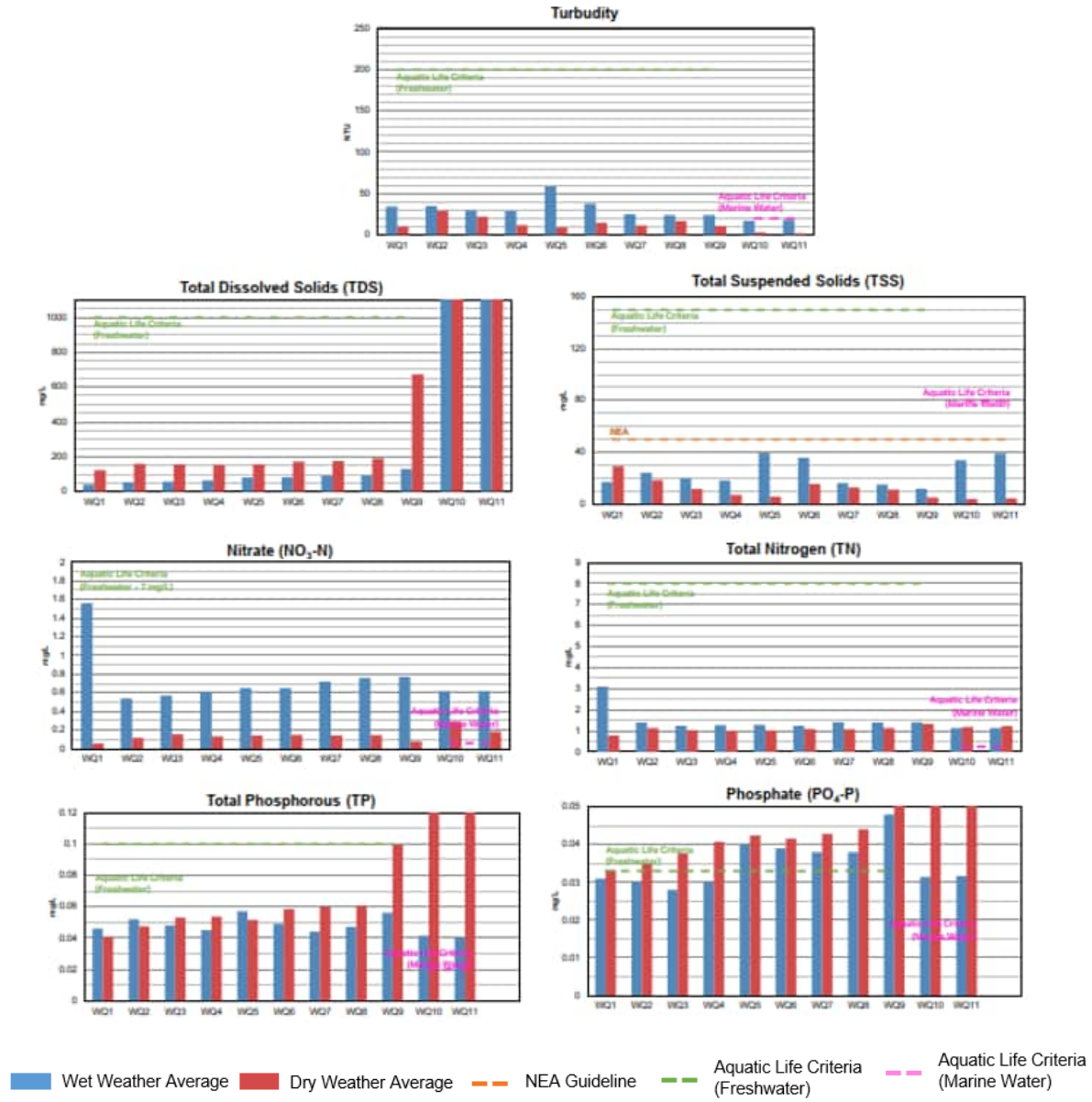
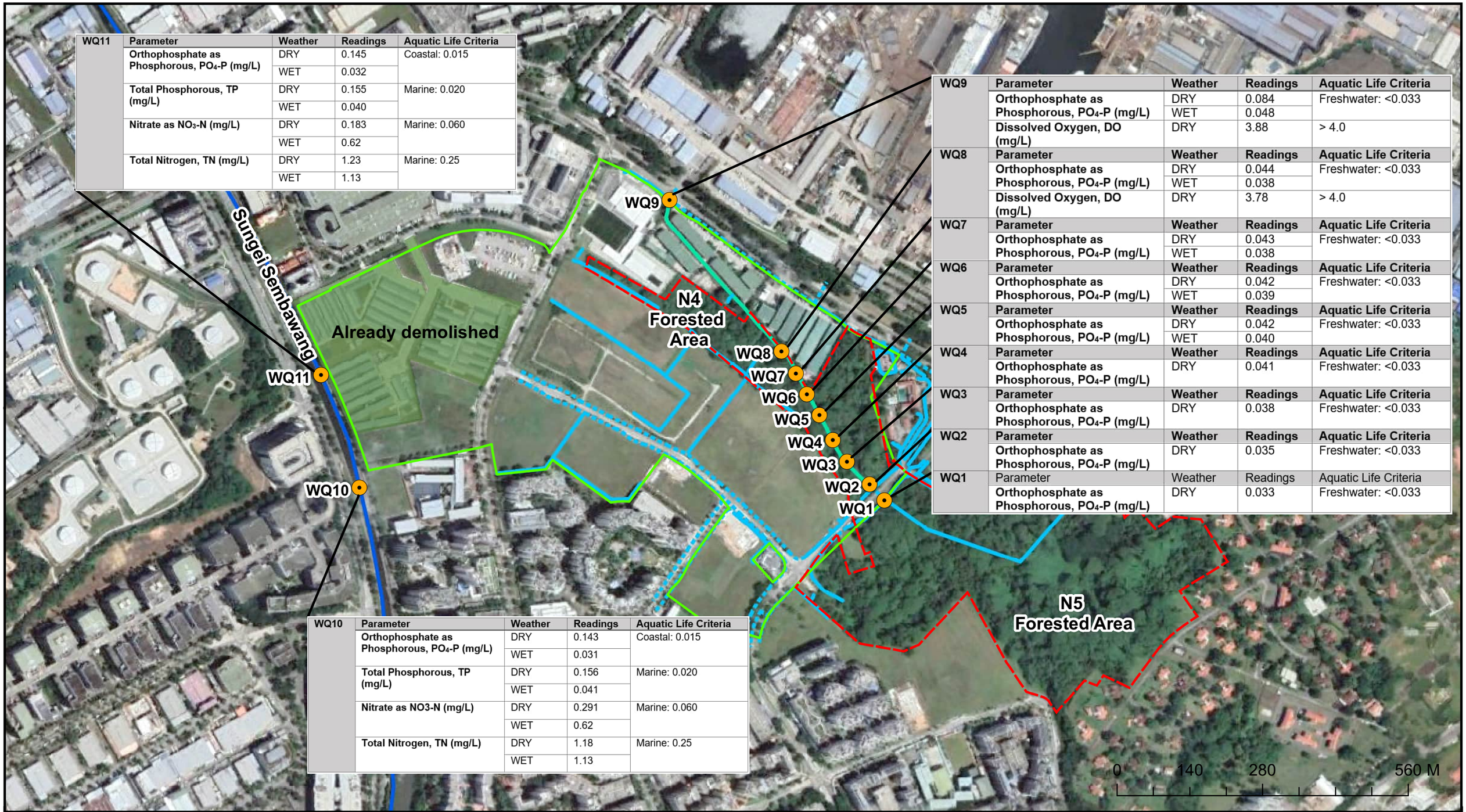


Figure 6.5.7 Average monitoring results of turbidity, TDS, TSS, nitrate, TN, TP, Phosphate for wet and dry weather conditions

WQ11	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.145	Coastal: 0.015
		WET	0.032	
	Total Phosphorous, TP (mg/L)	DRY	0.155	Marine: 0.020
		WET	0.040	
	Nitrate as NO_3-N (mg/L)	DRY	0.183	Marine: 0.060
		WET	0.62	
	Total Nitrogen, TN (mg/L)	DRY	1.23	Marine: 0.25
		WET	1.13	

WQ9	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.084	Freshwater: <0.033
		WET	0.048	
	Dissolved Oxygen, DO (mg/L)	DRY	3.88	> 4.0
WQ8	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.044	Freshwater: <0.033
		WET	0.038	
	Dissolved Oxygen, DO (mg/L)	DRY	3.78	> 4.0
WQ7	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.043	Freshwater: <0.033
		WET	0.038	
WQ6	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.042	Freshwater: <0.033
		WET	0.039	
WQ5	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.042	Freshwater: <0.033
		WET	0.040	
WQ4	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.041	Freshwater: <0.033
WQ3	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.038	Freshwater: <0.033
WQ2	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.035	Freshwater: <0.033
WQ1	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.033	Freshwater: <0.033

WQ10	Parameter	Weather	Readings	Aquatic Life Criteria
	Orthophosphate as Phosphorous, PO_4-P (mg/L)	DRY	0.143	Coastal: 0.015
		WET	0.031	
	Total Phosphorous, TP (mg/L)	DRY	0.156	Marine: 0.020
		WET	0.041	
	Nitrate as NO3-N (mg/L)	DRY	0.291	Marine: 0.060
		WET	0.62	
	Total Nitrogen, TN (mg/L)	DRY	1.18	Marine: 0.25
		WET	1.13	



Legend

- Project site
- Demolished Buildings
- Forested Area/ Biodiversity Study Area
- Surface Water Quality Sampling Locations
- Open drain
- Underground drain
- Sungei Sembawang
- Semi-naturalised drain

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	TYL	Final Report	SAG	JAG
-	JUL 2024	TYL	Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Water quality sampling locations with baseline exceedances

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
TYL	SAG	JAG	6.5.8	1	1 of 1
	Drawn TYL	Date AUG 2024	CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

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6.6 Airborne Noise

Baseline airborne noise monitoring was conducted to establish the existing noise levels in the Airborne Noise Study Area (detailed in Section 5.2.4).

6.6.1 Baseline Monitoring Personnel

The assessment and site surveys were conducted by the following personnel:

- Ms. Jagriti Dawra, AECOM (Airborne Noise Technical Reviewer)
- Ms. Yi Ting Sim, AECOM (Airborne Noise Consultant)
- Mr. Phyo Naing Zay (Airborne Noise Consultant)
- Ms. Kameshwari Ravi (Airborne Noise Consultant)
- Ms Leela Guvvala (Airborne Noise Consultant)

To understand the ambient noise environment within the N5 Forested Area, baseline noise monitoring was conducted on 08 August 2023 – 15 August 2023 with baseline noise levels captured for the purpose of developing the specific noise criteria applicable for the assessment of noise impacts arising from the construction and operational phase.

6.6.2 Airborne Noise Monitoring Results

Baseline monitoring was conducted to understand the ambient noise levels at locations in proximity of the Airborne Noise Study Area for the purposes of developing the applicable corrected noise criterions.

6.6.2.1 Construction Phase

The baseline airborne noise monitoring results captured through Monday – Sunday/ Public Holidays at NM01 for $L_{Aeq(12\ hrs)}$, $L_{Aeq(1\ hr)}$, and $L_{Aeq(5\ mins)}$ is summarised in Table 6.22 in accordance with local noise legislations for the construction phase. Noise levels recorded at NM01 is primarily representative of noise levels experienced by ecological receptors found traversing the N5 Forested Areas.

It should be noted that unlike human receptors, ecological receptors do not distinguish between Weekday (Monday – Saturday) and Weekend/ Public Holidays (Sunday/ Public Holidays), as such only overall baseline noise levels captured for Monday – Sunday/ Public Holidays was considered.

As observed, baseline airborne noise levels recorded in the N5 Forested Areas are considerably low and below the most-stringent NEA construction noise criteria with the exception of maximum $L_{Aeq(5\ mins)}$, 7am - 7pm and 7pm - 10pm potentially contributed by air traffic noise from nearby Sembawang Air Base.

Table 6.22 Summary of baseline noise monitoring results for construction noise impact assessment

Location	Monitoring Date	$L_{Aeq(12\ hrs)}$, dB(A)		$L_{Aeq(1\ hr)}$, dB(A)						$L_{Aeq(5\ mins)}$, dB(A)								
		7am – 7pm	7pm – 7am	7pm – 10pm			10pm – 7am			7am – 7pm			7pm – 10pm			10pm – 7am		
				Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
Overall (Monday – Sunday/ Public Holiday) – applicable to Ecological Receptors																		
NM01: Green Area within Sembawang N5	08 August – 15 August 2023	54	44	43	55	45	41	46	44	42	78	50	41	61	45	40	51	43
Note: Noise levels indicated in **Bold** exceeds the most-stringent NEA construction noise criteria.																		

6.6.2.1.1 Construction Noise Criteria

The airborne noise impacts on the ecological receptors are species dependent. Faunal species which are noise sensitive are those that use noise for their communication or navigation, at certain times of the day. Noise from construction works happening during these time periods where fauna is “active” can interfere their day-to-day activities. As such, the impact assessment would be based on the species identified during faunal surveys conducted within the airborne noise study area (as mentioned in Section 6.4.2 of this Report).

In general, construction noise impacts on human receptors are compared against the stipulated limits as per Singapore Environmental Protection and Management (Control of Noise at Construction Sites) Regulations, 2008 [R-24]. However, it is to be noted that this existing criteria for humans cannot be applied to fauna species as the noise impact from construction activities are more pronounced on the fauna and can have a direct impact on their habitat (place of living). Further, due to the absence of adequate research data on criterions applicable for the assessment of construction noise impacts on ecological receptors, with no current existing established guidelines or standards, a more stringent criterion of no-worse off than the average baseline was adopted for the purpose of assessment in this EIA.

This approach was taken as part of a conservative means that if no noise exceedances is predicted when compared to these stringent criteria, the airborne noise impact on the fauna in the vicinity of the proposed development will also not experience noise levels exceeding the existing baseline conditions, i.e., their current living conditions are not disturbed significantly.

Table 6.23 Noise criteria established for Ecological Receptors

Ecological receptor study area	$L_{Aeq\ (12\ hrs)}$, dB(A)		$L_{Aeq\ (1\ hr)}$, dB(A)		$L_{Aeq\ (5\ mins)}$, dB(A)		
	7am – 7pm	7pm – 7am	7pm – 10pm	10pm – 7am	7am – 7pm	7pm – 10pm	10pm – 7am
Overall (Monday – Sunday/ Public Holiday)							
Green Area within Sembawang N5	54	44	45	44	50	45	43

6.6.2.2 Operational Phase

The overall baseline airborne noise monitoring results recorded at NM01 for $L_{Aeq(15\ mins)}$ is summarised in Table 6.24 below in accordance with the local noise guidelines for the operational phase. Please refer to Appendix S for the Baseline Airborne Noise Monitoring Report detailing the daily recorded noise levels.

It should be noted that the recorded $L_{Aeq(15\ mins)}$ noise levels for the operational phase are only indicative at this stage as baseline noise levels captured are not aligned with the requirements for operational noise impact assessment outline in the ACMV Guidelines, 2018 [R-25] and TNIA Guidelines, 2023 [R-26], due to the lack of information on building boundaries, building type, detailed information traffic volume of new/ existing traffic networks associated with the proposed developments of this Project.

Hence, to meet requirements mandated by law, AECOM recommends that HDB/ the contractor contracted by HDB appoint a Noise Consultant(s) upon finalising of design plans at the detailed design stage to determine the appropriate baseline noise levels for the operational phase in accordance with the respective NEA guidelines.

Table 6.24 Summary of baseline noise monitoring results for operational noise impact assessment

Location	Monitoring Date	$L_{Aeq(15\ mins)}$, dB(A)								
		Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
Overall (Monday – Sunday/ Public Holiday) – applicable to Ecological Receptors										
NM01: Green Area within Sembawang N5	08 August – 15 August 2023	41	60	47	42	58	45	40	49	43

7 Prediction and Evaluation of Impacts During Construction Phase

7.1 Potential Sources of Impact

7.1.1 Impacts on Biodiversity

Within the biodiversity Study Area N4 Forested Area will be cleared entirely while N5 Forested Area development is not included in this Study. Loss of vegetation to habitats, mortality in plant species and the loss of/ reduction in habitats and food sources of faunal species are direct impacts that will occur in N4 Forested Area (approximately 6.61 ha) during the construction phase.

While faunal species remains to be assessed, the impacts during construction phase were separately assessed for habitats and floral and detailed in Section 7.4. There are two main categories in which the impacts fall into, namely, (1) direct, i.e., impacts to habitats and species within the worksites; and (2) indirect, i.e., impacts to habitats and species outside the worksites but within the impact zone. **Impact zones** for habitat and species receptors are defined as areas within 30 m from worksites of the proposed development (Figure 7.1.1).

Already demolished

Admiralty Rd W

Canberra Rd

Ottawa Rd

Montreal Dr

250 M

Legend

Habitat Receptors

- Abandoned-land forest
- Exotic-dominated secondary forest
- Scrubland
- Grassland
- Urban vegetation (Turf)
- Semi-naturalised drain
- Infrastructure

Flora Receptors

- Large Plant Specimen
- Other Plant Specimen of Value (< 3 m girth)
- CS Plant Specimen
- Project site
- Biodiversity Study Area
- 30 m Buffer

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	IT	Final Report	SAG	JAG
-	JUL 2024	IT	Final Report	SAG	JAG
1	JUN 2024	IT	Draft Final Report	SAG	JAG
--	MAY 2024	IT	Draft Final Report		JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Habitats and flora species receptors within 30 m from the proposed worksite in Sembawang N4 Study Area

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
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	Drawn IT	Date AUG 2024	CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

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The impacts are summarised in Table 7.1.

Table 7.1 Potential impacts on biodiversity from construction phase

Receptor	Impact type	Description	Impact category
Construction phase			
Habitat	Loss of habitats	Terrestrial habitat Direct removal of vegetation (with extensive underground root systems that protect against soil erosion) to create space for construction activities Aquatic habitat Changes in waterbody due to canalisation and diversion activities, and/ or changes in hydrology.	Direct
	Habitat degradation	Terrestrial habitat Improper disposal of construction waste, accidental release of hazardous materials (such as construction slurry, paint, and/or solvents) Aquatic habitat Changes in surface water quality	Indirect
Flora species	Mortality	Direct removal of vegetation to create space for construction activities	Direct
	Decline in plant health and survival	Changes in microclimatic conditions (i.e., dust, noise, and light, temperature, and humidity) and hydrology or surface water quality	Indirect
Faunal species	Loss of/reduction in habitats and food sources	Terrestrial habitat Direct removal of vegetation, nests or roost sites to create space for construction activities Aquatic habitat Changes in waterbody due to canalisation and diversion activities, and/or changes in hydrology.	Direct
	Accidental injury or mortality	Collisions with machinery, entrapments in construction materials (such as non-biodegradable erosion control blankets) and structures (such as exposed pits or drains), and accidental kills by construction personnel, including roadkills.	Direct
	Human-wildlife conflict	Negative consequences of human-wildlife interactions, such as deliberate killing and depopulation of faunal species perceived as nuisances or threats by construction personnel	Indirect
	Loss/reduction of ecological connectivity for faunal movement (within site)	Terrestrial habitat Habitat fragmentation from the removal of vegetation Aquatic habitat Changes that impede connectivity of waterbody	Indirect
	Light disturbances	Increase in light levels from construction activities	Indirect
	Human disturbances	Increase in human traffic flow, such as workers and site personnel	Indirect

7.1.2 Impacts on Biodiversity due to Changes in other Environmental Parameters

The list of potential impacts on biodiversity during construction phase of the Project due to changes in baseline hydrology, surface water quality and airborne noise is summarised in Table 7.2.

Table 7.2 Potential impacts on biodiversity during construction phase

Environmental Parameter	Potential Source(s) of Impacts	Potential Associated Impact on Environmental Parameter	Potential Associated Impacts on Ecological Receptors
Water Resources (Hydrology)	Temporary or permanent land use change with more impervious surfaces due to: • Site clearance (e.g. clearance of vegetation and trees within Project site not designated to be preserved, demolition of existing structures within and in the vicinity of Project site) • Earthworks, including site levelling and excavation works • Construction of temporary and permanent structures and infrastructure	• Altered surface water runoff velocity and peak flow • Altered water inflow distribution along the watercourses • Reduced seepage into soil, potentially disturbing current hydrological cycle of the site • Stormwater runoff from exposed and unstable slopes may cause soil erosion and accretion, potentially forming obstructions along the watercourses	• Disturbances in aquatic habitats due to altered dry and wet weather conditions • Localised flooding may have adverse impacts on surrounding terrestrial habitats
	Groundwater extraction/ soil dewatering during construction phase activities that require dry soil conditions such as foundation works	Reduction in groundwater baseflow feeding into the watercourses	Disturbances in aquatic habitats due to altered dry and wet weather conditions
Water Resources (Surface Water Quality)	• Discharge of potentially contaminated surface water runoff originating from exposed soil during site clearance and earthworks • Discharge of potentially contaminated stormwater and/ or groundwater pumped out from excavated areas • Discharge of construction wastewater, grouting and cement materials • Seepage of contaminants from excavated contaminated soil (if encountered) into the underlying soil and groundwater • Discharge of contaminants due to improper handling, transfer, storage and disposal of solid waste	• Elevated levels of suspended solids (e.g. silt) in receiving watercourses • Increased quantity of solid waste and contaminated material in receiving watercourses • Increase in the levels of oil, grease and other chemical substances in receiving watercourses	• Changes in surface water quality could have adverse impacts on aquatic habitats and species • Some contaminants, such as metals can accumulate in the root zone, affecting vegetation growth and long-term viability • Contamination may spread to downstream watercourses, affecting downstream habitats

Environmental Parameter	Potential Source(s) of Impacts	Potential Associated Impact on Environmental Parameter	Potential Associated Impacts on Ecological Receptors
	and chemical substances (e.g. construction debris) • Accidental spills and leaks of chemical substances used for construction phase activities, including the fuel and lubricants spillage from maintenance of construction vehicles and mechanical equipment • Seepage of contaminants due to inappropriate discharge of domestic sewage and poor maintenance of the portable chemical toilets, storage tanks and septic tanks		
Airborne Noise	Noise from trucks transporting spoil / equipment.	Potential for increase in ambient noise levels of the N5 Forested Area, due to long term continuous construction activity from the Project.	Potential for terrestrial transects to alter their natural behaviours or relocate to avoid unfamiliar noises caused by construction works in their habitats.
	Noise from traffic congestion caused due to inadequate lane compensation and traffic diversion during construction.		
	Noise generated by the use of Powered Mechanical Equipment (PME), (such as excavators, generators, pumps, cranes, etc.,) for various construction activities within the site, including construction of holding areas, site offices and road widening works.		

7.2 Identification of Sensitive Receptors

7.2.1 Habitats

All habitats within the N4 Forested Area and its 30 m impact zone were identified as the sensitive receptors for habitats (Figure 7.1.1). There are four different habitat types within the N4 Forested Area; namely exotic-dominated secondary forest, scrubland, grassland, and a semi-naturalised drain, Within the aforementioned impact zone, there are five different habitat types; namely abandoned-land forest, exotic-dominated land forest, scrubland, grassland and urban vegetation (turf) which occur in N5 Forested Area.

7.2.2 Flora

A total of 24 species were selected for the assessment of ecological impacts; There are 17 species which occur only in N5 Forested Area, seven species occur in N4 Forested Area and four species occurring in both N4 And N5 Forested Area. The selection was based on the following: (1) Priority 1 species of conservation significance, large specimens, other specimens of value and/or common native trees that had their ecological value raised in

Section 6.4.4.2 which occur inside the worksites or 30 m from worksite, (2) Priority 1 conservation significance species that make up ⩽1% of the total conservation significance specimen count, (3) Priority 1 keystone species that are of conservation significance and/or are considered as large specimens (i.e., *Ficus* species), and (4) species that are associated with important fauna.

7.2.3 Fauna

Following the assessment of ecological value of faunal species in Section 6.4.4.3, all species with a Priority 1 ecological value will be identified as sensitive receptors. Species of conservation significance deemed of probable occurrence will also be identified as sensitive receptors with the only exception being the unidentified bamboo bat (*Tylonycteris* spp.). As species-level identification was not possible, both bamboo bat species (*Tylonycteris fulvida* and *T. malayana*) in Singapore were identified as sensitive receptors instead, as both species are threatened, and were deemed of probable occurrence. In addition, smooth-coated otter (*Lutrogale perspicillata*) was identified as a sensitive receptor for the record of unidentified *Mustelidae*. A total of 75 sensitive receptors were identified in the biodiversity Study Area, of which 14 were recorded from the field assessment, and the remaining were deemed of probable occurrence. Breaking down the sensitive receptors by taxon, there are five aculeate hymenopterans, 21 butterflies, one odonate, two reptiles, 39 birds, three non-volant mammals, four bats and one freshwater fish.

7.3 Minimum Control Measures

This section proposes minimum controls or standard practices commonly implemented in Singapore for the purposes of impact assessment during construction phase.

7.3.1 Biodiversity

This section lists biodiversity-specific minimum control measures that are commonly implemented in Singapore for construction activities. These are assumed to be implemented for the purpose of the impact assessment and should be proposed in tandem with the measures proposed for other environmental receptors (e.g., hydrology, noise). Minimum controls for each potential impact occurring from the construction phase is listed in Table 7.3. The main construction activities that would likely occur at all worksites include vegetation clearance and excavation, followed by below and above ground construction.

Table 7.3 Minimum control measures for the construction phase

Work activities	Minimum controls for construction phase
General	• Installation of hoarding to delineate worksite • Execute wildlife response plan when a trapped/ injured/ dead/ dangerous animal is encountered around or within the worksite according to Section 10 of the Wildlife Act • Avoid fogging by implementing preventive measures for mosquito to remove sources of stagnant water or water-bearing receptacles, e.g., providing well-maintained pitched roofs, clearing discarded items daily, storing materials appropriately, leveling up ground depression/ uneven surfaces, ensuring effective drainage flow • Daily checks by Environmental Control Officer on site for trapped fauna and roadkill.
Vegetation Clearance	• Set up Tree Protection Zones (TPZs) around trees or other plant specimens to be retained within the worksites, if any, within which no construction works are allowed. This should be executed by certified arborists and in accordance with NParks' guidelines (NParks, 2019) • Before vegetation clearance, pre-felling fauna inspection should be conducted by an Ecologist who is able to identify wildlife or nesting structures that are being actively used such as bird nests, tree hollows, burrows, and bamboos clusters; in compliance with Section 10 Wildlife Act • Soil erosion control measures (e.g. implementation of biodegradable erosion control blankets, ECM tanks etc) are to be executed once vegetation has been removed and soil is exposed as described in Section 7.3.2 under Water Resources
Excavation	• Implement soil erosion control measures as described in Section 7.3.2 under Water Resources • Implement dust control measures • Implement noise barrier as described in Section 7.3.3 under Airborne Noise.

Work activities	Minimum controls for construction phase
Below and Above Ground Construction	Proper storage of materials that are likely to leech harmful chemicals and fuel-powered equipment away from waterbodies or sensitive habitats as described in Section 7.3.1.

7.3.2 Water Resources

Table 7.4 has a non-exhaustive list of minimum controls for potential impacts on hydrology and surface water quality (as identified in Section 7.1.2 of this Report) which is based on local regulation and common practices.

Table 7.4 Minimum control measures during construction phase applicable for water resources

Potentially Affected Environmental Parameter	Potential Source(s) of Impact	Minimum Control Measures
Water Resources (Hydrology)	Temporary or permanent land use change during construction phase activities such as site clearance. Temporary or permanent land use change due to earthworks, including site levelling and excavation works. Temporary or permanent land use change due to construction of temporary and permanent structures and accompanying infrastructure.	• The drainage diversion for the watercourse affected by this development, Stream D2 within N4 Forested Area, will be installed before any construction phase begins. • Ensure continual free flow in the existing drain D2 until the permanent diversion drain is operational. • The Contractor must not fill or interfere with the existing drains without prior approval from PUB. • Obtain PUB's approval for any diversion of existing drains and canals before beginning the diversion work. • Design adequate drainage in accordance with PUB COP to effectively manage runoff from within, upstream of, and adjacent to the work site. The proposed system must not cause flooding nearby. • Conduct regular maintenance of stormwater and drainage systems to prevent channel blockages and consequent flooding. • Include geotechnical aspects of site slope stability, such as Earth Retaining Stabilizing Structure (ERSS), in the detailed engineering design for the construction phase. • The design engineers must propose ERSS when the site is clear and excavated. Simultaneously, the Environmental Control Officer (ECO) must ensure successful implementation of these measures during construction. • Implement a phased Excavation, Cut and Fill, and Earthmoving plan to minimize the area disturbed at any given time, reducing erosion and topsoil loss. • Develop water recycling systems on-site to minimize discharge from the construction site into the surface water drainage system. • Establish temporary routes for heavy vehicles/machinery to lessen soil compaction and soil permeability as much as possible. • Formulate a detailed emergency evacuation plan for potential flash floods on-site, including the development of an early warning system where applicable. • Install pumping stations to remove excess water accumulated within the site after heavy rainfall events. • Implement a construction Environmental Management and Monitoring Plan (EMMP) and ensure complete

Potentially Affected Environmental Parameter	Potential Source(s) of Impact	Minimum Control Measures
		preparation of associated plans and procedures.
	Groundwater extraction/ soil dewatering during construction activities which require dry soil conditions.	• Soil dewatering will be planned in phases to prevent the generation of large quantities of water discharged into receiving watercourses. This phased approach will also decrease groundwater drawdown and minimize the reduction of baseflow feeding the stream. • The Contractor must install piezometers to monitor changes in groundwater level, as required by Building Control Regulations 2003. This installation must be part of the instrumentation and monitoring plan, endorsed by a Qualified Professional (QP). • Appropriate Earth Retaining Stabilizing Structures (ERSS) will be carefully selected and designed to control groundwater settlement. • Implementation of a construction Environmental Management and Monitoring Plan (EMMP) is essential, ensuring thorough preparation of associated plans and procedures.
Water Resources (Surface Water Quality)	Discharge of potentially contaminated surface water runoff originating from exposed soil containing elevated levels of suspended solids.	• The planning, design, and submission of Earth Control Measures (ECM) plans to PUB will be handled by a Qualified Erosion Control Professional. This includes the installation, maintenance, monitoring, reporting, provision of erosion control blankets, CCTV at discharge points, Siltation and Erosion Control Measures (SIDS), sedimentation tanks, to comply with PUB's COP on Surface Water Drainage. • The Contractor must synchronize earthworks with ECM provision. Progress of earthworks will be carefully regulated to avoid exposing more areas than the proposed ECM can manage. • Biodegradable erosion blankets must be promptly provided to areas with bare soil surfaces on the same day of soil exposure. • Demolition and earthworks scheduling will be organized to minimize the quantity of stockpiles stored on-site. • ECM tanks/ponds will be designed with sufficient capacity to contain turbid stormwater before treatment at the ECM facility. • Contractors must ensure proper operation and maintenance of their CCTV system at all times in line with PUB's circular on Preventing Muddy Waters from Construction Sites. This measure aims to prevent deliberate tampering with the CCTV system to disguise silty discharge. • Effective implementation of ECM and monitoring will adhere to the Code of Practice on Surface Water Drainage to ensure that discharge into the stormwater drainage system does not exceed prescribed limits for Total Suspended Solids (TSS) under the Sewerage and Drainage (Surface Water Drainage) Regulations. • A Sediment Control Plan will be formulated, including measures such as sealing site hoarding and installing berms along the site hoarding, to prevent silty water from leaking out and accumulating at the site entrance. • Topsoil removed will be stockpiled in a designated area and adequately covered to prevent soil loss from secondary erosion. Conserved soil can be used for backfilling, while excess soil material must be stored

Potentially Affected Environmental Parameter	Potential Source(s) of Impact	Minimum Control Measures
		properly for potential reuse. • Approved materials of the same or superior quality as the surrounding area will be used for backfilling works. All backfilled material will be free of debris and of good soil quality. • Where feasible, clean water flow will be segregated from silty water flow to maximize sedimentation tank holding capacity. • Manholes will always be adequately covered and temporarily sealed. • Implementation of a construction Environmental Management and Monitoring Plan (EMMP) and thorough preparation of associated plans and procedures will be ensured.
Water Resources (Surface Water Quality)	Discharge of liquid waste, including construction wastewater	• Finalise a complete inventory of all anticipated wastewater streams and volumes before the onset of construction phase works. • Maintain daily records of wastewater volume, as well as the volumes of sludge and other produced onsite. • Ensure containment ponds are made of impervious material and designed with sufficient capacity to hold the volumes of wastewater produced on site, accounting for stormwater runoff and firefighting needs as well. • Provide temporary storage volumes for overflow situations of untreated wastewater. This temporary storage should have sufficient capacity to capture any unexpected additional volumes, ensuring that untreated wastewater is not released to watercourses unless it complies with NEA guidelines on trade effluent discharge concentrations. • Equip containment ponds, as well as wastewater generating areas on site with spill clean-up kits. • Design adequate drainage systems, including cut-off drains, sump pit, road kerb, piping and toe walls to channel construction process wastewater streams (e.g. wash water) and stormwater runoff separately through detailed design to capture and treatment in the containment pond(s)/ kerb(s). Where applicable, include oil-water separators. • Seek approval from relevant authorities (i.e. PUB and NEA) in accordance with PUB Sewerage and Drainage (Trade Effluent) Regulations, if the wastewater is planned to be disposed to public sewer, or NEA's Trade Effluent Discharge Limits to watercourse if disposal to surface watercourses is intended. If such discharges are not approved, the trade effluent will be stored, treated or recycled on site and finally disposed off-site. • Obtain comments and approval from relevant authorities (e.g., Singapore Civil Defence Force [SCDF] and NEA) for the use of treated wastewater for firefighting purposes. • Provide appropriate concrete washout areas, ensuring these are not located near watercourses. • All vehicles are to undergo a wheel washing process before leaving the site to prevent earth, mud, and debris from being disposed of on surrounding roads. The wastewater generated from this activity should be

Potentially Affected Environmental Parameter	Potential Source(s) of Impact	Minimum Control Measures
		stored and removed for treatment and disposal offsite by an approved Waste Management Contractor. • Establish regular and dedicated procedures for the inspection and maintenance of wastewater collection, storage, and treatment infrastructure (e.g., pipes, oil-water separators). • Implement regular and dedicated procedures for the management of stormwater collection, settling, testing, and eventual discharge to watercourses. • Develop a training program for all onsite workers, including subcontractors, to educate them on their obligations regarding proper water quality management. • Prohibit the discharge of pumped groundwater from soil dewatering and other wastewaters into aquatic habitats. • Prohibit the unmanaged discharge of any wastewater stream. • No trade effluent other than the nature or type approved by the NEA Director-General will be discharged into any watercourse or soil. • Apply the principles of reduce, reuse, and recycle to wastewater management onsite. • Store hazardous wastewater, such as oil water, thinners, solvents, or paints, on a hard stand under shelter with a curb around the storage area. Ensure this wastewater is removed for treatment and disposed of offsite by an approved Waste Management Contractor. Handle hazardous liquids as Hazardous Waste. • Implement a construction Environmental Management and Monitoring Plan (EMMP) and ensure full preparation of associated plans and procedures.
Water Resources (Surface Water Quality)	Seepage and leakage of contaminants from solid waste generated, handled, and stored on site.	• Provide an adequate number of enclosed bins. • Ensure waste disposal facilities are cleared up as often as necessary to prevent buildup. Conduct housekeeping checks at least once a day to ensure all litter is cleared from the site. • Develop a Standard Operating Procedure (SOP) for the safe handling, transfer, storage, and disposal of solid waste. • Conduct appropriate tests to ascertain the presence or absence of contamination in excavated soil. • Ensure appropriate disposal of any waste listed in the Environmental Public Health (General Waste Collection) Regulations by a licensed waste operator. • Implement the construction Environmental Management and Monitoring Plan (EMMP) and ensure complete preparation of associated plans and procedures.
Water Resources (Surface Water Quality)	Seepage of contaminants due to inappropriate discharge of domestic sewage and poor maintenance of portable chemical toilets, storage tanks, and septic tanks.	• Provide a sufficient number of proper sanitary facilities and ensure their maintenance. It is recommended to have one portable toilet per 10 individuals, serviced three times per week by NEA's Licensed Waste Collector (LWC) for regular sewage disposal. • Ensure toilet facilities are appropriately located away from any nearby watercourses. • If on-site dormitories are present, it is advised to install

Potentially Affected Environmental Parameter	Potential Source(s) of Impact	Minimum Control Measures
		container toilets and obtain written approval from PUB to connect them to public sewers. • Establish a regular maintenance schedule to check and maintain the cleanliness and functionality of sanitary facilities on site, at least once a week, depending on the number of facilities. • Conduct inspections and audits to assess the hygienic conditions on site. • Implement the construction Environmental Management and Monitoring Plan (EMMP) and ensure complete preparation of associated plans and procedures.
Water Resources (Surface Water Quality)	Seepage and leakage of contaminants from toxic waste generated, handled, and stored on site.	• Conduct leak detection tests periodically on toxic waste storage containers. • Store toxic waste and hazardous substances on a hard stand, under shelter with a kerb around the storage area. • Provide spill trays for all waste containers and regularly maintain them to prevent rain from washing out pollutive substances. • Ensure appropriate disposal of toxic waste in accordance with the Environmental Public Health (Toxic Industrial Waste) Regulations by a Licensed Waste Operator/Collector. • Establish a consignment notification/tracking system and a transport emergency response plan for the transportation of toxic waste. • Develop a Standard Operating Procedure (SOP) for the safe handling, transfer, and storage of toxic waste; conduct housekeeping checks at least once a day to ensure all toxic waste is cleared from the site. • Implement the construction Environmental Management and Monitoring Plan (EMMP) and ensure complete preparation of associated plans and procedures.
Water Resources (Surface Water Quality)	Direct or indirect (e.g. via seepage into soil and groundwater) contamination of watercourses originating from chemicals used and/ or stored on site.	• Remove any hazardous substances or chemicals if safer alternatives are available. • Ensure chemical storage areas are adequate, located on paved ground, bunded, sheltered with adequate ventilation, and positioned away from waterways and drains. Safety Data Sheets (SDS) must be kept together with the stored chemicals. • The storage area must have a volume of 110% of the largest volume of chemical substances to be stored. • Utilize secondary containment with a capacity of more than 10% volume for single large containers and 25% of the total volume for multiple containers for all chemical stores and diesel generators to minimize spillages and soil and surface water contamination as per requirements in COPPC/SS593. Take caution around watercourses to prevent leaks of toxic chemicals such as petrol, diesel, oil, paint, and thinner from equipment. • Include oil-water separators in the proposed infrastructure for separate channelling of construction wastewater streams and stormwater runoff to capture inadvertent spills or leaked oils or greases, particularly in the vicinity of liquid storage or refuelling areas. • Immediately maintain or remove off-site any

Potentially Affected Environmental Parameter	Potential Source(s) of Impact	Minimum Control Measures
		construction equipment causing pollution to the water system due to oil or fuel leakage. • Conduct all activities involving repair, servicing, engine overhaul works, etc., in appropriately contained areas (e.g., concreted area with proper containment), and channel all wastes for proper treatment or disposal to meet regulations. • Prepare an emergency response plan, train the Emergency Response Team (ERT) to be competent in the response mechanism, and provide response kits for any spillages. • Implement good housekeeping practices to minimize careless spillage and maintain storage and workspace cleanliness. Assign a responsible person (e.g., ECO) to oversee the efficient operation of containment ponds/kerbs, adhering to good housekeeping practices. Regularly check containment ponds/kerbs at least daily to ensure proper functionality. Provide appropriate training, including safety codes and relevant manuals, to personnel handling chemicals on site. • Implement the construction Environmental Management and Monitoring Plan (EMMP) and ensure complete preparation of associated plans and procedures.

7.3.3 Airborne Noise

The list below is non-exhaustive and should be practised as minimum control to reduce noise levels during the construction phase of the Project. It should be noted that since the impact assessment was limited only to ecological receptors, minimum controls have been listed based on impacts to biodiversity only.

- Label all machinery and equipment with a weather-proof sticker clearly indicating its noise emission level (at source) under normal operating conditions.
- All machinery and equipment used onsite are sound-reduced as much as practicable.
- House stationary noisy equipment in enclosures onsite where necessary.
- Train and brief machine operators and workers on quieter work techniques.
- Conduct ad-hoc noise monitoring during noisy operations as work progresses.
- Erect noise barriers to minimise noise pollution affecting biodiversity within the biodiversity Study Area.
- Limit construction works involving noisy machinery to daylight hours, from 8 am to 6 pm and minimise noisy construction activities during night works period.
- Implement additional noise measures when noise monitoring indicates that levels are approaching or exceeding permissible limits.
- Avoid shouting, whistling, sirens, or similar loud intermittent noises, especially in construction zones near ecologically sensitive receptors (e.g., N5 Forested Area), which can be impacted by such disturbances.

7.4 Impacts on Biodiversity

Identified biodiversity sensitive receptors were evaluated based on impact intensity and likelihood, which eventually gives the impact significance. The impact intensity and likelihood of each impact type during

construction phase are defined for habitats (Table 7.5 and Table 7.6), flora species (Table 7.7 and Table 7.8) and fauna species (Table 7.9 and Table 7.10) receptors below.

Three assumptions made in defining the levels of impact intensity and likelihood during the construction phase are:

- Habitats and plant species within 30 m from the worksites are assumed to experience the greatest extent of indirect effects.
- The likelihood of habit degradation (i.e., improper disposal of construction waste, accidental release of hazardous materials [such as construction slurry, paint, and/ or solvents], increase in dust, noise, and light levels, changes in forest hydrology; refer to Table 7.1) is presumed to be **'Unlikely'** for all habitat receptors, based on the assumption that all minimum controls (Section 7.3.1) are adequately and properly implemented.
- Other factors that will most likely cause habitat degradation (e.g., excessive water surface runoff during monsoon reasons, littering from construction staff, lack of general compliance by contractors) were also considered in this assumption.

Table 7.5 Definitions of each level of impact intensity for impact types during construction for habitat receptors

Impact Type	Negligible	Low	Medium	High
Loss of habitat	The habitat does not overlap with the worksites	≤ 10% of the habitat overlaps with the worksites	10–40% of the habitat overlaps with the worksites	> 40% of the habitat overlaps with the worksites
Habitat degradation	Terrestrial habitat The habitat type does not overlap with areas 30 m from the worksites Aquatic habitat No change in surface water quality	Terrestrial habitat ≤ 10% of the habitat type overlaps with areas 30 m from the worksites Aquatic habitat Some changes in surface water quality	Terrestrial habitat 10–40% of the habitat type overlaps with areas 30 m from the worksites Aquatic habitat Considerable changes in surface water quality	Terrestrial habitat > 40% of the habitat type overlaps with areas 30 m from the worksites Aquatic habitat Extensive changes in surface water quality

Table 7.6 Definitions of each level of likelihood for all impact types during construction for habitat receptors

Likelihood	Loss of habitat	Habitat degradation
Unlikely/Remote	The habitat does not overlap with the worksites	N.A.
Less Likely/ Rare	N.A.	N.A. (see assumption above)
Possible/ Occasional	N.A.	N.A.
Likely/ Regular	N.A.	N.A.
Almost Certain/ Continuous	The habitat overlaps with the worksites	N.A.

Table 7.7 Definitions of each level of impact intensity for impact types during construction for plant species receptors

Impact Type	Negligible	Low	Medium	High
Mortality **Decline in plant health and survival**	No plant specimens of this species are within the worksites	Less than 50% of all plant specimens of this species are within the worksites	More than or exactly 50% of all plant specimens of this species are within the worksites	All plant specimens of this species are within the worksites

Table 7.8 Definitions of each level of likelihood for impact types during construction for plant species receptors

Likelihood	Mortality	Decline in plant health and survival
Unlikely/Remote	No plant specimens of this species are within the worksites	No formation of forest edges (i.e., construction activities are fully underground and/or in existing built-up areas outside the mangrove or forest) that changes the existing microclimate conditions
Less Likely/ Rare	Plants specimens of this species located in the worksite is less likely to be inflicted with mechanical injuries during construction	Formation of scrubland edges in scrubland areas only.
Possible/ Occasional	No count data and/or locations of specimens of this species is available, but specimens could possibly be within the worksites or	Formation of some forest and scrubland edges in urban vegetation, scrubland and/or mangrove/forested areas.
Likely/ Regular	N.A.	N.A.
Almost Certain/ Continuous	Plant specimens of this species located within the worksite are cleared	Formation of new forest edges (i.e., complete clearance within mangrove/forested areas) or

Table 7.9 Definitions of level of impact intensity for all impact types during construction for faunal species receptors

Impact type	Negligible	Low	Medium	High
Loss of/reduction in habitats and food sources	No loss of habitat, raptor nests, or roosts	Loss of <10% of habitat, or roosts	Loss of 10–40% of habitat, or roosts	Loss of >40% of habitat or roosts; loss of any raptor nests
Accidental injury or mortality	Species with negligible susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc,) and roadkills	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills: – Volant species (e.g., odonates, butterflies, highly volant birds, most bats) – Aquatic species (most fishes, crabs, shrimps)	Species that are mobile but possibly susceptible to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills: – Less volant birds – All amphibians –Some mammals (e.g., squirrels, shrews)	Species with high susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills: – Reptiles – Some mammals (e.g., Sunda pangolin, long-tailed macaque, smooth-coated otter)
Human-wildlife conflict	Species that are not perceived as nuisances or threats by construction personnel: – Odonates – Butterflies – Most birds – Aquatic species	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments: – Some reptiles – Most amphibians – Most bats	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict: – Smooth-coated otter – Aculeate hymenopterans	Species that are typically perceived as both nuisances and threats by construction personnel, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict: – Long-tailed macaque – Some snakes

Impact type	Negligible	Low	Medium	High
Loss of/reduction in of ecological connectivity for faunal movement (within site)	Terrestrial habitat Not dependent on connected habitats for dispersal and able to traverse urban infrastructure Aquatic habitat No change to waterbody	Terrestrial habitat Slightly dependent on connected habitats for dispersal and adaptable to traverse urban infrastructures if needed Aquatic habitat Minimal changes in waterbody that may affect connectivity for aquatic species	Terrestrial habitat Dependent on connected habitats for dispersal Aquatic habitat Some changes in waterbody that may affect connectivity for aquatic species	Terrestrial habitat Highly dependent on connected habitats for dispersal Aquatic habitat Considerable changes in waterbody that may affect connectivity for aquatic species
Light disturbances	Species that are not sensitive to changes in light levels: aculeate hymenopterans, most aquatic and marine species	Species that are slightly sensitive to changes in light levels: odonates, butterflies	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds
Human disturbances	Species that are not sensitive to human presence	Species that are slightly sensitive to human presence	Species that are sensitive to human presence	Species that are extremely sensitive to human presence, and nesting birds

Table 7.10 Definitions of each level of likelihood for all six impact types during construction for faunal species receptors

Likelihood	Loss of/ reduction in habitats and food sources	Accidental injury or mortality	Human-wildlife conflict	Loss of/ reduction in ecological connectivity for faunal movement	Light disturbances	Human disturbances
Unlikely/ Remote	Impact is not expected to happen during the construction phase of the project					
Less Likely/ Rare	Impact is not likely to happen during the construction phase of the project					
Possible/ Occasional	Impact could possibly happen or known to occur during the construction phase of the project					
Likely/ Regular	Impact is a common occurrence during the construction phase of the project					
Almost Certain/ Continuous	Impact is a continual or repeated process during the construction phase of the project					

7.4.1 Habitats

Two construction phase impacts were identified and assessed for the habitat receptors: loss of habitat and habitat degradation. Impact significance was assessed for the habitat receptors identified in Section 7.2.1. A summary of biodiversity habitat receptors impacted during construction phase is shown in Table 7.11. Detailed evaluation of each habitat types is provided in Appendix L.

Loss of habitats

There are four habitat types that will be impacted due to the clearance of N4 Forested Area, while N5 Forested Area development is not included in this Study. For this reason, only habitat types within N4 Forested Area were assessed for loss of habitat. Approximately, 4.25 ha (44.6%) of exotic-dominated secondary forest, 0.68 ha

(47.9%) of grassland, 1.76 ha (21%) of scrubland, and 100% of the semi-naturalised drain in N4 will be subjected to total land clearance. Based on the area of habitat loss, the likelihood is deemed as Certain, hence the resulting impact significance is **Major** for all habitat types within N4 Forested Area (Table 7.11).

Habitat degradation

Once N4 Forested Area has been cleared, only a small portion (30 m from worksite) of N5 Forested Area will be subjected to habitat degradation. The five remaining affected habitat types in the 30 m impact zone from worksite are listed in Table 7.11 below. Improper disposal of construction waste or the accidental release of hazardous materials into the habitat types assessed is Less Likely due to the existing 'setback' provided by Canberra Road. In addition, the practice of minimum control measures reduces the likelihood of habitat degradation which renders the impact significance **Negligible**.

Table 7.11 Impact significance of biodiversity habitat receptors affected during the construction phase

Impact type	Impact Significance			
	Major	Moderate	Minor	Negligible
Loss of vegetation	• Exotic-dominated secondary forest • Grassland • Scrubland • Semi-naturalised drain	-	-	-
Habitat degradation	-	-	-	• Abandoned-land forest • Exotic-dominated secondary forest • Grassland • Scrubland • Urban vegetation

7.4.2 Flora

Two construction phase impacts were identified and assessed for the flora receptors: mortality and decline in plant health and survival. Impact significance was assessed for the flora receptors identified in Section 7.2.2. A summary of biodiversity flora receptors impacted during construction phase is shown in Table 7.12. The detailed evaluation for each species is provided in Appendix L.

Mortality

Out of the 24 flora species receptors identified, a total of seven species occurring within the N4 Forested Area will be impacted by mortality. The remaining 17 species only occur in N5 Forested Area and hence will not be impacted by mortality. The significance of the impacts was assessed to be **Major** for four species, **Moderate** for three species, and **Negligible** for 17 species.

Four species will experience **Major** impacts owing to mortality (i.e., *Calophyllum inophyllum*, *Cyperus compressus*, *Tectaria* cf. *semipinnata* and *Trema tomentosum*). These species are expected to be cleared from site as it is located within the development footprint, resulting in High impact intensity. As the likelihood is Certain for site clearance, the resulting impact significance is therefore **Major**.

Three flora species will experience Moderate impacts owing to mortality. This includes large keystone specimen (i.e., *Ficus benjamina*, *Ficus microcarpa*) and *Macaranga griffithiana*. All these species were assessed as Low impact intensity as less than 50% of the specimens will be impacted by the proposed developments. However, since these specimens lie within the construction footprint, it is Certain (likelihood) that they would be cleared. Hence, the impact significance is **Moderate**.

The remaining 17 species in N5 Forested Area were accorded a Negligible impact significance as none of the specimens will be directly affected by land clearance.

Decline in plant health and survival

Out of the 24 flora species receptors identified, a total of 21 species occurring within the N5 Forested Area and 30 m from worksite were assessed for this impact type. The assessment of decline in plant health and survival is not applicable for the remaining seven species as they are expected to be cleared (i.e., subjected to mortality impact).

The presence of the existing Canberra Road reduces the likelihood that changes in microclimatic conditions will affect the health and survival of the remaining plants in N5 Forested Area. The impact significance was assessed to be Negligible for all 21 flora receptor species.

Table 7.12 Summary of construction phase impacts to flora species receptors

Impact Type	Number of Species			
	Major	Moderate	Minor	Negligible
Mortality	4	3	0	17
Decline in plant health	0	0	0	21

7.4.3 Fauna

Six construction phase impacts were identified and assessed for faunal receptors: (1) loss of or reduction in habitats and food sources, (2) human-wildlife conflict, (3) accidental injury or mortality, (4) loss of or reduction in ecological connectivity for faunal movement, (5) light disturbances, and (6) human disturbances. Impact significance was assessed for the faunal receptors identified in Section 7.2.3. The resulting impact significance ranges from Negligible to Major, with the assumption that minimum controls (detailed in Section 7.3.1) are properly implemented and enforced. All impacts in construction phase assessed for bamboo bats (*Tylonycteris* spp.) are assigned with the impact intensity of Negligible, as there are no bamboo clusters within the N4 Forested Area and therefore the species is not expected to occur there. The species' absence in N4 Forested Area was also corroborated by the lack of acoustic records during the baseline surveys. The more substantial impacts arising from each impact type are briefly summarised below. A summary of biodiversity faunal receptors impacted during construction phase is shown in Table 7-13. The detailed evaluation for each species is provided in Appendix M.

Table 7-13 Summary of construction phase impacts to fauna receptors in biodiversity Study Area

Impact Type	Impact Significance / No. of Species			
	Major	Moderate	Minor	Negligible
Loss of or reduction in habitats and food sources	73	0	0	2
Human-wildlife conflict	0	8	3	64
Accidental injury or mortality	0	7	0	68
Loss of or reduction in ecological connectivity for faunal movement	0	0	0	75
Light disturbances	0	0	0	75
Human disturbances	0	0	0	75

Loss of or Reduction in Habitats and Food Sources

The loss of the entire N4 Forested Area due to residential developments of Sembawang N4 amounts to a total of 23.5% of the biodiversity Study Area. This likelihood is Certain for 74 species assessed and hence the impact significance was assigned as Major. For example, aquatic species such as the probable three spot gourami (*Trichopodus trichopterus*) is deemed Certain to experience loss of habitat as the entire semi-naturalised drain will be backfilled and converted into a concrete drain. Furthermore, when construction works for the semi-naturalised drain takes place, there will be no suitable habitats for the fish to re-establish, as the downstream portions of the semi-naturalised drain are fully concretised and it channels into the open sea. The impact intensity of Negligible was assigned for both species of bamboo bats (*Tylonycteris* spp), as these species occur only in N5 Forested Area and will be unaffected by clearance works.

Human-wildlife Conflict

Human-wildlife conflict between faunal species and construction site personnel is deemed to be Negligible for species not perceived as nuisances or threats to construction personnel, such as butterflies, odonates, and birds that would avoid human presence. The impact intensity of Negligible was assigned for both species of bamboo bats (*Tylonycteris* spp), as these species' roost are located in the east of N5 Forested Area and are unlikely to venture into N4 Forested Area.

For the remainder of the species, the likelihood is Possible. Human-wildlife interactions may escalate into conflicts for many reasons. Nuisance species, such as long-tailed macaques (*Macaca fascicularis*), may be attracted to food waste or other materials within the worksite, and lead to negative interactions with site personnel. Similarly, smooth-coated otter (*Lutrogale perspicillata*) is not a naturally aggressive species and can co-exist with humans, but a lack of understanding regarding how to safely interact with wildlife, can cause species to retaliate in defence. Certain species are threats to human safety, and may elicit fear in construction personnel when encountered, resulting in conflict. This includes snakes of probable occurrence such as the black-headed collared snake (*Sibynophis melanocephalus*) and aculeate hymenopterans that may sting. The impact significance is hence assessed to be Moderate for these species.

Cave nectar bat (*Eonycteris spelaea*), naked bulldog bat (*Cheiromeles torquatus*) and Sunda pangolin (*Manis javanica*) were deemed Less Likely from human-wildlife conflict, yielding a Minor impact significance, because these species can be perceived as threats and nuisance by human.

Accidental Injury or Mortality

Accidental injury or mortality of fauna during the construction phase was deemed Negligible for species predominantly volant and highly mobile, and thus able to move away from construction activities. Bamboo bats (*Tylonycteris* spp), though highly susceptible to accidental injury or mortality, are assigned with the impact intensity of Negligible, as they are only located within N5 Forested Area and will be unaffected by the constructions works.

For the remainder of species that are less mobile, or ground-dwelling that are unable to move quickly, they would be more susceptible to this impact. Hence their likelihood is Possible. Some examples are reptiles of probable occurrence such as black-headed collared snake (*Sibynophis melanocephalus*) and Malayan box terrapin (*Cuora amboinensis*). On the other hand, more mobile species would also be susceptible to accidental injury, as they would be able to enter the construction site, thus risking entrapment. This includes mammals such as long-tailed macaque (*Macaca fascicularis*), Sunda pangolin (*Manis javanica*), and smooth-coated otter (*Lutrogale perspicillata*) and birds such as white-browed crake (*Poliolimnas cinereus*) and greater painted-snipe (*Rostratula benghalensis*). After considering the key minimum control measure of the installation of hoarding around worksites involving heavy machinery to prevent fauna entry, avoidance of fogging as a vector control measure, and fauna inspections before any vegetation clearance, the impact significance for these species is Moderate.

Loss of or Reduction in Ecological Connectivity for Faunal Movement

The likelihood of the loss of or reduction in ecological connectivity for faunal movement was deemed Negligible for all 76 species assessed as N4 Forested Area is already an isolated forest patch from N5 Forested Area.

Light Disturbances

The assessment of light disturbances from construction works assumes the presence of night works and considers the extent of impact to the remaining species occurring in N5 Forested Area. Aquatic fauna of probable occurrence such as the three spot gourami (*Trichopodus trichopterus*) was not assessed for light disturbances due to its absence in N5 Forested Area and hence deemed as Unlikely. In addition, aculeata hymenopterans that are not light-sensitive have also been assigned the same likelihood (Unlikely) and impact intensity (Negligible).

While the presence of Canberra Road is already lit at night, the assessment considers any light disturbances greater than its baseline. Future road widening works at Canberra Road is the main concern for light disturbances affecting receptors in N5 Forested Area due to its proximity. Noise barriers (refer to Section 7.3.3) that extend above the height of the light stands can significantly reduce direct light spillage into N5 Forested Area. Similarly, the likelihood for all species remaining in N5 Forested Area is deemed as Unlikely and the impact significance is Negligible.

Human Disturbances

The assessment of human disturbance during construction phase was deemed Unlikely for all 76 species and was assessed for the receptors in N5 Forested Area. Aquatic fauna of probable occurrence such as the three spot gourami (*Trichopodus trichopterus*) and the Malayan box terrapin (*Cuora amboinensis*) are not assessed for human disturbances and hence deemed as Unlikely. Given that the worksite will be demarcated by hoarding and works will be kept strictly within the hoarding zone, the impacts of human disturbances by worksite personnel is Negligible.

7.4.4 Preliminary Recommended Mitigation Measures

In this section, mitigation measures for the future residential developments are discussed. Mitigation measures are implemented in the following order following the mitigation hierarchy: (1) avoidance, (2) minimisation, and (3) enhancement/ rehabilitation as well as compensation. Avoidance of the impact is first attempted. If avoidance is not possible, the construction impacts will be minimised. Finally, if habitat loss must occur, compensation and enhancement/rehabilitation of remaining and/ or nearby habitats will be suggested as a form of impact mitigation.

It is important to note that the successful implementation of mitigation measures requires the commitment of contractors, arborists, and biodiversity specialists. Some of the major concerns around this Project include habitat loss, habitat connectivity and human-wildlife interactions/ conflict.

7.4.4.1 Design Phase

The design of the development should be considered first in the mitigation plan as it has the potential to influence the extent and types of impacts that can influence any sensitive ecological receptors at the operational phase.

7.4.4.1.1 Compensatory Measures

The key mitigation measures to compensate for biodiversity impacts through the design of the proposed development at Sembawang N4 are summarised in Table 7.14 and detailed in the paragraphs below.

Table 7.14 Key recommended design measures to compensate for biodiversity impacts during design phase

Receptors	Impact Types	Mitigation Measures
Habitats **Fauna species**	Loss of habitats Loss of/reduction in habitats and food sources	• Design for native planting in proposed vegetated areas within the development • Habitat creation of rain gardens, butterfly gardens and swales within the proposed vegetated area to attract biodiversity e.g. butterflies, odonates and birds, can be considered

7.4.4.2 Construction Phase

The proximity of development to the N5 Forested Area means that the biodiversity receptors present in the forest may experience indirect impacts from the adjacent construction works at Sembawang N4 Project site, even though construction works are not expected to encroach into N5 Forested Area. The N4 Forested Area is expected to be cleared entirely to make way for residential buildings. Key measures to avoid and minimise these impacts are described below and should be implemented as part of the Environmental Monitoring and Management Plan (EMMP) during the construction phase.

7.4.4.2.1 Avoid

In addition to minimum controls in **Section 7.3, Table 7.15** provides a summary of the key recommended measures to avoid biodiversity impacts during the construction phase.

Table 7.15 Key recommended measures to avoid biodiversity impacts during construction phase

Receptors	Impact Types	Mitigation Measures
Habitats	Loss of vegetation	• Ensure no works outside of worksite or agreed working space. This includes additional clearance of vegetation for material storage,

Receptors	Impact Types	Mitigation Measures
Flora species **Fauna species**	Mortality of floral receptors Loss of/reduction in habitats and food sources	access routes, trampling and vegetation damage, outside of worksite. • For the proposed road widening at Canberra Road, some vegetation clearance within N5 Forested Area may be required for the working space of the works. Vegetation clearance of forested area should be avoided/minimised where possible. After completion of works, cleared areas should be turfed or replanted where possible.
Habitats	Habitat degradation	• Ensure no works outside of worksite or agreed working space. This includes additional clearance of vegetation for material storage, access routes, and associated works, outside of worksite. • Ensure that minimum control measures as well as engineering controls are in place to prevent contamination and siltation into the sensitive habitats and waterways (see Section 7.3.2). • Ensure any associated slope stabilisation and grading works will not impact topography of areas outside worksite and, water quality and hydrology of the conserved waterbodies within the Study Area.

7.4.4.2.2 Minimise

In addition to minimum controls in Section 7.3, some measures to minimise biodiversity impacts during the construction phase are summarised in Table 7.16**.**

Table 7.16 Key recommended measures to minimise biodiversity impacts during construction phase

Receptors	Impact Types	Mitigation Measures
Habitat	Loss of vegetation Habitat degradation	• Conduct regular inspections to ensure contractor compliance to the EMMP, with oversight by HDB. • Ensure minimum control measures stated in Section 7.3 are properly implemented. This includes soil erosion measures, dust control measures, installation of tree protection zones, pre-felling fauna inspection and wildlife response plan. • Retain ground cover for as long as possible before removal. When ground cover is removed, ECM is to be in place.
Flora species	Mortality of floral receptors Decline in plant health	• Set up Tree Protection Zones (TPZs) around trees or other plant specimens to be retained within the worksites, within which no construction works are allowed. This should be executed by certified arborists and in accordance with NParks' guidelines (NParks, 2019) • Transplant or harvest or propagate trees/ saplings of conservation significance if they are to be cleared • Engage flora specialist to monitor health of transplanted individuals • Engage with a certified arborist if pruning is needed for any tree specimens • Conduct regular arboriculture inspections to monitor the health of the retained specimens, if any. • Conduct regular inspections to ensure contractor compliance to the EMMP
Fauna species	Loss of/reduction in ecological connectivity for faunal movement Accidental injury or mortality Human-wildlife conflict	• To minimise entry of fauna into the site, the integrity of hoarding must be maintained at all times. Gaps in hoarding facilitates entry of fauna into the construction site. Regular inspections should be conducted to ensure there are no gaps in hoarding at all times. • Establish a **Wildlife Response Plan** in consultation with NParks Animal Management Centre, to be executed during encounters with trapped, injured or dead wildlife, as well as incidents of human-wildlife conflict • Use only fully biodegradable erosion control blankets (ECB) to avoid trapping fossorial fauna such as snakes • Erect signages to educate the public on possible fauna crossing along Canberra Road • Conduct training for site personnel on biodiversity awareness and actions to take when encountering wildlife every 6 months throughout the duration of construction • Remind site personnel on biodiversity awareness and actions to

Receptors	Impact Types	Mitigation Measures
		take when encountering wildlife during toolbox briefings • Ensure good housekeeping controls such as provision of wildlife-proof bins and indoor eating areas • Conduct regular inspections to ensure contractor compliance to the EMMP and identify potential faunal entrapments
Faunal species	Light disturbances	• Avoid night-time works during bird migratory season (September to February), where possible • Develop Light Management Plan for night works including but not limited to the following measures: ○ Review construction method statements and site lighting plan with the EMMP Specialist and Ecologist before the commencement of night works and where necessary ○ Reduce light spillage into adjacent areas by adopting the following measures: ○ Worksite hoarding to be opaque, and dark-coloured where possible ○ Increase the height of worksite hoarding, especially in areas adjacent to natural areas ○ Ensure that no light sources are directly visible from the forest edge as much as possible ○ Ensure that lighting is only used where really necessary; remainder of worksite to remain dark as much as possible ○ Lighting to be directed downwards to reduce light spillage upwards, as it may impact migratory birds ○ To establish a **Wildlife Response Plan** to be executed when fauna (e.g., disoriented birds) is found on-site during night-time works • For lighting equipment, consider: ○ Using warm lighting where possible during construction works after 6pm (i.e., soft white and warm white light bulbs, preferably at < 2,700 K) ○ Avoid using high UV and broad-spectrum lights (except for safety reasons)
Faunal species	Human disturbances	• No entry of site personnel to vegetated areas outside of the agreed working space.

7.4.5 Residual Impacts

7.4.5.1 Habitats

The assessment of residual impacts took into consideration the mitigation measures for habitats assessed in Section 7.4.1. It also assumes minimum controls are properly implemented and enforced. A summary of the key biodiversity habitat receptors impacted during construction phase is shown in Table 7.16. The detailed evaluation for each habitat type is provided in Appendix L.

Loss of vegetation

Due to the loss of vegetation within the N4 Forested Area, the impact remains to be **Major**. Mitigation is not possible for such an impact.

Habitat degradation

Pre-mitigated impact significance for habitat degradation was deemed to be **Negligible** for all habitat types within the 30 m impact zone of N5 Forested Area. With the implementation of mitigation measures, the impact significance remains as Negligible, as it is the lowest could practically be.

Table 7.17 Impact significance of biodiversity habitat receptors affected during the construction phase after the incorporation of mitigation measures

Impact type	Impact Significance			
	Major	Moderate	Minor	Negligible
Loss of vegetation	• Exotic-dominated secondary forest • Grassland • Scrubland • Semi-naturalised drain	-	-	-
Habitat degradation	-	-	-	• Abandoned-land forest • Exotic-dominated secondary forest • Grassland • Scrubland • Urban vegetation

7.4.5.2 Flora

Similar to the pre-mitigation impact assessment, all 24 flora species receptors are assessed for two ecological impact types: mortality and decline in plant health. The assessment considers mitigation measures for flora species assessed in Section 7.4.2. It also assumes minimum controls are properly implemented and enforced. A summary of the impact to flora receptors is provided in Table 7.17. The detailed evaluation for each species is provided in Appendix L.

Mortality

The pre-mitigated impact significance for the several floral species receptors in N4 Forested Area ranged from Negligible to Major. With the implementation of mitigation measures stated in Section 7.4.4.2.2, the impact significance can be reduced to Negligible. It is to note that this assessment does not take into the consideration the success rate of these specimens after they have been salvaged/transplanted from their existing habitat. There is a possibility that some specimens may still be subjected to mortality after the process of salvaging/transplantation.

The other 17 floral species receptors occurring in N5 Forested Area remains to be Negligible as they are not directly affected by the proposed developments.

Decline in plant health and survival

The pre-mitigated impact significance for the 21 floral species receptors in N5 Forested Area is Negligible. With the implementation of mitigation measures stated in Section 7.4.4.2.2; the impact significance remains as Negligible.

Table 7.18 Summary of construction phase residual impacts to flora receptors

Impact Type	Number of Species			
	Major	Moderate	Minor	Negligible
Mortality	0	0	7	17
Decline in plant health	0	0	0	21

7.4.5.3 Fauna

Similar to the pre-mitigation impact assessment, all 75 faunal species receptors are assessed for six ecological impact types. The assessment considers mitigation measures for construction phase detailed in Section 7.4.4.2. A summary of residual impacts to fauna receptors is given in Table 7-19 and detailed in Appendix M.

Loss of or reduction in habitats and food source

The residual impact significance remains as Negligible for Bamboo bats (*Tylonycteris* spp), and Major for the remaining 73 species as there are no mitigation measures for this impact.

Accidental injury or mortality and human-wildlife conflict

The likelihood of accidental injury or mortality, human-wildlife conflict, and human disturbance can be reduced if mitigation measures recommended in Section 7.4.4 are followed, thus reducing the impact significance from Moderate to Minor and Minor to Negligible. Mitigation measures to reduce these impacts include, regular site inspections, biodiversity awareness training, implementation of biodegradable erosion control blankets (ECB) and signages for possible fauna crossing.

Loss of or reduction in ecological connectivity for faunal movement, light disturbances, human disturbances

The pre-mitigated impact significance for the 75 faunal species receptors is Negligible. With the implementation of mitigation measures, the impact significance remains as Negligible, as it is the lowest could practically be. Mitigation measures to reduce these impacts include restriction of site personnel entry into N5 Forested Area.

Table 7-19 Summary of construction phase residual impacts to fauna receptors

Impact Type	Impact Significance / No. of Species			
	Major	**Moderate**	**Minor**	**Negligible**
Loss of or reduction in habitats and food sources	73	0	0	2
Human-wildlife conflict	0	0	8	67
Accidental injury or mortality	0	0	7	68
Loss of or reduction in ecological connectivity for faunal movement	0	0	0	75
Light disturbances	0	0	0	75
Human disturbances	0	0	0	75

7.4.6 Cumulative Impacts

7.4.6.1 Removal of Cochrane Lodge and Recreational Centre

Impacts to habitat and flora

There are no direct impacts (i.e., vegetation removal) resulting from the removal of both Cochrane Lodge and Recreational Centre and LTA TOL. Indirect impacts such as habitat degradation, as well as dust impacts to plants may occur at the edges of the remaining N4 Forested Area in the north, which will concurrently be cleared. The cumulative impact to habitats and flora is expected to be minimal.

Impacts to fauna

During the removal of the Cochrane lodge and recreational centre, the N4 northern parcel will still be vegetated. Indirect impacts of human-wildlife conflict, light disturbances and human disturbances may occur due to the proximity of the removal works to the remaining forest of N4. However, with proper minimum control measures i.e., hoarding and prohibition of night works, the impacts from the removal works are expected to be minimal.

7.4.6.2 Demolition works within Sembawang Shipyard

Impacts to habitat and flora

There are no direct impacts (i.e., vegetation removal) resulting from the demolition works within Sembawang shipyard. As it is located across the Admiralty Road West, no cumulative impacts on habitat and flora is expected.

Fauna

During the demolition works within Sembawang shipyard, the N4 northern parcel will still be vegetated. However, Admiralty Rd West provides a setback between any expected demolition works and the remaining forest in N4, rendering the impacts minimal with proper minimum control measures.

7.5 Impacts on Biodiversity due to Changes in Other Environmental Parameters

7.5.1 Impacts due to Hydrological Changes

As detailed in Section 3 of this Report, the construction phase of the Project is expected to last approximately 4 years, during which the Study Area will go through significant changes. Site preparation activities, especially activities such as site clearance and earthworks will inevitably change the current land cover(s) and uses. Vegetated areas (both low-lying vegetation in the southern and central portions of the Project site as well as N4 Forested Area) are mostly going to be cleared, making space for the proposed residential developments. This will lead to more impervious surfaces within the site, which will consequently reduce the infiltration of surface water into the ground and also potentially increase the surface water peak flow and velocities, especially during the heavy rainstorm events. It should also be noted that certain construction phase activities such as foundation works require dry soil conditions and therefore groundwater extraction will be carried out in these locations. This may not only cause the localised groundwater level reduction but could also lead to reduction of the groundwater baseflow feeding the downgradient watercourses.

If not managed properly, these planned activities and changes may have adverse impacts on hydrology and consequently on identified ecological sensitive receptors. The following sub-sections provide qualitative assessment and evaluation of impacts on receptors due to hydrological changes during the construction phase of the Project.

7.5.1.1 Identification and Categorisation of Sensitive Receptors

Screening of ecological sensitive receptors with regards to potential hydrological changes was conducted for the Study Area for the construction phase of the Project, with reference to biodiversity baseline findings (refer to Section 6.4 of this Report) as well as taking into consideration proposed future land use plans. Sensitivity of identified ecological receptors was based on the criteria detailed in Table 5.2.

Biodiversity baseline study has found that the N5 Forested Area consists of 5 different terrestrial habitats, including abandoned-land forest, scrubland, exotic-dominated secondary forest, grassland, and urban vegetation (turf) with a man-made drain (D1) passing through. Based on the hydrology baseline findings (refer to Section 6.5.2.2) this concrete drain collects the water from the N5 Forested Area and partially from the surrounding urbanised area and is located upstream from the development area. As the concrete drain D1 within N5 Forested Area receives water from the sub-catchment which will not be disturbed by the proposed developments, it is unlikely that hydrological conditions will change during the construction and operational phase of the Project. For this reason, it was assumed that habitats within N5 Forested Area will not be impacted and were not considered as potential ecological receptors.

The N4 Forested Area is dominated by exotic-dominated secondary forest and scrubland, with patches of grassland. Semi-naturalised drain (D2) runs through the forest, discharging the water into a culvert below Admiralty Road West and eventually into East Johor Straits (EJS). Based on biodiversity baseline findings, aquatic habitat that is formed in this watercourse is a common habitat in Singapore that generally supports moderate flora and fauna species richness. During the site surveys, mostly exotic fauna species were recorded, such as mosquitofish. Based on the historical maps of the area (refer to Section 6.1), this drain was likely built in the 1950s and has remained in this location since. As per the latest land use plan, N4 Forested Area is planned to be cleared during the construction phase, and eventually this area will be converted into mostly residential developments. In addition, semi-naturalised drain is planned to be replaced with a new concrete drain which will be built as part of the new developments. As current terrestrial habitats within N4 will eventually cease to exist, they were not considered as potential ecological receptors.

Based on the site-specific and regional analysis (refer to Section 6.5.2), the water from the Project site eventually gets discharge into the sea. Furthermore, during the construction phase, water may get discharged into Sungei

Sembawang when, and if necessary. Given the potential impacts that hydrological changes may have on Sungei Sembawang and consequently marine area of East Johor Straits (EJS), these two waterbodies were taken into consideration for the purposes of this impact assessment exercise.

Table 7.20 Classification of potential sensitive receptors identified within the Study Area for construction phase with respect to hydrological changes

Sensitive Receptor	Receptors Description	Receptor Classification
Sungei Sembawang and associated habitats	• Tidally-influenced manmade concrete watercourse • Upper reaches of this watercourses (i.e. south of the Project site) support mangrove habitats • Eventually, water from Sungei Sembawang gets discharged into the sea (i.e. EJS) • As Sungei Sembawang supports biocenosis of potentially high ecological value (e.g. mangroves), accompanying habitat could potentially be disturbed by the changes in surface water quality	Priority 1
East Johor Straits (EJS) and associated habitats	• International strait, located between Singapore and peninsular Malaysia • Supports marine habitats and accompanying flora and fauna	Priority 1

7.5.1.2 Impact Assessment

As mentioned previously, certain construction phase activities, especially activities such as site clearance and earthworks are expected to lead to temporary and/ or permanent land use changes within the Project site. During the site preparation for the main construction activities, existing structures and vegetation within the site not intended to be preserved will be demolished/ cleared and removed from the site. This will reduce the quantity of the vegetation cover, exposing the bare soil within the site. As the Project progresses, urbanised areas within the Project site will increase, eventually covering the majority of the area with impervious surfaces such as buildings, roads, pavements, etc.

Abovementioned temporary and/ or permanent land use changes are likely going to alter the existing catchment areas of the watercourses present within the site, significantly changing the hydrological conditions of the site. Furthermore, due to the reduced seepage of surface water into the soil, quantities of stormwater surface runoff may increase, with reduced runoff propagation over the land and increased peak flows. Appropriate drain diversion will have to be assured for the watercourse D2 and other impacted drains.

The drainage within Project site should be designed with reference to PUB COP so that it could effectively drain away the runoff originating within or from the vicinity of the Project site in order to prevent flooding and/ or ponding. It is to be noted that flooding of areas adjacent to watercourses is not allowed. Even though the water originating from the site may get discharged into Sungei Sembawang, given the larger catchment area of the receiving watercourse (approx. >200 ha), it is unlikely that such discharges would significantly alter current flow regime of the canal. Based on these considerations, hydrological impact intensity on Sungei Sembawang during construction phase was assessed to be **Low**. Therefore, the consequence of impacts on habitats within Sungei Sembawang and EJS (i.e. Priority 1 ecological receptors) was assessed to be **Low** (as per Impact Consequence Matrix, as shown in Table 5.17).

Perimeter drains during construction phase have to be developed as part of minimum control measures, and are expected to be designed in accordance with PUB COP. Furthermore, it is expected that other minimum controls, such as appropriate stormwater storage systems will be implemented on the site, when and if needed. Therefore, it is **Unlikely** that the potential hydrological changes may impact Sungei Sembawang and its habitats. Hence, the overall impact on the ecological receptors due to hydrological changes was assessed to be **Negligible**, as per impact significance matrix (Table 5.19).

Groundwater extraction during the construction phase of the Project is **Unlikely** to have adverse impacts on the manmade concrete drain D1 and Sungei Sembawang as they are all concrete drains whose main source of water

originates from surface sources (refer to hydrological baseline findings at Section 6.5.2). Hence, the consequent impact on identified ecological receptors was assessed to be **Negligible**.

7.5.1.3 Proposed Mitigation Measures

No additional mitigation measures aside from the proposed minimum controls were proposed to further minimise the adverse impacts on the water resources as none of the impacts on the ecological sensitive receptors have been assessed to be Moderate or Major.

7.5.1.4 Residual Impact Assessment

No residual impact assessment has been undertaken as no Moderate or Major impact significance on the ecological receptors were assessed.

7.5.1.5 Cumulative Impacts

At the time of writing this Report, limited information about concurrent Projects was available. However, it is assumed that all the concurrent developments will comply with the construction standards and environmental management and control. Therefore, it is not expected that they will increase impacts on water resources.

7.5.2 Impacts due to Surface Water Quality Changes

Construction phase of the Project will entail various on-site activities which could directly, or indirectly cause the pollution of the receiving watercourses within or in the vicinity of the Project site. Consequently, this may cause disturbances and have adverse impacts on the surrounding habitats, flora, and fauna. Given the variety of the activities planned for the construction phase, it is expected that sources (and therefore potential pollutants), pathways and mechanisms of pollution will vary. Following sub-sections provide the key considerations and detail prediction and evaluation of impacts on water resources and consequent impacts on identified ecological receptors, expected to arise from the construction phase of the Project.

7.5.2.1 Identification and Categorisation of Sensitive Receptors

As detailed in Section 7.5.1, the planned activities during construction phase will be carried out outside of the catchment area of manmade concrete drain D1. In addition, this drain and its catchment area are located upstream from the Project site. Hence, water quality changes of baseline conditions due to proposed activities are not expected. For this reason, terrestrial habitats within N4 Forested Area will not be included in impact assessment. As semi-naturalised drain D2 within N4 Forested Area and existing terrestrial habitats will be cleared during construction phase of the project, these were also not included as potential sensitive receptors.

During the construction phase, the water collected from construction site may eventually be discharged into Sungei Sembawang and from there into the sea. Therefore, both Sungei Sembawang and EJS and their respective associated habitats were identified as potential ecological receptors.

Table 7.21 Classification of potential sensitive receptors identified within the Study Area for construction phase with respect to surface water quality changes

Sensitive Receptor	Receptors Description	Receptor Classification
Sungei Sembawang and associated habitats	• Tidally-influenced manmade concrete watercourse • Upper reaches of this watercourses (i.e. upstream of the Project site) support mangrove habitats • Eventually, water from Sungei Sembawang gets discharged into the sea (i.e. Straits of Johor) • As Sungei Sembawang supports biocenosis of potentially high ecological value (e.g. mangroves), accompanying habitat could potentially be disturbed by the changes in surface water quality	Priority 1
East Johor Straits (EJS) and	• International strait, located between Singapore and peninsular Malaysia	Priority 1

Sensitive Receptor	Receptors Description	Receptor Classification
associated aquatic habitats	• Supports marine habitats and accompanying flora and fauna	

7.5.2.2 Impact Assessment

As detailed in Section 7.1.2 of this Report, surface water quality of watercourses within and in the vicinity of the Project site could be impacted due to various pollution sources and waste streams expected to be generated during the construction phase of the Project. Consequently, such pollution could have adverse impacts on the surrounding flora, fauna, and associated habitats. Based on the proposed construction phase activities, the following key sources of impact were identified:

- Silty effluent originating from surface runoff from exposed soil
- Extracted groundwater
- Other liquid effluents and construction wastewater
- Leachate of pollutants from waste stored on-site
- Accidental spills and leaks of pollutants due to improper management (storage, handling, disposal) of chemicals and waste

Silty Effluent

Construction phase activities such as site clearance, earthworks and foundation works are expected to increase the amount of exposed soil within the Study Area. If left uncovered, rainfall events could cause the erosion of such bare soil areas. Consequently, the concentration of pollutants in resulting surface runoff could increase, namely from elevated concentrations of suspended solids (e.g. silt) and any pollutants within the soil due to historical pollutive activities (if any). Untreated, such silted discharges could deteriorate the quality of receiving watercourse by increasing its turbidity and sedimentation rates. Besides the reduction of aesthetic quality of a waterbody, increased turbidity could also have environmental consequences which could be fatal for the aquatic life.

In the event that silty effluent gets discharged into Sungei Sembawang accidentally, baseline quality of this watercourse may alter, consequently impacting associated habitats. Therefore, impact intensity was assessed to be **Medium**. As the habitats found within Sungei Sembawang and EJS have been identified as Priority 1 receptors, impact consequence on these receptors was assessed to be **Medium** (as per Table 5.17). The biodegradable erosion blankets should be used to cover any bare soil on site which will reduce the amount of TSS getting discharged into the environment, especially during the heavy storm events. In addition, appropriate ECM must be implemented on the site to ensure that no silty effluent, other than the one with allowed concentrations of TSS as per NEA Trade Effluent guidelines, gets discharged into the surrounding waterbodies. Under the assumption that these and other proposed minimum control measures were successfully implemented, planned, and controlled discharges of water from the site into Sungei Sembawang are not expected to significantly alter current baseline quality as it will have to meet water quality criteria prior to discharge. In addition, potential amount of water discharged from the site into Sungei Sembawang would be significantly smaller compared to the overall catchment area of the river, which would increase dilution effects of pollutants, if any. For comparison, based on the publicly available data, catchment of Sungei Sembawang is at least 200 ha, while the overall Project site's area is 53 ha. With **Less Likely** likelihood of occurrence, the overall impact significance was assessed to be **Minor**.

Other Liquid Effluents and Construction Wastewater

Besides silty effluents, it is expected that the proposed construction activities will result in significant amount of other liquid effluents and construction wastewater which may include sanitary discharges, stormwater runoff from waste storage facilities etc. Such effluents, besides elevated silty content may also contain variety of other pollutants ranging from human pathogens (e.g. from sanitary discharges) to heavy metals and other toxic substances (e.g. from waste storage areas). Given the variety of pollutants, both in nature and concentration, uncontrolled discharge of such effluent could affect the baseline quality of receiving watercourse, potentially

affecting the associated habitats. Therefore, impact intensity was assessed to be **Medium**. As Sungei Sembawang and EJS were categorised as Priority 1 receptors, impact consequence on these waterbodies was assessed to be **Medium** (as per Table 5.17). As mentioned in the Section 7.3.2, dedicated procedures for inspection and maintenance of wastewater collection, storage and treatment structure(s) must be developed prior to construction works and adhere to over the course of the Project. Under the assumption that the minimum control measures have been successfully implemented it is not expected that the potentially polluted liquid effluents would get discharged uncontrollably into the surrounding area. In addition, prior to any discharge into surrounding watercourses and/ or soil, the Contractor will have to seek an approval from NEA Director-General and effluent will have to meet certain water quality criteria prior to discharge. Therefore, the likelihood was assessed to be **Less Likely/ Rare** and the overall impact significance was assessed to be **Minor**.

Leachate of pollutants from waste stored on-site

Based on the planned activities during the construction phase of the Project, it is expected that significant amount of solid waste would be generated. This includes waste such as faulty construction material, solid materials from excavation and site clearance activities, empty containers, etc. If not stored and managed properly, pollutants originating from these materials/ waste may seep into the ground, potentially contaminating groundwater, and consequently downgradient watercourses. If these contaminants reach downgradient watercourses, they can alter the water quality of the receiving watercourse, potentially impacting the related habitats. Hence, the impact intensity was assessed to be **Medium**. As Sungei Sembawang and EJS were categorised as Priority 1 sensitive receptors, impact consequence was assessed to be **Medium** (as per Table 5.17). Under the assumption that the dedicated minimum control measures have been successfully implemented (e.g. appropriate waste storage and/ or facilities, dedicated SOP for waste handling, appropriate disposal of toxic waste, locating the storage facilities away from watercourses, etc) potential for leachate to reach watercourses is considered to be minimal, if any. Quantity of waste stored on-site is expected to be limited, with the assumption that the generated waste will be periodically removed and disposed off-site. Therefore, the likelihood of this impact was assessed to be **Rare**, and therefore the overall impact significance was assessed to be **Minor** on all the identified receptors.

Accidental spills and leaks of pollutants

Another potential mechanism to surface water contamination during construction phase of the Project could be through accidental spills and leaks of chemicals used and stored on site due to improper management practices, human mistakes, and faulty equipment. In the event of such releases, contaminants could either be discharged directly into the watercourse or it can reach watercourse via soil and groundwater. Given the quantities and varying chemical composition of the potential pollutant, these have a potential to alter significantly baseline water quality of receiving watercourses, and the impact intensity was assessed to be **Medium**. As the Sungei Sembawang and EJS were categorised as Priority 1 sensitive receptors, the impact consequence on these receptors was assessed to be **Medium**. It is to be noted that it is assumed (as part of minimum control measures) chemicals used during the construction phase will be stored at designated sheltered area with access-controlled entrance and concrete bund walls or in storage containers with good ventilation. In the event that chemical spillage does occur, spill kits will be provided on-site to be operated by an emergency response team competent in their use. With beforementioned in mind, quantities of this type of pollutants released in the environment are expected to minimal and quickly remediated (i.e. removed). Hence, likelihood was assessed as **Less Likely** and the overall impact significance on sensitive receptors was assessed to be **Minor.**

7.5.2.3 Proposed Mitigation Measures

No additional mitigation measures aside from the proposed minimum controls were proposed to further minimise the adverse impacts on the water resources as none of the impacts on the ecological sensitive receptors have been assessed to be Moderate or Major.

7.5.2.4 Residual Impact Assessment

No residual impact assessment has been undertaken as no Moderate or Major impact significance on the ecological receptors were assessed.

7.5.2.5 Cumulative Impacts

It is assumed that all the concurrent developments will comply with the construction standards and environmental management and control. Therefore, it is not expected that they will increase impacts on water resources. It is to be noted that there are expected demolition works within Sembawang Shipyard which will coincide with this

Project's timeline. The details of associated activities were not known at the time of writing the Report, however it is recommended for the responsible parties to liaise with each other to make sure that discharges originating from the sites do not cause significant cumulative impact to water quality.

7.5.3 Impacts due to Noise Generated During Site Construction Activities

This section elaborates on the predicted noise impacts arising from noise emissions associated with construction activities of the project on noise sensitive ecological receptors. It is to be noted that human receptors have been excluded from assessment in this Report, based on directions from technical agency NEA.

A quantitative means of assessment was applied to determine the impacts of the predicted noise emissions experienced by the ecological NSRs in the N5 forested area (study area). A semi-quantitative means of assessment was applied to determine the cumulative noise impacts accounting for potential noise emissions from other concurrent developments in proximity to the Project site where any such information is available. Where quantifiable information is unavailable, a qualitative means of assessment for the other concurrent developments were applied.

Construction noise impacts were assessed and studied following the below key steps:

- Review baseline noise monitoring data, conduct and assess current baseline noise levels in the Airborne Noise Study Area (see Section 6.6);
- Identify and classify sensitivity of ecological receptors located in proximity to the Project site (within Airborne Noise Study Area);
- Conduct noise impact assessment to quantitatively assess potential noise impacts arising from construction works of the project;
- Recommend minimum control and mitigation measures to be implemented; and
- Determine overall significance of residual noise impacts upon implementation of mitigation measures.

7.5.3.1 Identification and Categorisation of Sensitive Receptors

As detailed in Section 5.1.1, the assessment of the airborne noise impacts on ecological NSRs shall consider the biodiversity Study Area outside of Project site i.e., the N5 forested area for assessment. This shall include the fauna species identified in the N5 forested area during biodiversity baseline surveys (refer to Table 5.2).

Based on the assessment methodology presented in Table 5.2, the classification of ecological receptors is deduced based on the auditory sensitivities of the respective fauna species as reflected below:

- Priority 1 – Areas with fauna species of conservation significance and having high auditory sensitivity (that use sound for communication, foraging and breeding etc.)
- Priority 2 – Areas with fauna species of conservation significance but having low auditory sensitivity (less affected by airborne noise / have the ability to move away temporarily)
- Priority 3 – Areas with fauna species that are not considered conservation significance or having low auditory sensitivity.

Details of the fauna field surveys are provided in Section 6.4.2. The faunistic field assessment conducted within these areas identified fauna species of CS / non-CS status that use sound for communication, foraging and breeding, and are known to have their behaviours disrupted by the increase in airborne noise levels with the ability to move away temporarily to neighbouring areas not impacted by construction noise.

A preliminary list of fauna species and their auditory sensitivities (refer to Appendix T) were analysed for the purpose of deducing the receptor sensitivity of the ecological study area (N5 forested area). Upon analysis, the N5 forested area has been classified entirely as "**Priority 1**" ecological NSR and the same considered for assessment. This is owing to the presence of species of conservation significance and high auditory sensitivity in the study area.

7.5.3.2 Prediction and Evaluation Impact Assessment

This section details the impact assessment consisting of the potential source of impacts, assessment methodologies, assumptions applied as part of the airborne noise impact assessment which includes the prediction and evaluation of construction noise impacts on the noise sensitive ecological receptors.

7.5.3.2.1 Potential Sources of Impacts

This section discusses on the equipment and activities which could potentially contribute to noise impacts at N5 forested area during construction phase of the project. The main sources of noise will originate from the PMEs used for construction states. The PMEs and their respective SWLs used in this study are listed in the equipment inventory list provided in Appendix U.

As stated in Section 3.3 of the Report, construction activities categorised as pre-construction and main construction works are planned to be executed in two phases, each corresponding to southern and northern parcels. The different construction phases include:

- Pre-Construction Activities
  - Site Clearance (of forested areas), demolition works and Earthworks – 7 am to 7 pm.
- Main Construction Activities
  - Foundation Works – 7 am to 10 pm.
  - Superstructure Construction (Installation of Pre-fab) – 7 am to 10 pm.
  - Landscaping Works – 7 am to 10 pm.
  - Reinstatement works and removal of foundation – 7 am to 10 pm.
  - Road Construction works – 7 am to 7 pm.

The construction plan sequence was studied for the project, based on the construction award programme provided by HDB (for each Build-To-Order [BTO] plot) and the tentative timeline for each construction activity stated in the equipment inventory. It was observed that there is a potential for overlap of construction phases at different areas of the Project site. Due to confidentiality of the HDB's BTO parcel plan information, the construction activities listed in this section are allocated among the Southern and Northern parcels only.

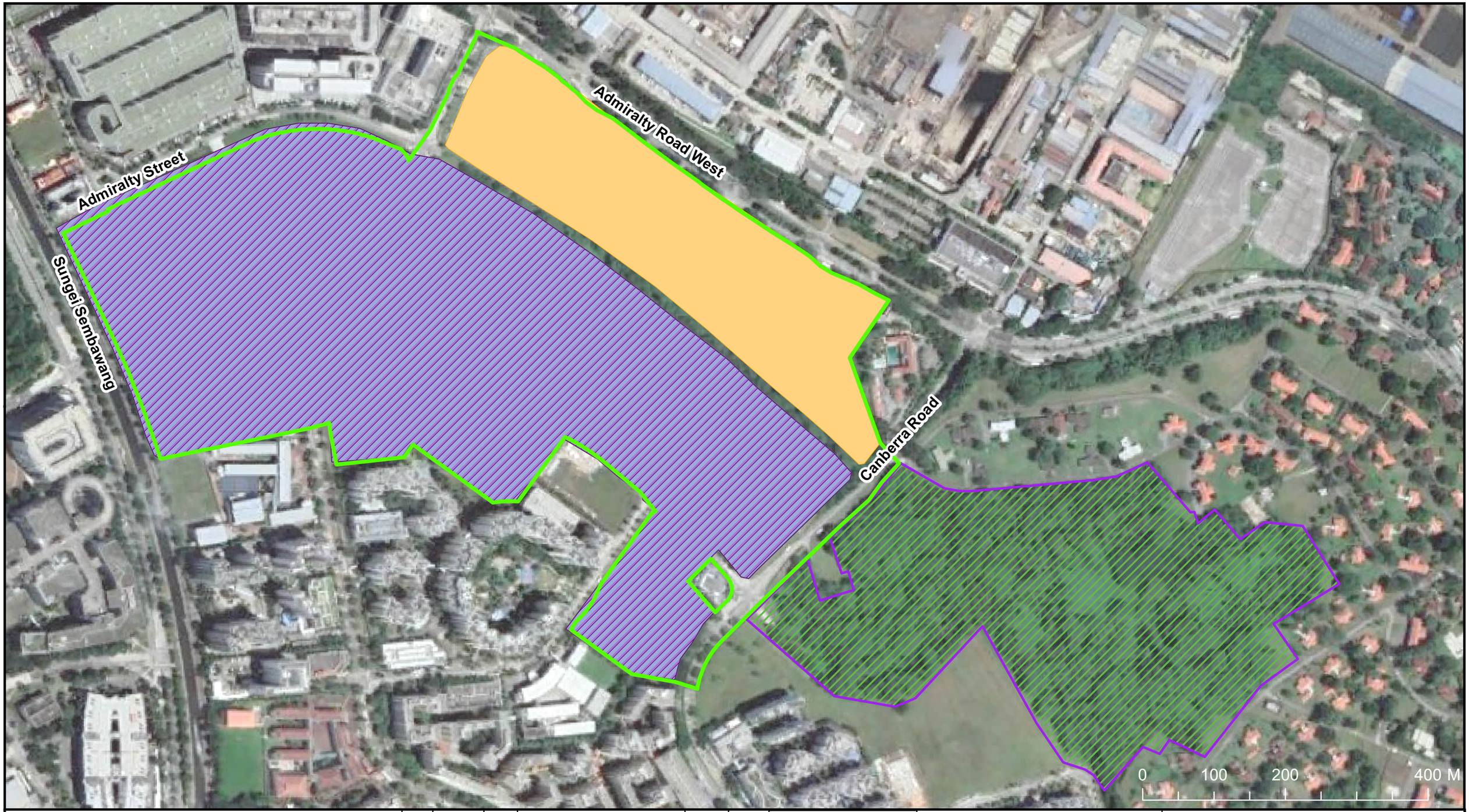
7.5.3.2.2 Determination of Assessment Scenario

The equipment inventory provides the PMEs (the number used on site, their percentage on time) used for every construction phase. The effective sound power level (SWLs) for each of the above-mentioned construction phase are calculated and typically the worst phase of construction activity is chosen for modelling (as a conservative measure). However, based on the tentative construction timeline considered, HDB will be constructing at southern parcels and then subsequently at northern parcels with overlap of some construction works in between. Hence, in order to provide a meaningful assessment which covers both conservative and realistic cases, AECOM has studied the cumulative construction noise source levels of every quarter in the construction year and chose two worst case years as modelling scenarios. The worst-case scenarios selected for the project are as given below and represented in Figure 7.5.1 and Figure 7.5.2.

Scenario 1: Foundation works at Southern Parcels + Earthworks at Northern Parcels

Scenario 2: Foundation works at Northern Parcels + Reinstatement works at Southern Parcels

These represent two "time periods" when the construction noise impacts are expected to be experienced at the peak level. The rationale behind deducing the worst-case scenario is under the assumption that if these construction periods with the highest cumulative SWLs can be mitigated for instance with permanent fixtures such as noise barriers or other mitigation options, noise impacts from other construction time periods (with relatively lower SWLs) will be addressed. Due to unavailability of equipment data, "demolition of existing structures" was not considered as a scenario for noise modelling / impact assessment.



Legend

- Project Boundary
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels
- Ecological Receptor

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	LLG	Final Report	SAG	JAG
-	JUL 2024	LLG	Final Report	SAG	JAG
1	JUN 2024	LLG	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :
Airborne Noise Sources Scenario 1: Site Clearance & Earthworks at Northern Parcels, Foundation Works at Southern Parcels and Overall Road Construction Works

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
TYL	SAG	JAG	7.5.1	1	1 of 1
	Drawn LLG	Date AUG 2024	CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

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Legend

- Project Boundary
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels
- Ecological Receptor

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	LLG	Final Report	SAG	JAG
-	JUL 2024	LLG	Final Report	SAG	JAG
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Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :
Airborne Noise Sources Scenario 2: Foundation Works at Northern Parcels, Reinstatement and Landscaping Works at Southern Parcels

Designed	Checked	Approved
TYL	SAG	JAG
	Drawn: LLG	Date: AUG 2024

Figure No. :	Rev.	Sheet
7.5.2	1	1 of 1

CAD File Name : NA — A3

Note: Source of basemap - Google Earth Map

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The effective SWLs generated from the different construction phases of the project are summarised in Table 7.22. Subsequently, the SWLs of both the selected assessment scenarios applied for construction phase modelling are reflected in Table 7.23. Given that the selected scenarios are an amalgamation of different phases of construction happening at different areas of Project site, they will henceforth be referred only to as “Scenario 1” and “Scenario 2” in the Report.

Table 7.22 Effective Sound Power Level

Construction Phases	Effective Sound Power Level from Construction Phases, SWL, dB(A)				
	LAeq (12hrs)		LAeq (1hr)	LAeq (5mins)	
	7am to 7pm	7pm to 7am	7pm to 10pm	7am to 7pm	7pm to 10pm
Site Clearance and Earthworks (7am to 7pm)	115	-	-	120	-
Foundation Works (7am to 10pm)	125	123 (120*)	125	126 (125*)	126 (125*)
Superstructure (Pre-fab Installation) (7am to 10pm)	117	115	116	118	118
Landscape Works (7am to 10pm)	119 (116*)	117 (114*)	118 (115*)	120 (117*)	120 (117*)
Reinstatement (removal of temporary features) (7am to 10pm)	120	117	119 (118*)	120	120
Road Construction (7am to 7pm)	110	-	-	113	-
Note: Applicable to individual plots of both Northern and Southern parcels. Input in noise modelling software reflects the plots (per HDB’s plan). Due to confidentiality, the Report provides only overall of Northern and Southern parcels. Information on equipment inventory and construction working hours provided by HDB. ** The effect sound power level values within the brackets reflect the sound power levels for some individual plots where a reduced equipment inventory has been considered for the size of the plot.*					

Table 7.23 Effective Sound Power Level - Noise Model Input

Scenario(s)	Effective Sound Power Level from Construction Phases, SWL, dB(A)				
	LAeq (12hrs)		LAeq (1hr)	LAeq (5mins)	
	7am to 7pm	7pm to 7am	7pm to 10pm	7am to 7pm	7pm to 10pm
Scenario 1:					
Site Clearance and Earthworks (7am to 7pm) at Northern Parcels	115	-	-	120	-
Foundation Works at Southern Parcels (7am to 10pm)	125	123 (120*)	125	126 (125*)	126 (125*)
Road Construction (7am to 7pm)	110	-	-	113	-
Scenario 2:					
Foundation Works at Northern Parcels (7am to 10pm)	125	123 (120*)	125	126 (125*)	126 (125*)
Superstructure (Pre-fab Installation) at Southern Parcels (7am to 10pm)	117	115	116	118	118
Landscape Works (7am to 10pm)	119 (116*)	117 (114*)	118 (115*)	120 (117*)	120 (117*)
Reinstatement (removal of temporary features) at Southern Parcels (7am to 10pm)	120	117	119 (118*)	120	120
Note: Applicable to individual plots of both Northern and Southern parcels. Input in noise modelling software reflects the plots (per HDB’s plan). Due to confidentiality, the Report provides only overall of Northern and					

Scenario(s)	Effective Sound Power Level from Construction Phases, SWL, dB(A)				
	LAeq (12hrs)		LAeq (1hr)	LAeq (5mins)	
	7am to 7pm	7pm to 7am	7pm to 10pm	7am to 7pm	7pm to 10pm

Southern parcels. Information on equipment inventory and construction working hours provided by HDB.

** The effect sound power level values within the brackets reflect the sound power levels for some individual plots where a reduced equipment inventory has been considered for the size of the plot.*

7.5.3.2.3 Likelihood of Occurrence of Impacts

The likelihood of occurrence of airborne noise impacts was determined based on the frequency of exposure based on the categorisation provided in Section 5.3.3.2. The frequency of exposure was calculated using the active duration of the proposed equipment provided by HDB in Appendix U over the daily working period (e.g., 7am to 7pm, 7pm to 10pm), as detailed in Table 7.24.

It should be noted that in accordance with the information provided by HDB, the construction schedules vary among the different phases. For e.g., while site clearance and earthworks are scheduled to be conducted 7am to 7pm, construction of superstructures and reinstatement works are scheduled to happen between 7am to 10pm. This implies variation in the daily working period amongst different construction phases. Since the worst-case scenarios are a combination of one or more construction phases, the likelihood of the longest occurring activity will be considered.

The active duration of equipment over a continuous time period of 12 hours (for LAeq (12hrs), dB(A)) was defined based on the actual percentage on time provided by HDB, for e.g., a value of 0.6 was taken (active for 60% of the time over a continuous time period of 12 hours). The active duration of equipment over a continuous time period of 5 minutes (for LAeq(5mins), dB(A)) was assumed to be 1.0 (i.e., active for 100% of the time over a continuous time period of 5 minutes).

The calculation of frequency of exposure and subsequent categorisation of likelihood for different modelling scenarios are provided in following Table 7.24.

Table 7.24 Likelihood evaluation for airborne noise impact assessment (construction phase)

Assessment Scenario(s)	LAeq, dB(A)	Working time period	Frequency of Exposure	Likelihood of Occurrence (ref to Table 5.18)
Scenario 1 *(longest activity is Foundation works happening 7am to 10pm)*	LAeq(12hrs), dB(A)	7am to 7pm	• Daily working period over 24 hours = 0.625 • Active duration of equipment = 0.9 (90% as provided in equipment inventory) • Frequency of exposure = 0.625 x 0.9 = 0.56	Certain / Continuous
		7pm to 7am	• Daily working period over 24 hours = 0.625 • Active duration of equipment = 0.5 (50% as provided in equipment inventory) • Frequency of exposure = 0.625 x 0.5 = 0.31	Likely / Regular
	LAeq(1hr), dB(A)	7pm to 10pm	• Daily working period over 24 hours = 0.625 • Active duration of equipment = 0.7 (70% assumption) • Frequency of exposure = 0.625 x 0.7 =	Likely / Regular

Assessment Scenario(s)	LAeq, dB(A)	Working time period	Frequency of Exposure	Likelihood of Occurrence (ref to Table 5.18)
			0.43	
	LAeq (5 mins), dB(A)	7am to 7pm	• Daily working period over 24 hours = 0.625 • Active duration of equipment = 1.0 (100% assumption) • Frequency of exposure = 0.625 x 1.0 = 0.625	Certain / Continuous
		7pm to 10pm		
Scenario 2 *(longest activity is superstructure/reinstatement happening 7am to 10pm)*	LAeq(12hrs), dB(A)	7am to 7pm	• Daily working period over 24 hours = 1.0 • Active duration of equipment = 0.9 (90% as provided in equipment inventory) • Frequency of exposure = 1.0 x 0.9 = 0.9	Certain / Continuous
		7pm to 7am	• Daily working period over 24 hours = 1.0 • Active duration of equipment = 0.5 (50% as provided in equipment inventory) • Frequency of exposure = 1.0 x 0.5 = 0.5	Likely / Regular
	LAeq(1hr), dB(A)	7pm to 10pm	• Daily working period over 24 hours = 1.0 • Active duration of equipment = 0.7 (70% assumption) • Frequency of exposure = 1.0 x 0.7 = 0.7	Certain / Continuous
	LAeq (5 mins), dB(A)	7am to 7pm	• Daily working period over 24 hours = 1.0 • Active duration of equipment = 1.0 (100% assumption) • Frequency of exposure = 1.0 x 1.0 = 1.0	Certain / Continuous
		7pm to 10pm		
Note: The colour of the cells corresponds to that of the assessment matrices in Section 5.3.3.				

7.5.3.2.4 Noise Prediction Methodology

The noise levels generated from the assessment scenarios for the construction phase shall be predicted through noise modelling using SoundPLAN v8.2. Information on the effective SWL of the assessment scenarios, proposed development areas constituting as area sources, noise sensitive ecological receptors as receivers, and topography before and after site clearance were input into the noise model to determine the predicted noise levels experiences by the NSRs. Topography data from the surveys conducted as part of the project were used for noise modelling purposes.

Where topography is not available, a flat terrain based on the nearest spot height from topographic surveys will be taken within the Project site and study area. The NSRs will then be assessed in accordance with the impact evaluation matrix in Section 5.3.3. Noise contours will be provided for the ecological receptor area with demarcation of impact intensity and impact significance. Based on the impact evaluation, mitigation to reduce airborne noise impacts will be recommended where necessary. The contours will be evaluated at the height of 0.5 m only which is most representative of ground dwelling fauna. Human receptors are excluded from the current assessment.

7.5.3.2.5 Noise Impact Evaluation Methodology

As detailed in the assessment methodology (see Section 5.3.3), NSRs are first identified and classified by the nature of receptors as reflected in Section 8.5.3.1. The unmitigated predicted noise levels for Scenario 1 and

Scenario 2 are presented from Figure 7.5.3 to Figure **7.5.12**. Then, Impact Intensity is determined by the magnitude of noise exceedances predicted as shown in Table 7.25 and Table 7.26. The magnitude of noise exceedances was predicted through noise modelling with SoundPLAN v8.2.

For the assessment of construction noise impacts on ecological receptors, the recorded average baseline noise levels are added to predicted noise levels to account for pre-existing baseline conditions. Therefore, the adjusted predicted noise levels were compared against the average baseline noise levels established as the no-worse-off than the average baseline criterion for ecological receptors adopted in this EIA (refer to Section 6.6.2.1). Noise exceedances derived from this comparison will then be used to deduce Impact Intensity.

By considering both Impact intensity and Receptor Sensitivity, Impact Consequence can be obtained as per the matrix in Table 5.17. Thereafter, likelihood of the impact from construction activities as calculated in Table 7.24 were applied to the evaluation. By relating the Impact Consequence and Likelihood of Occurrence, the Impact significance of airborne noise impacts was predicted as per the matrix in Table 5.19.

Further analysis and evaluation were then conducted to recommend additional mitigation measures (e.g., noise barriers etc.,) where necessary. At the end, a monitoring plan was established and triggers for action determined so that the impacts can be controlled within acceptable limits or as low as reasonably practicable.

7.5.3.2.6 Predicted Construction Noise Impacts

7.5.3.2.6.1 Scenario 1: Foundation works at Southern Parcels + Earthworks at Northern Parcels

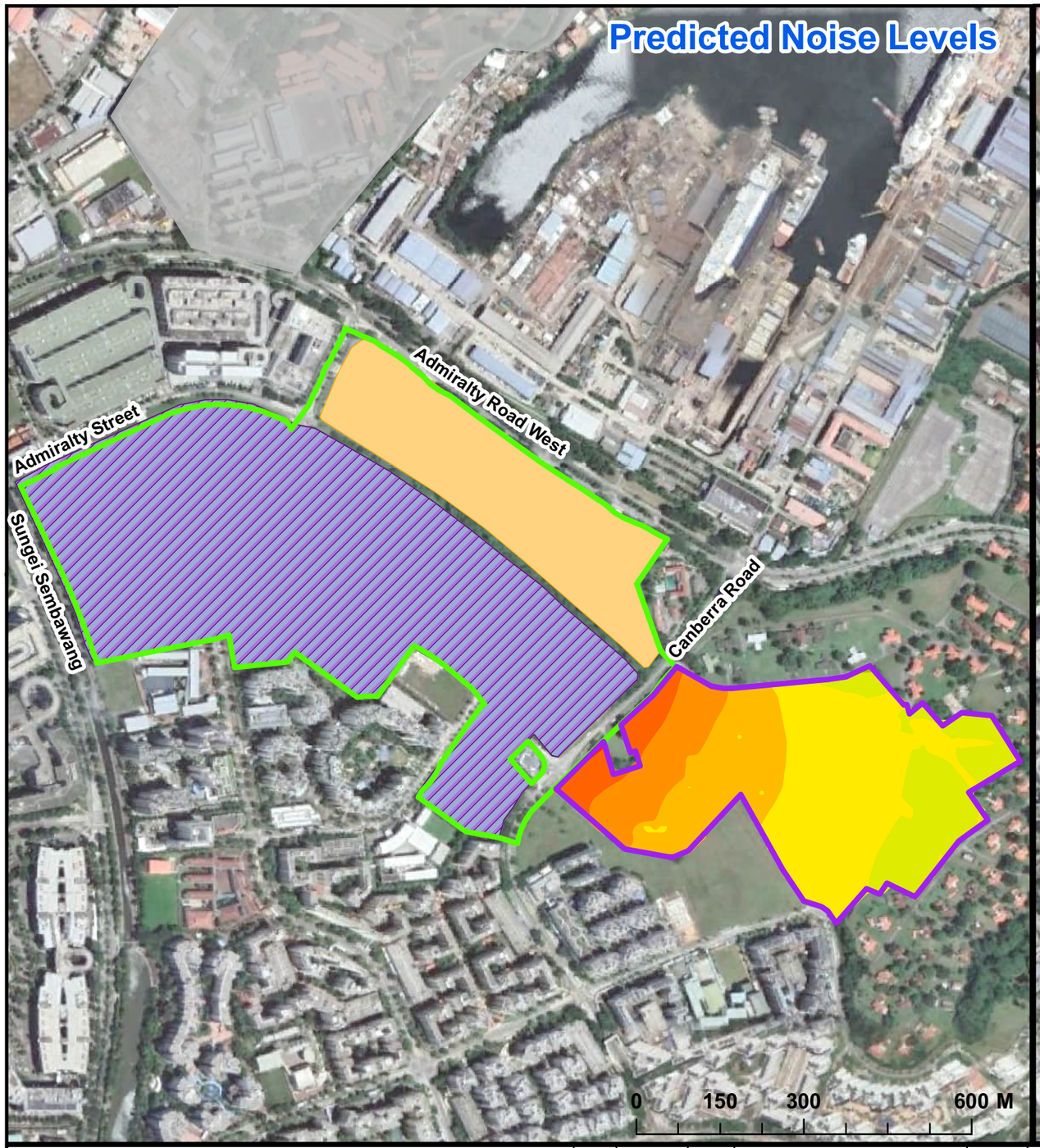
Based on the results predicted by the noise models, ecological receptors are predicted to experience noise exceedances of up to 20 dB(A) for $L_{Aeq(12hrs)}$ (7am – 7pm) and 24 dB(A) for $L_{Aeq(5\ mins)}$ (7am – 7pm), (see Table 7.25) arising from noise emissions associated with Scenario 1 (Foundation works at Southern Parcels and Earthworks at Northern Parcels). The resulting overall Impact Intensity is High due to the predicted noise exceedances corresponds to an overall Impact Consequence of High for the assessment Scenario 1.When relating the Impact Consequence of High with a Likelihood of Occurrence of Certain / Continuous (refer to Table 7.24), it was determined that the overall Impact Significance arising from the proposed construction activities associated with the assessment Scenario 1 would be **Major during 7am to 7pm.**

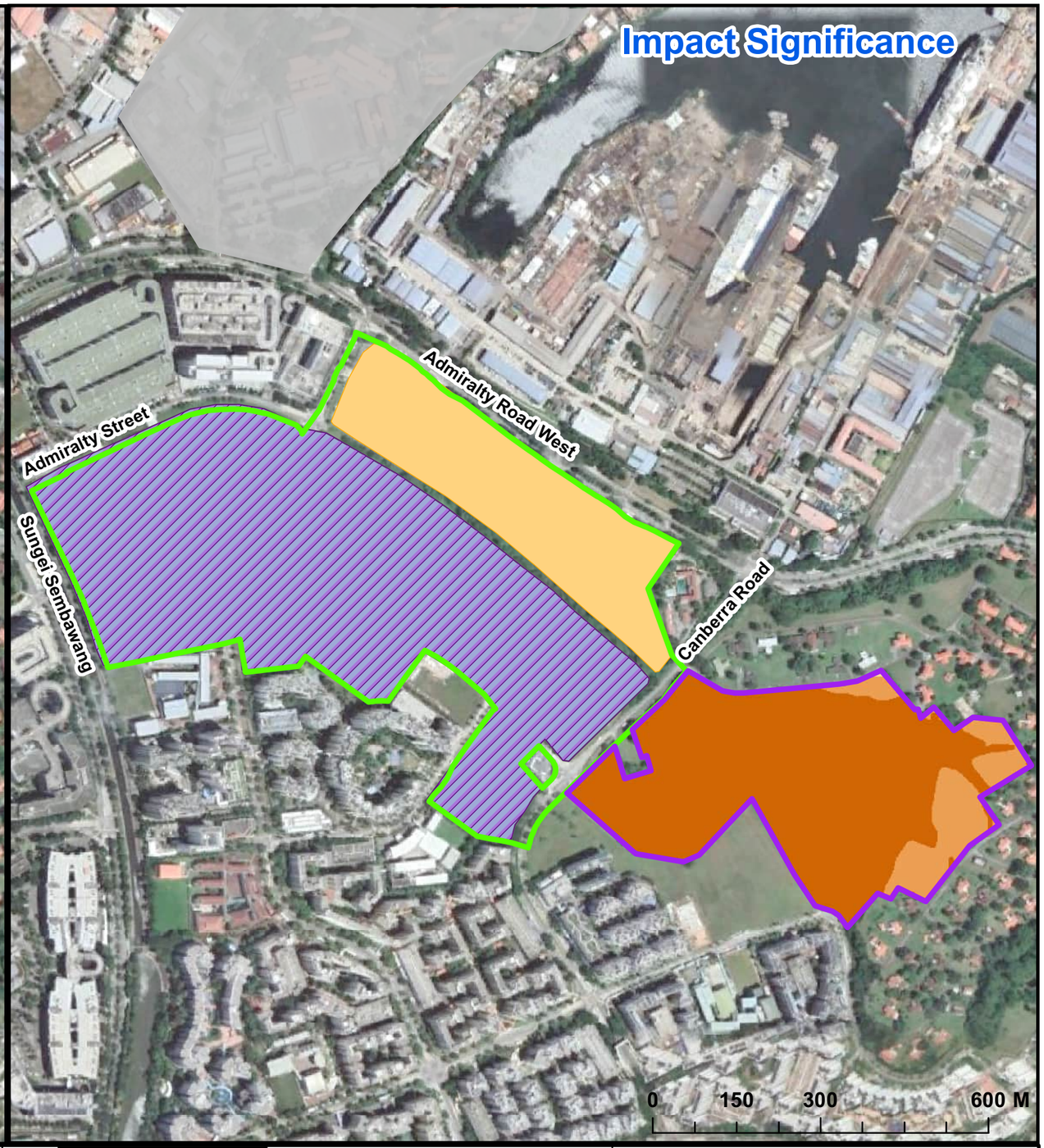
Based on the results predicted by the noise models, ecological receptors are predicted to experience noise exceedances of up to 24 dB(A) for $L_{Aeq(12hrs)}$ (7pm – 7am), 28 dB(A) for $L_{Aeq(1hr)}$ (7pm – 10pm) and 28 dB(A) for $L_{Aeq(5\ mins)}$ (7pm – 10pm), (see Table 7.25) arising from noise emissions associated with Scenario 1 (Foundation works at Southern Parcels and Earthworks at Northern Parcels). The resulting overall Impact Intensity is High due to the predicted noise exceedances corresponds to an overall Impact Consequence of High for the assessment Scenario 1.When relating the Impact Consequence of High with a Likelihood of Occurrence of Likely/Regular ($L_{Aeq(12hrs)}$ and $L_{Aeq(1hr)}$) and Certain / Continuous ($L_{Aeq(5\ mins)}$) (refer to Table 7.24), it was determined that the overall Impact Significance arising from the proposed construction activities associated with the assessment Scenario 1 would be **Major during 7pm to 10pm.**

`

Table 7.25 Preliminary Construction Noise Impacts (Scenario 1)

Assessment Scenario(s)	Ecological Receptor Sensitivity	Maximum Predicted Noise Level, dB(A)	Exceedances, dB(A)	Impact Intensity	Impact Consequence	Likelihood of Occurrence	Maximum Overall Significance	Area (ha)	Percentage Distribution (%)
Scenario 1: $L_{Aeq(12hrs)}$, dB(A) 7am to 7pm	Priority 1	74	20	High	High	Certain / Continuous	Major	18.1	85.38%
Scenario 1: $L_{Aeq(12hrs)}$, dB(A) 7pm to 7am	Priority 1	68	24	High	High	Likely / Regular	Major	21.2	100%
Scenario 1: $L_{Aeq(1hr)}$, dB(A) 7pm to 10pm	Priority 1	73	28	High	High	Likely / Regular	Major	21.2	100%
Scenario 1: $L_{Aeq(5min)}$, dB(A) 7am to 7pm	Priority 1	74	24	High	High	Certain / Continuous	Major	21.2	100%
Scenario 1: $L_{Aeq(5min)}$, dB(A) 7pm to 10pm	Priority 1	73	28	High	High	Certain / Continuous	Major	21.2	100%





Legend

- Ecological Receptor
- Project Boundary
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels

Impact Significance

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(12 hours), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

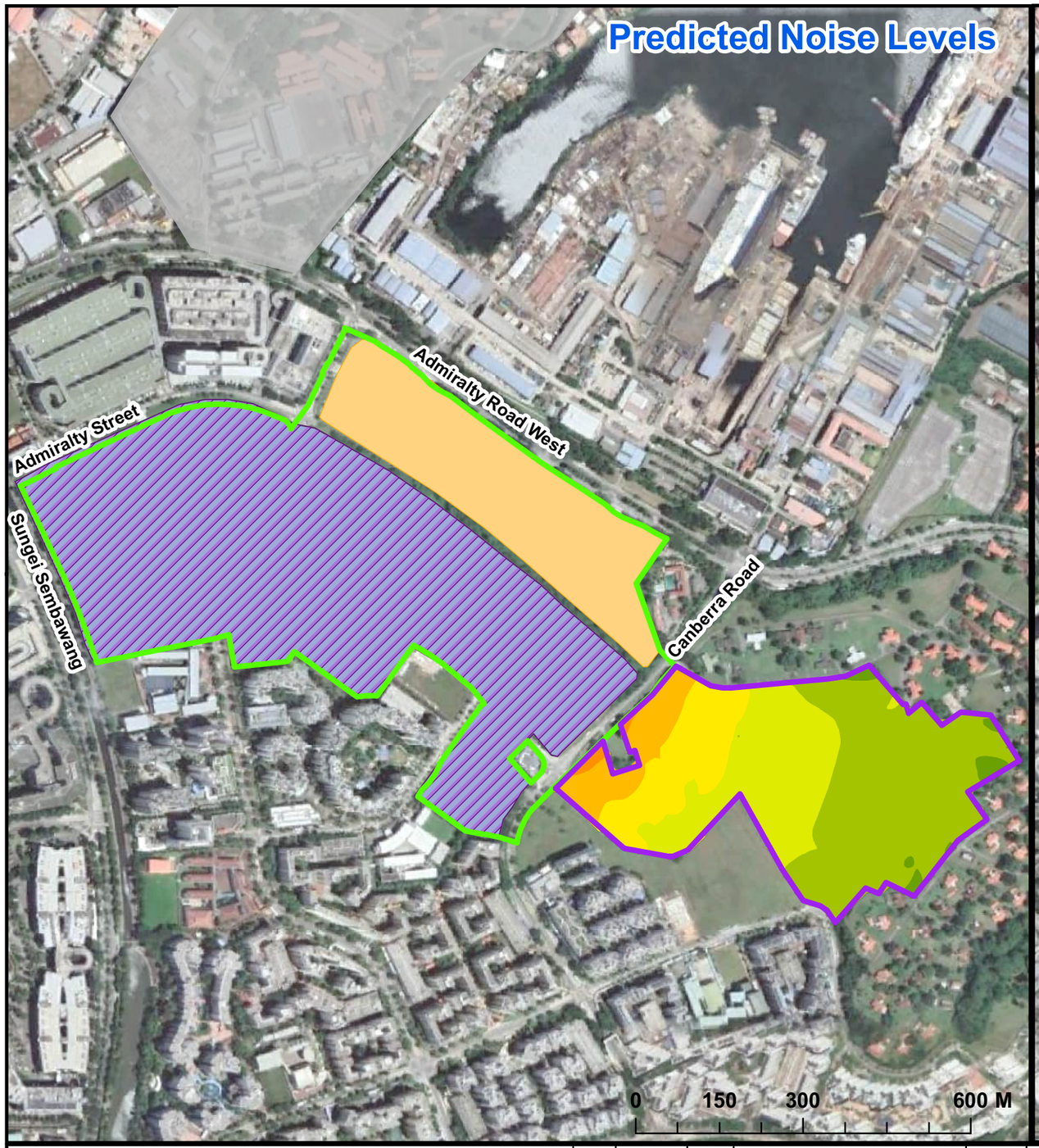
Figure Title :
Ecological Noise Sensitive Receptors - Scenario 1: Site Clearance & Earthworks, Foundation Works and Road Construction Works, LAeq (12 hours), 7am - 7pm (Unmitigated Predicted Noise Levels)

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
TYL	SAG	JAG	7.5.3	1	1 of 1
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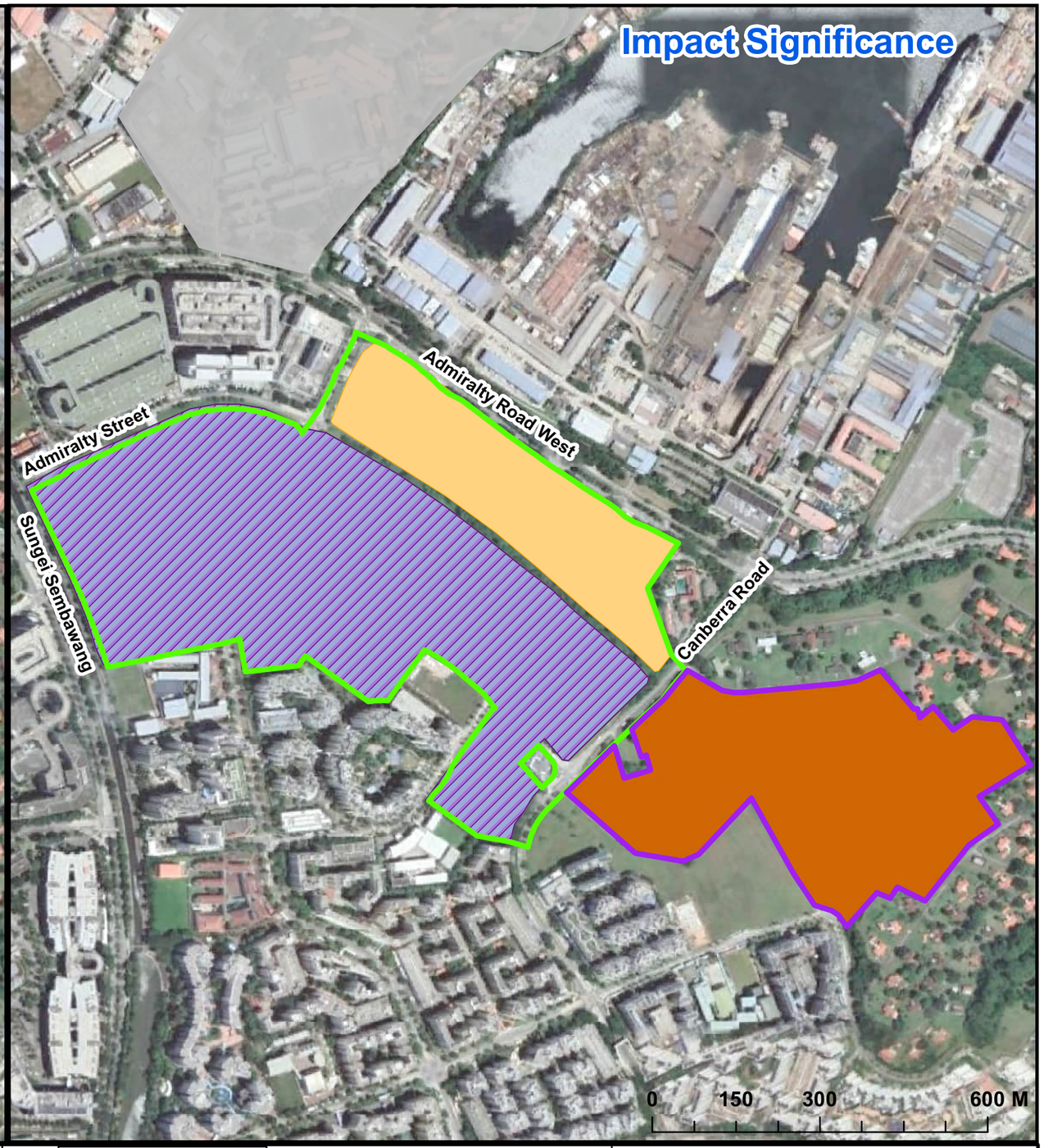
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Predicted Noise Levels



Impact Significance



Legend

- Ecological Receptor
- Project Boundary
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels

Impact Significance

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq (12 hours), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

Rev.	Date	By	Description	Chk'd	App'd
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Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
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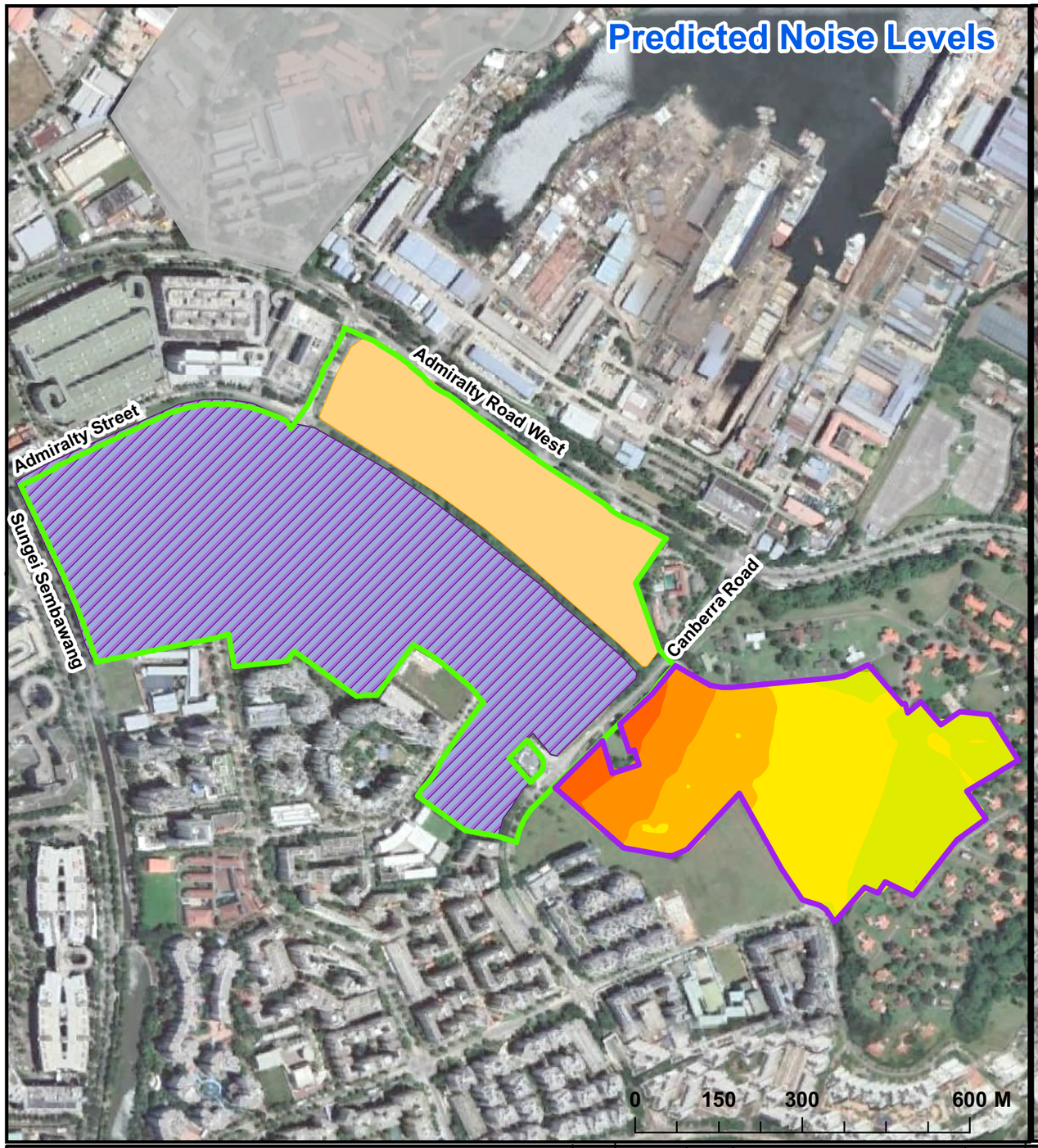
Figure Title :
Ecological Noise Sensitive Receptors - Scenario 1: Site Clearance & Earthworks, Foundation Works and Road Construction Works, LAeq (12 hours), 7pm - 7am (Unmitigated Predicted Noise Levels)

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
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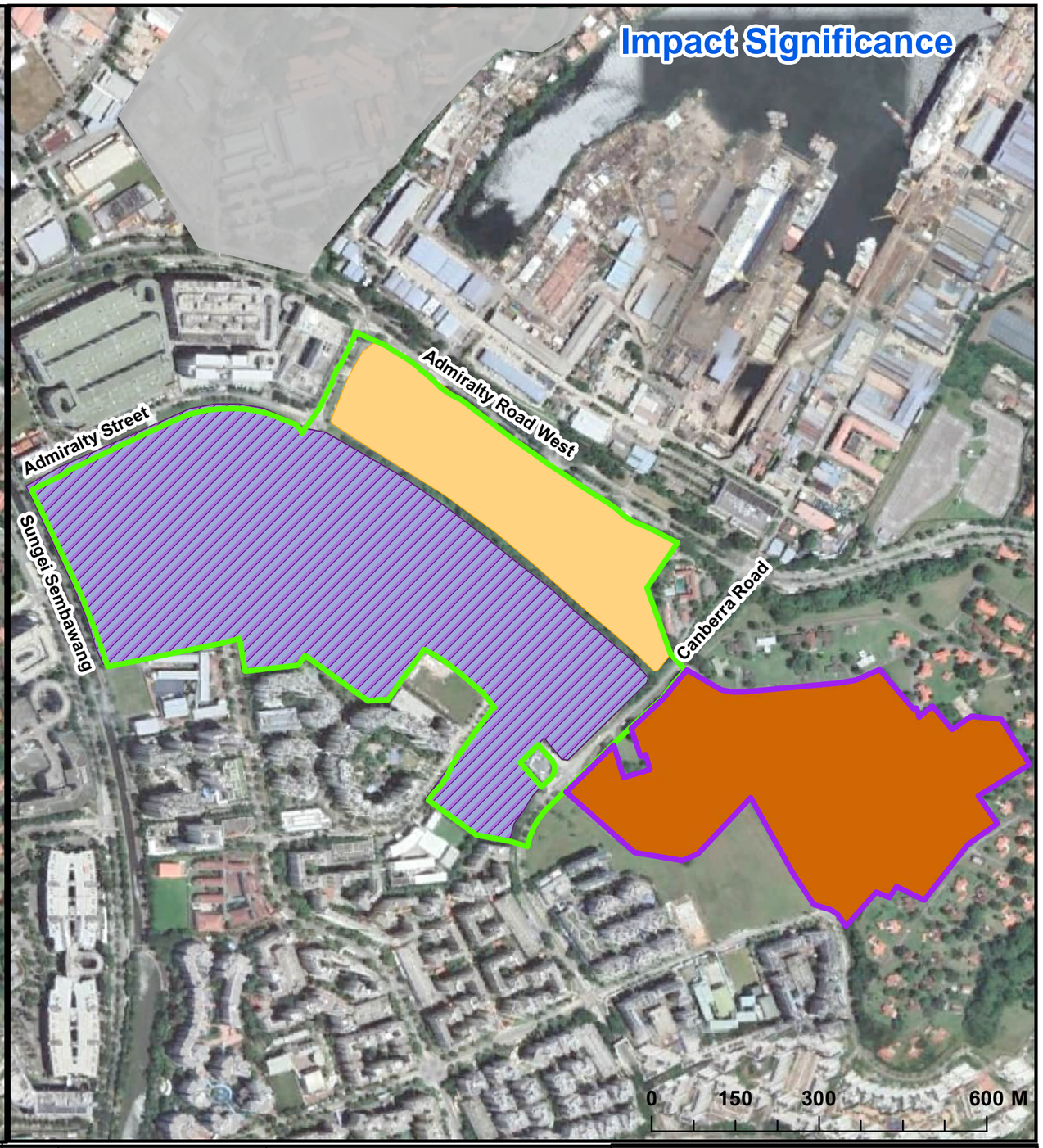
Note: Source of basemap - Google Earth Map

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Predicted Noise Levels



Impact Significance



Legend

- Ecological Receptor
- Project Boundary
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels

Impact Significance

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(1 hour), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
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Figure Title :
Ecological Noise Sensitive Receptors - Scenario 1: Site Clearance & Earthworks, Foundation Works and Road Construction Works, LAeq (1 hour), 7pm - 10pm (Unmitigated Predicted Noise Levels)

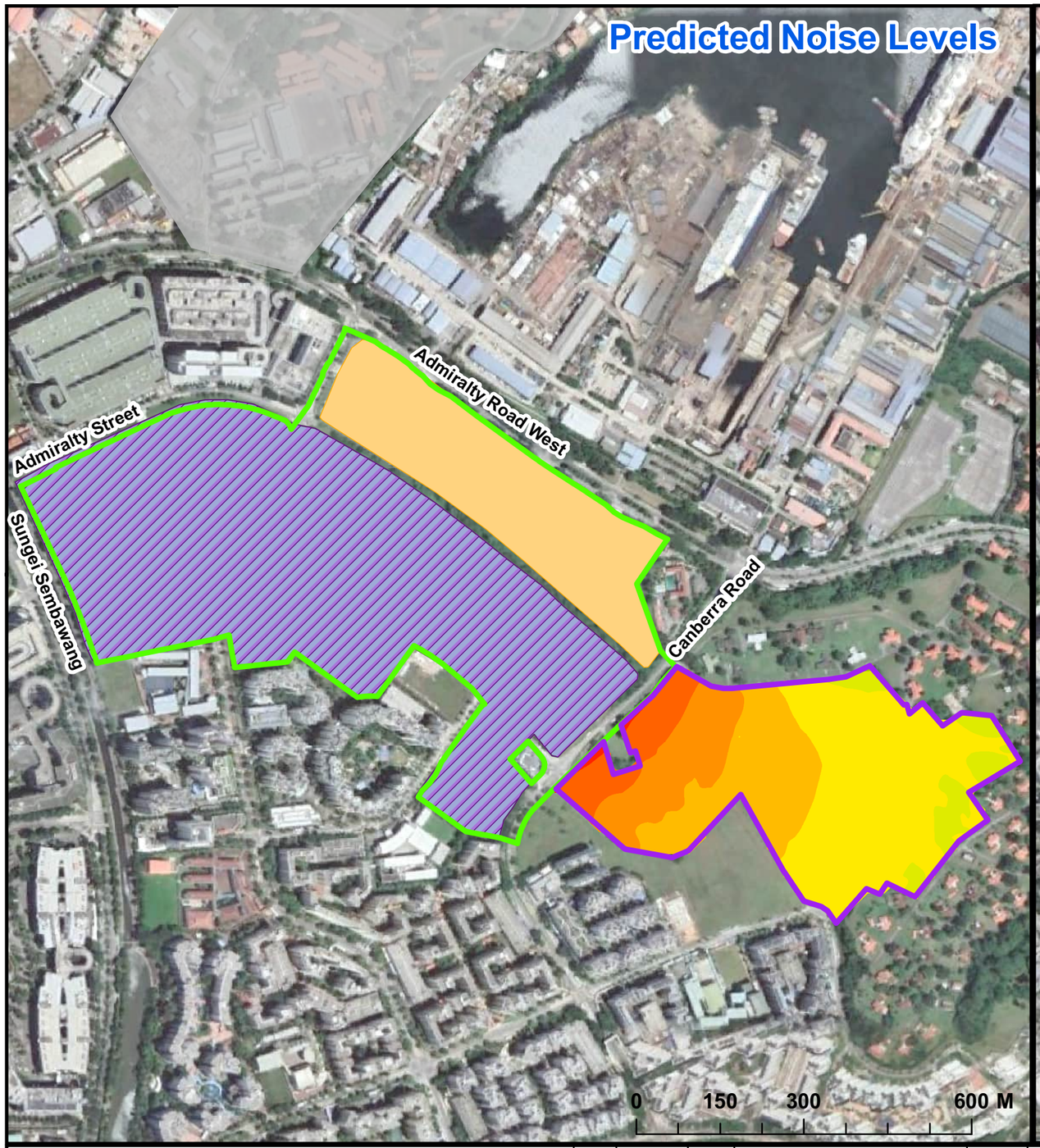
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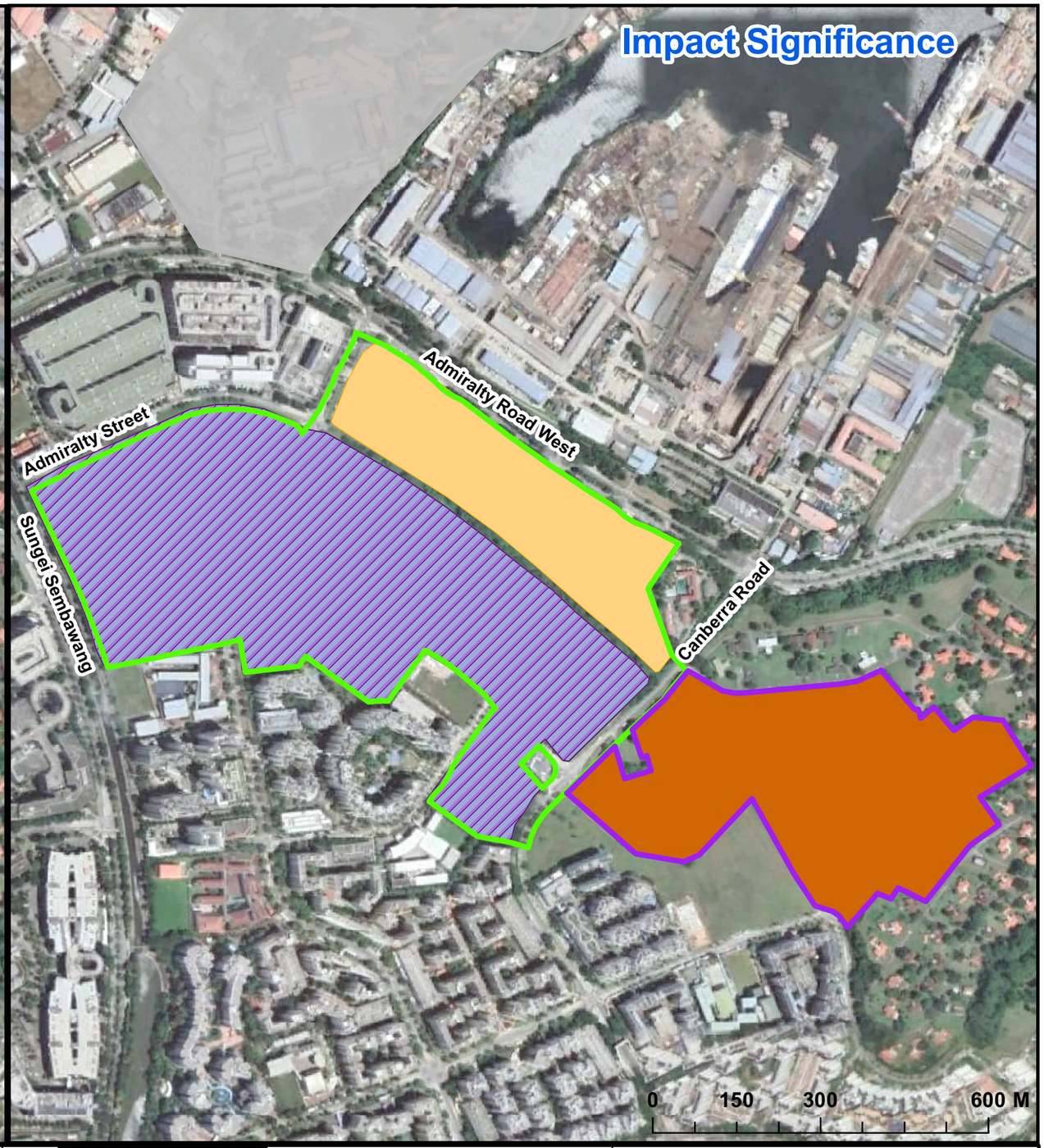
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Legend

- Ecological Receptor
- Project Boundary
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels

Impact Significance

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(5 mins), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

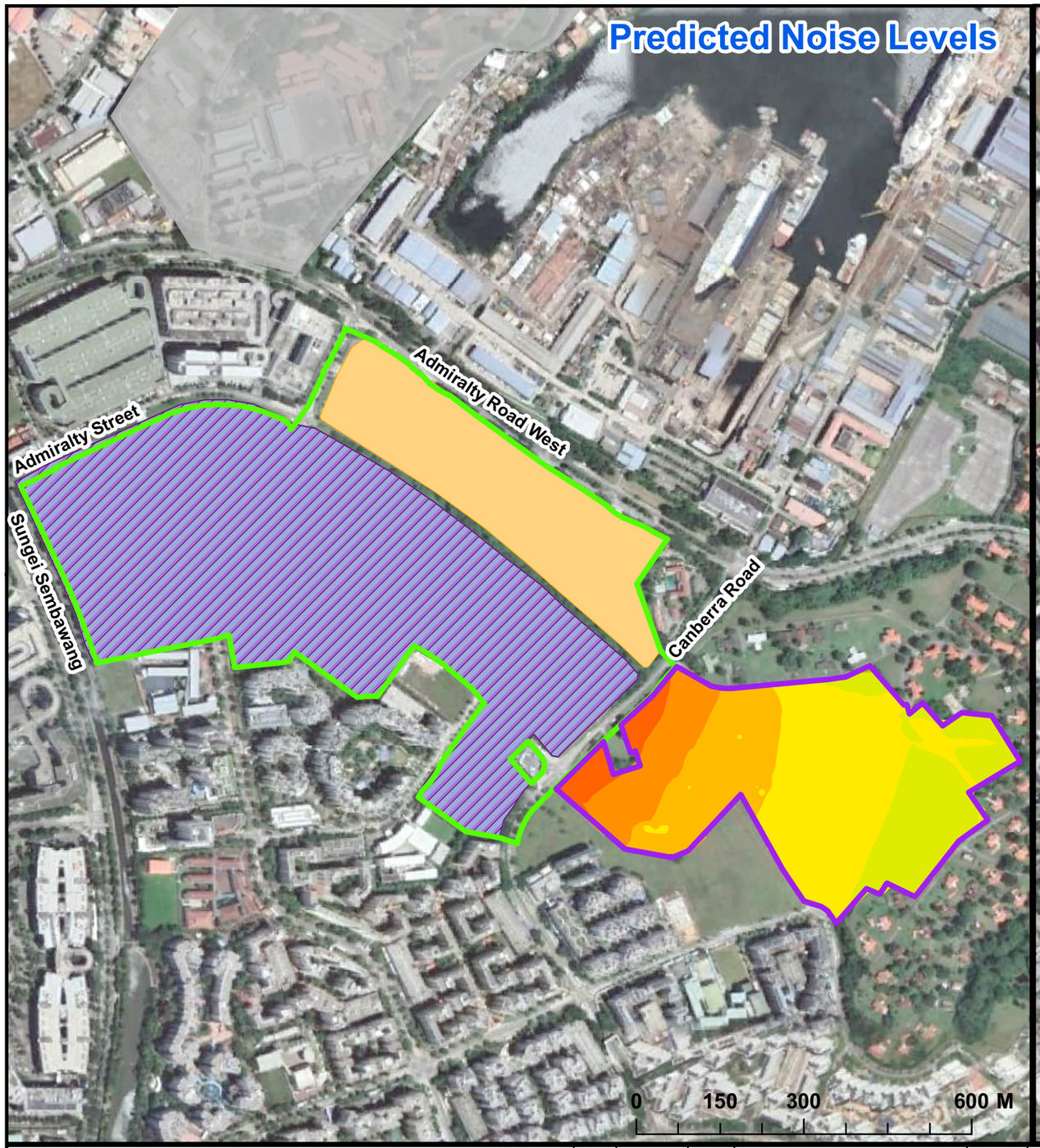
Project Title :
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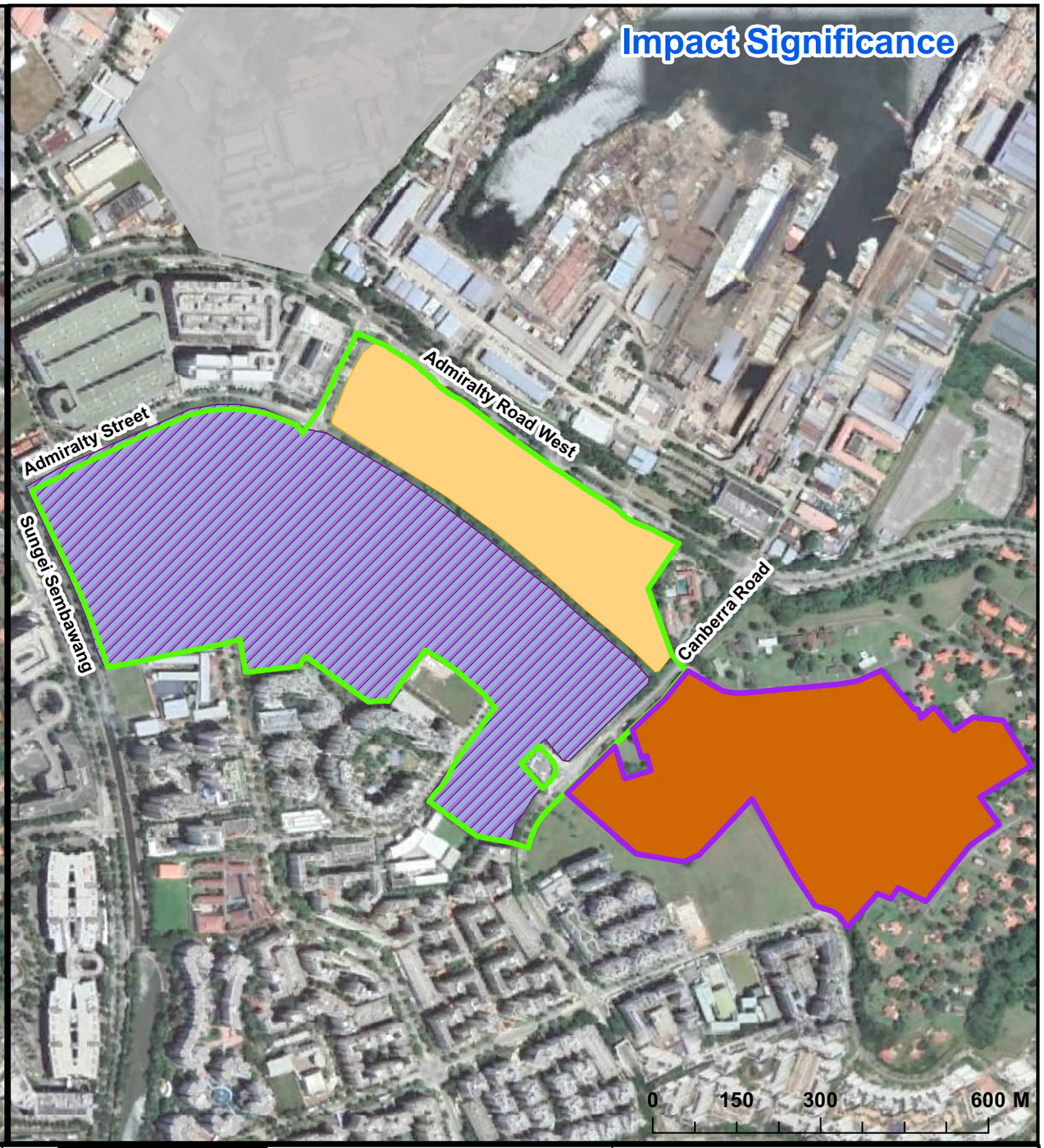
Figure Title :
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Legend

- Ecological Receptor
- Project Boundary
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels

Impact Significance

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(5 mins), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

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Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :
Ecological Noise Sensitive Receptors - Scenario 1: Site Clearance & Earthworks, Foundation Works and Road Construction Works, LAeq (5 min), 7pm - 10pm (Unmitigated Predicted Noise Levels)

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7.5.3.2.6.2 Scenario 2: Foundation works at Northern Parcels + Reinstatement works at Southern Parcels

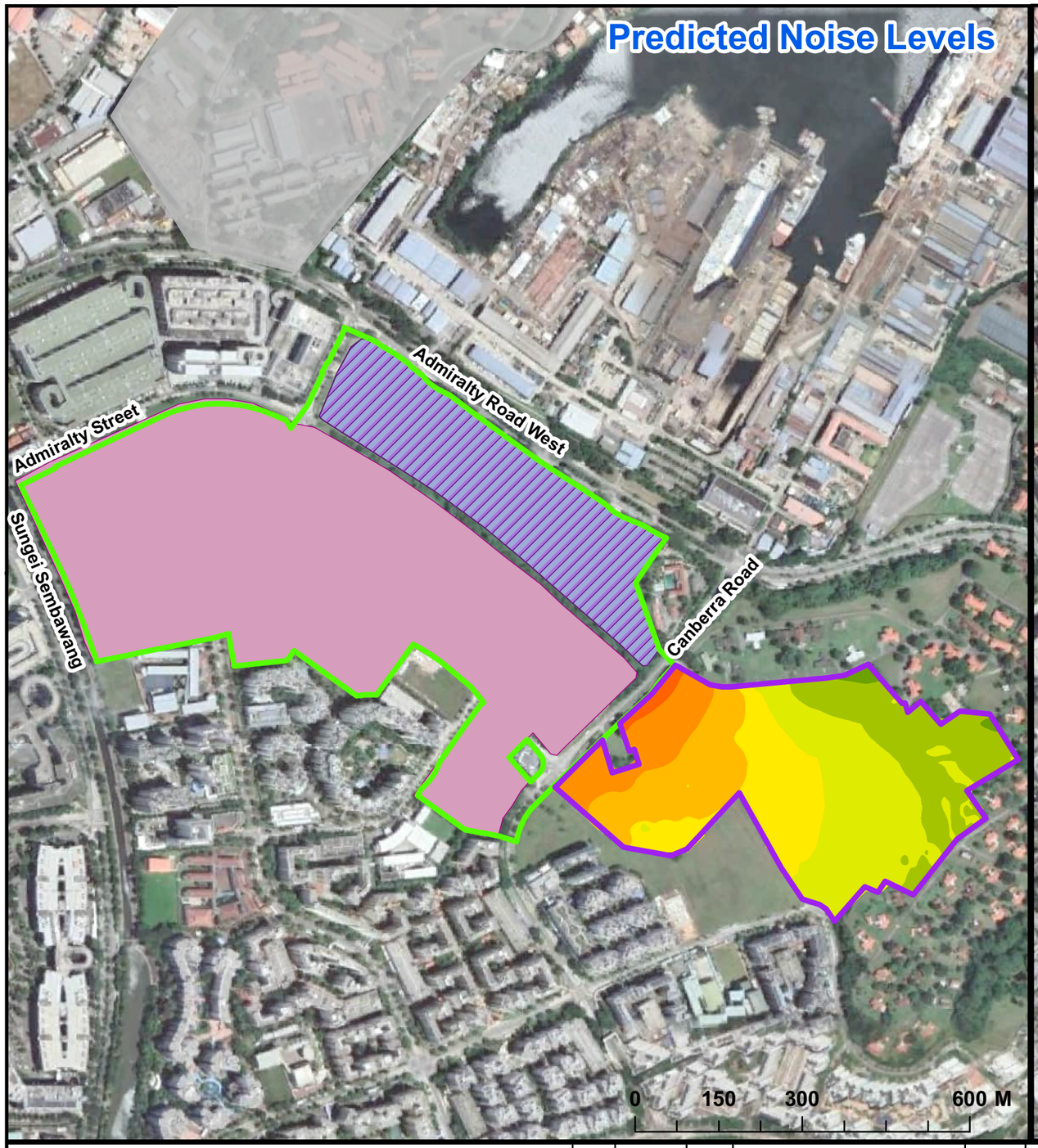
Based on the results predicted by the noise models, ecological receptors are predicted to experience noise exceedances of up to 17 dB(A) for $L_{Aeq(12hrs)}$ (7am – 7pm) and 22 dB(A) for $L_{Aeq(5\ mins)}$ (7am – 7pm), (see Table 7.26) arising from noise emissions associated with Scenario 2 (Foundation works at Northern Parcels and Reinstatement works at Southern Parcels). The resulting overall Impact Intensity is High due to the predicted noise exceedances corresponds to an overall Impact Consequence of High for the assessment Scenario 2.When relating the Impact Consequence of High with a Likelihood of Occurrence of Certain / Continuous (refer to Table 7.24), it was determined that the overall Impact Significance arising from the proposed construction activities associated with the assessment Scenario 2 would be **Major during 7am to 7pm.**

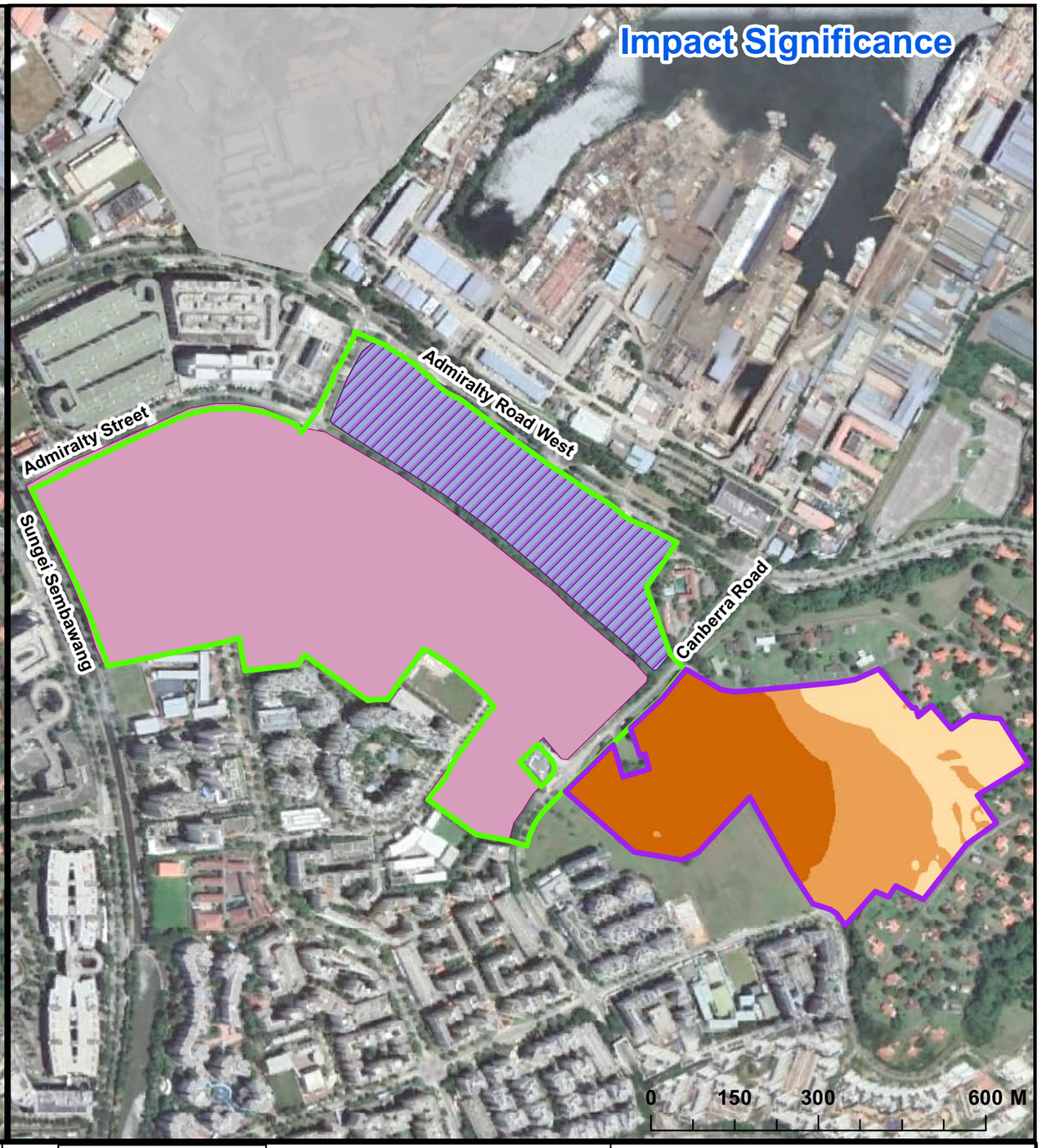
Based on the results predicted by the noise models, ecological receptors are predicted to experience noise exceedances of up to 25 dB(A) for $L_{Aeq(12hrs)}$ (7pm – 7am), (see Table 7.26) arising from noise emissions associated with Scenario 2 (Foundation works at Northern Parcels and Reinstatement works at Southern Parcels). The resulting overall Impact Intensity is High due to the predicted noise exceedances corresponds to an overall Impact Consequence of High for the assessment Scenario 1.When relating the Impact Consequence of High with a Likelihood of Occurrence of Likely/Regular for $L_{Aeq(12hrs)}$ (refer to Table 7.24), it was determined that the overall Impact Significance arising from the proposed construction activities associated with the assessment Scenario 2 would be **Major during 7pm to 7am** for $L_{Aeq(12hrs)}$.

Based on the results predicted by the noise models, ecological receptors are predicted to experience noise exceedances of up to 25 dB(A) for $L_{Aeq(1hr)}$ (7pm – 10pm) and 27 dB(A) for $L_{Aeq(5\ mins)}$ (7pm – 10pm), (see Table 7.26) arising from noise emissions associated with Scenario 2 (Foundation works at Northern Parcels and Reinstatement works at Southern Parcels). The resulting overall Impact Intensity is High due to the predicted noise exceedances corresponds to an overall Impact Consequence of High for the assessment Scenario 1.When relating the Impact Consequence of High with a Likelihood of Occurrence of Certain / Continuous ($L_{Aeq(5\ mins)}$) (refer to Table 7.24), it was determined that the overall Impact Significance arising from the proposed construction activities associated with the assessment Scenario 2 would be **Major during 7pm to 10pm for** $L_{Aeq(1hr)}$ and $L_{Aeq(5\ mins)}$.

Table 7.26 Preliminary Construction Noise Impacts (Scenario 2)

Assessment Scenario(s)	Ecological Receptor Sensitivity	Maximum Predicted Noise Level, dB(A)	Exceedances, dB(A)	Impact Intensity	Impact Consequence	Likelihood of Occurrence	Maximum Overall Significance	Area (ha)	Percentage Distribution (%)
Scenario 2: $L_{Aeq(12hrs)}$, dB(A) 7am to 7pm	Priority 1	71	17	High	High	Certain / Continuous	Major	10	47.17%
Scenario 2: $L_{Aeq(12hrs)}$, dB(A) 7pm to 7am	Priority 1	69	25	High	High	Likely / Regular	Major	21.2	100%
Scenario 2: $L_{Aeq(1hr)}$, dB(A) 7pm to 10pm	Priority 1	70	25	High	High	Certain / Continuous	Major	21.2	100%
Scenario 2: $L_{Aeq(5min)}$, dB(A) 7am to 7pm	Priority 1	72	22	High	High	Certain / Continuous	Major	21	99.06%
Scenario 2: $L_{Aeq(5min)}$, dB(A) 7pm to 10pm	Priority 1	72	27	High	High	Certain / Continuous	Major	21.2	100%





Legend

- Project Boundary
- Ecological Receptor
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels

Impact Significance

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(12 hours), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
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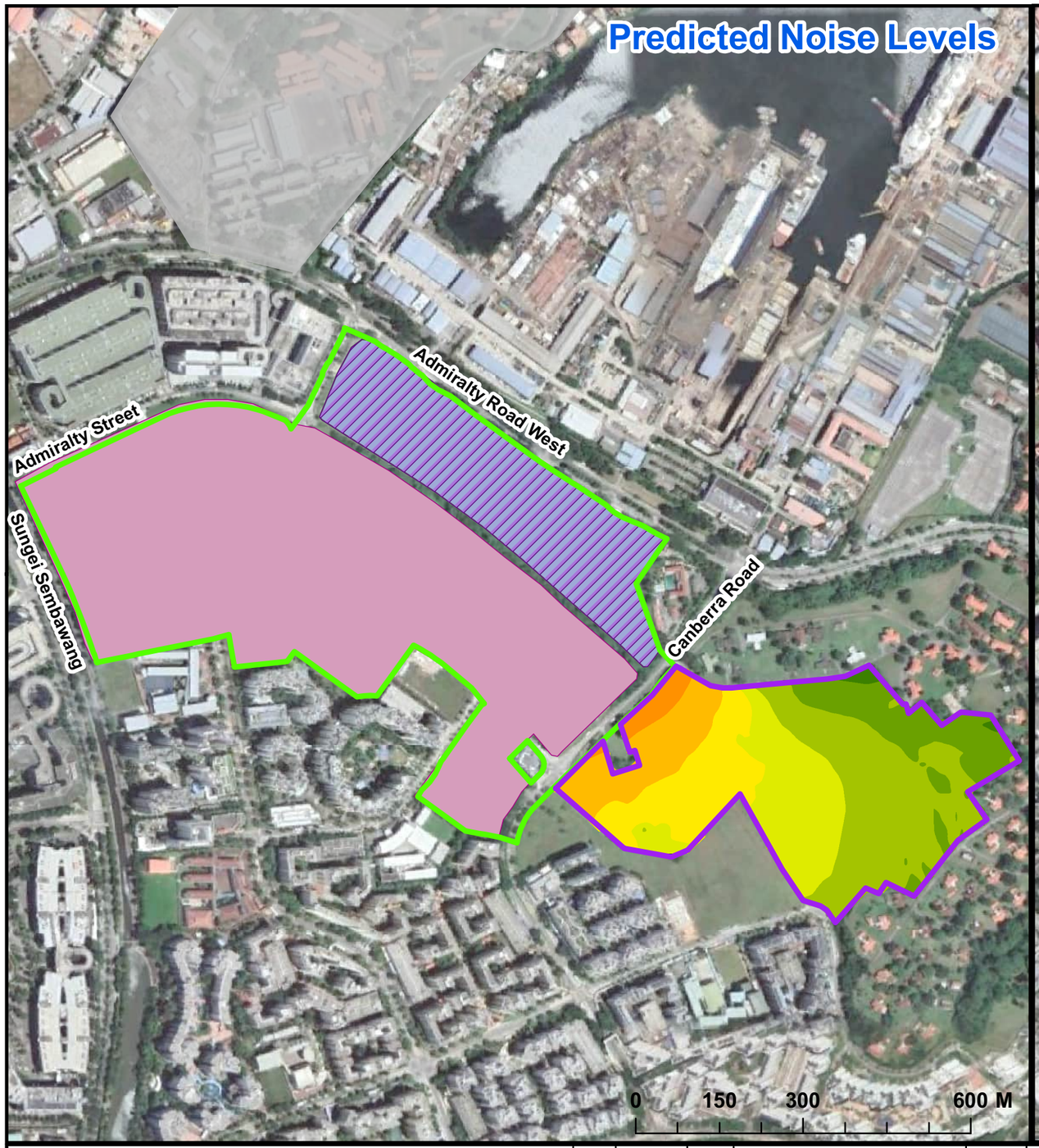
Figure Title :
Ecological Noise Sensitive Receptors - Scenario 2: Site Foundation Works at Northern Parcels, Reinstatement and Landscaping Works at Southern Parcels LAeq (12 hours), 7am - 7pm (Unmitigated Predicted Noise Levels)

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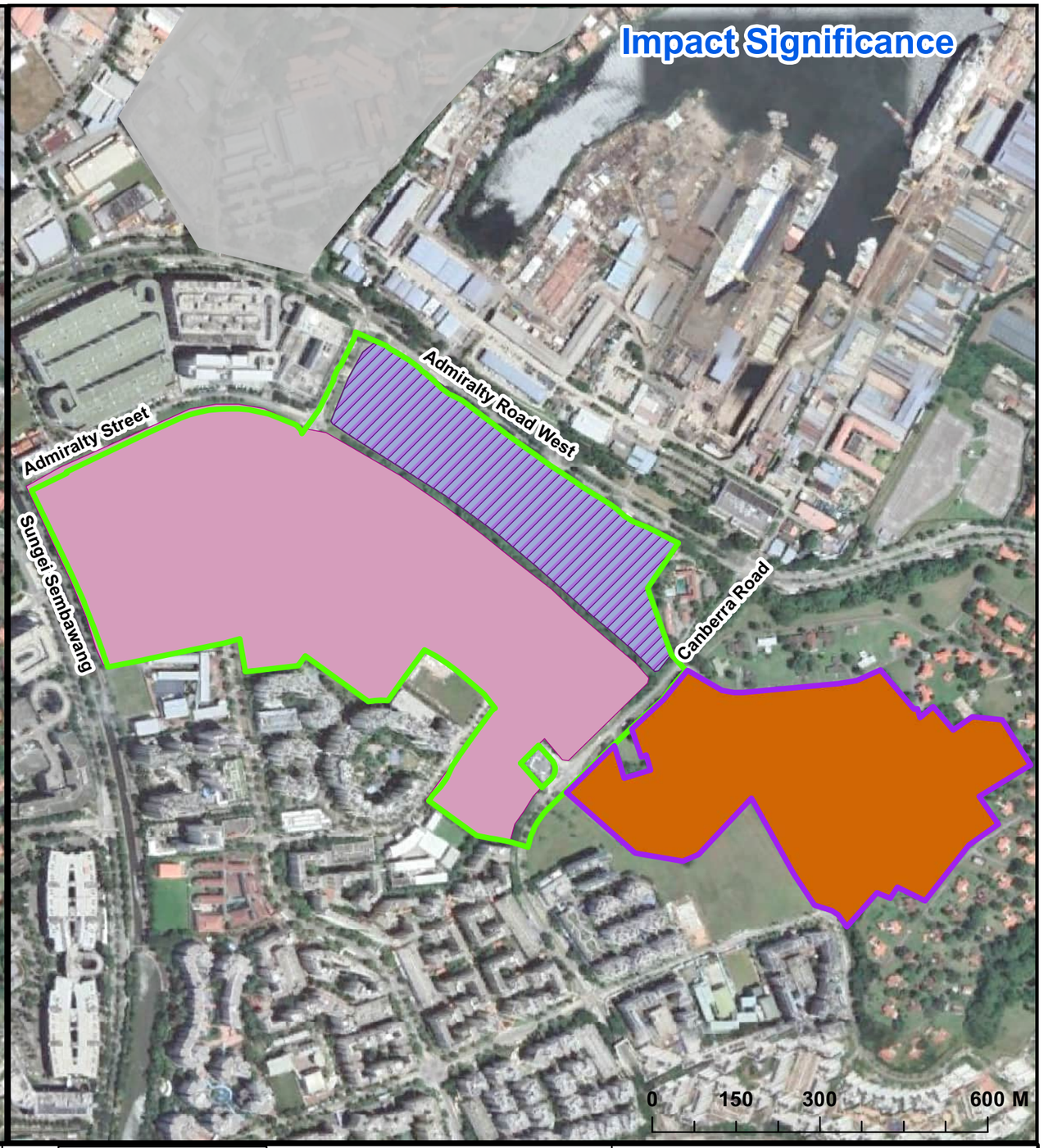
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Predicted Noise Levels



Impact Significance



Legend

- Ecological Receptor
- Project Boundary
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(12 hours), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

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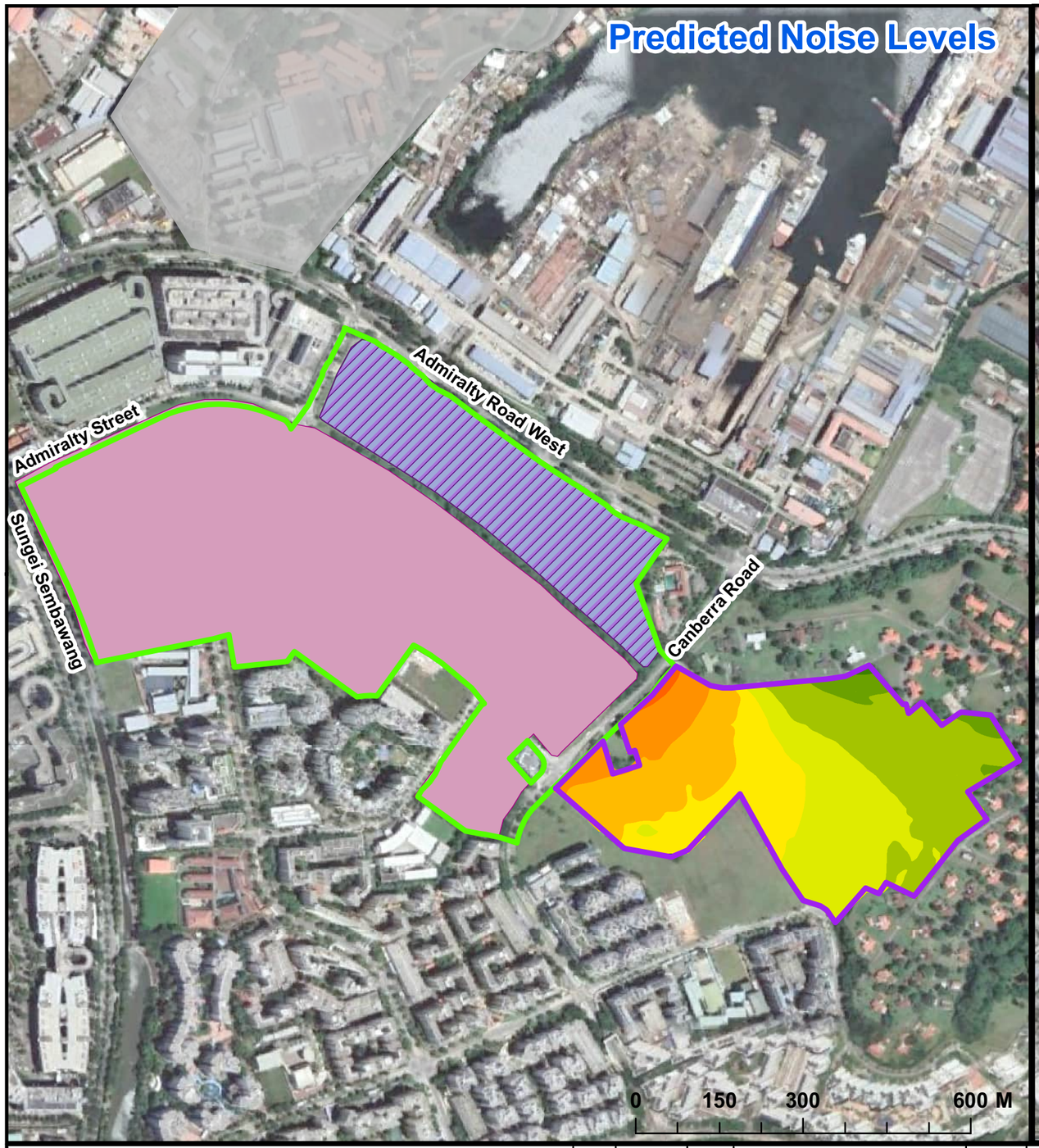
Figure Title :
Ecological Noise Sensitive Receptors - Scenario 2: Site Foundation Works at Northern Parcels, Reinstatement and Landscaping Works at Southern Parcels LAeq (12 hours), 7pm - 7am (Unmitigated Predicted Noise Levels)

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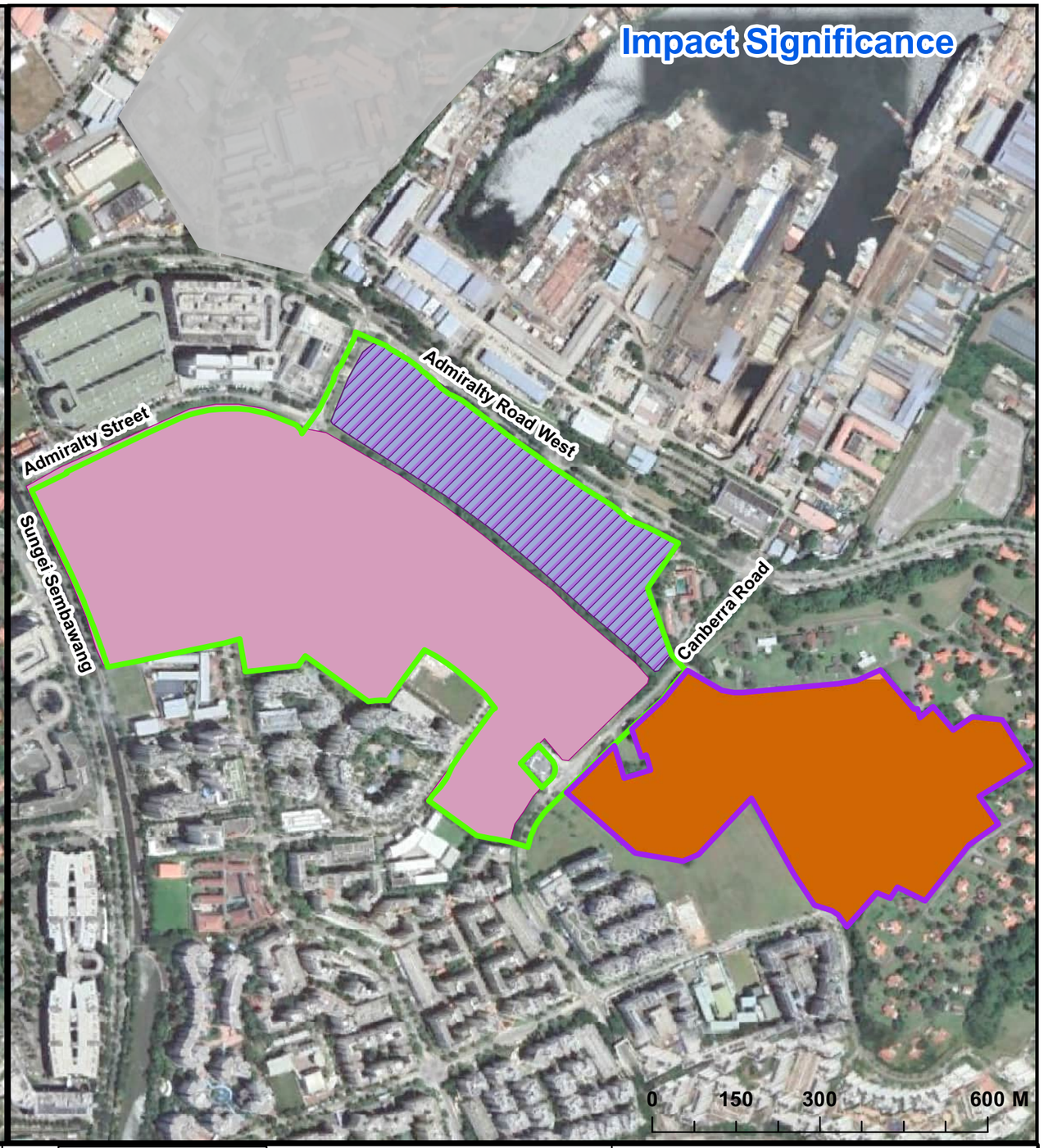
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Predicted Noise Levels



Impact Significance



Legend

- Ecological Receptor
- Project Boundary
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq (1 hour), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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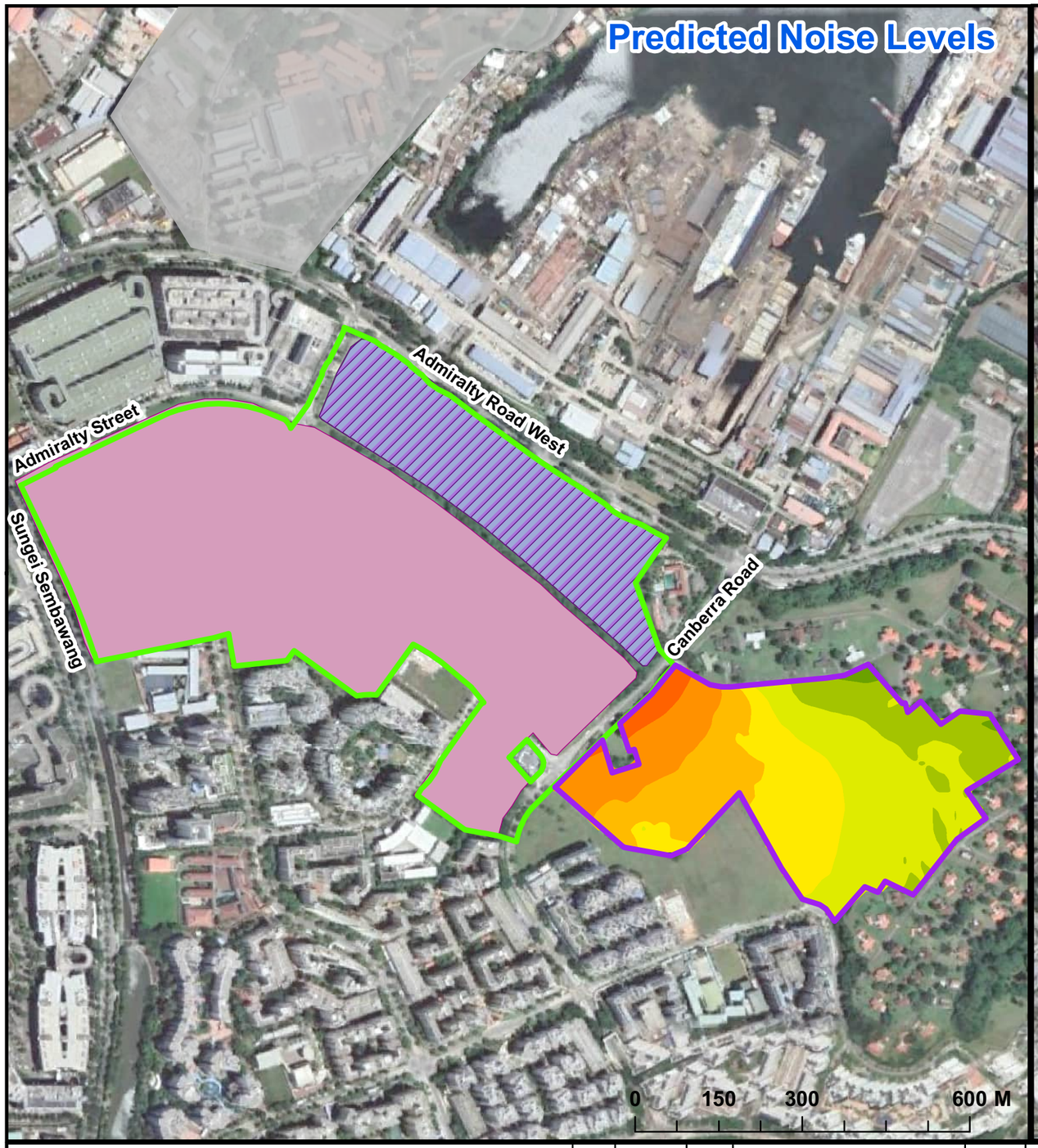
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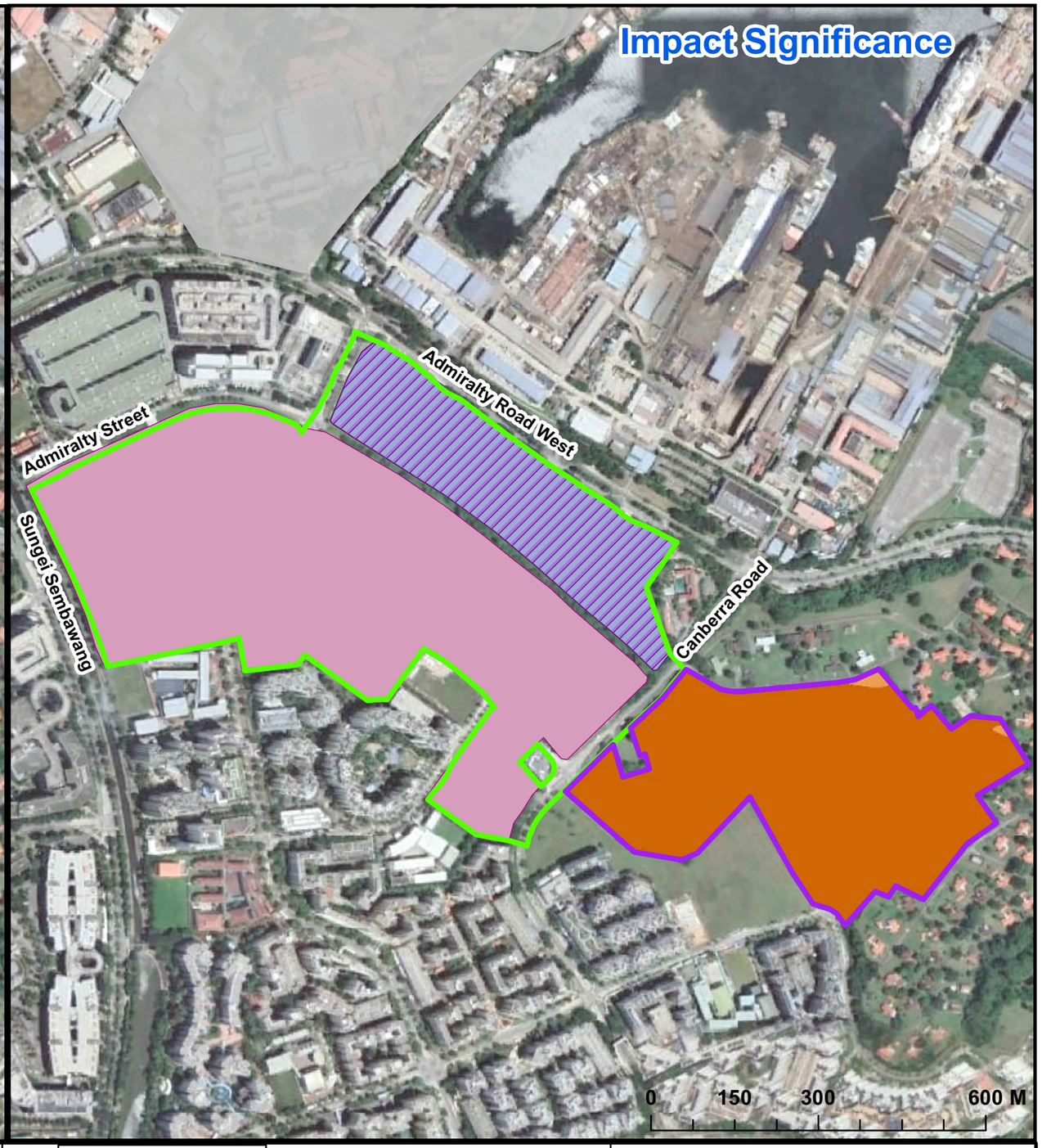
Figure Title :
Ecological Noise Sensitive Receptors - Scenario 2: Site Foundation Works at Northern Parcels, Reinstatement and Landscaping Works at Southern Parcels LAeq (1 hour), 7pm - 10pm (Unmitigated Predicted Noise Levels)

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Legend

- Ecological Receptor
- Project Boundary
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(5 mins), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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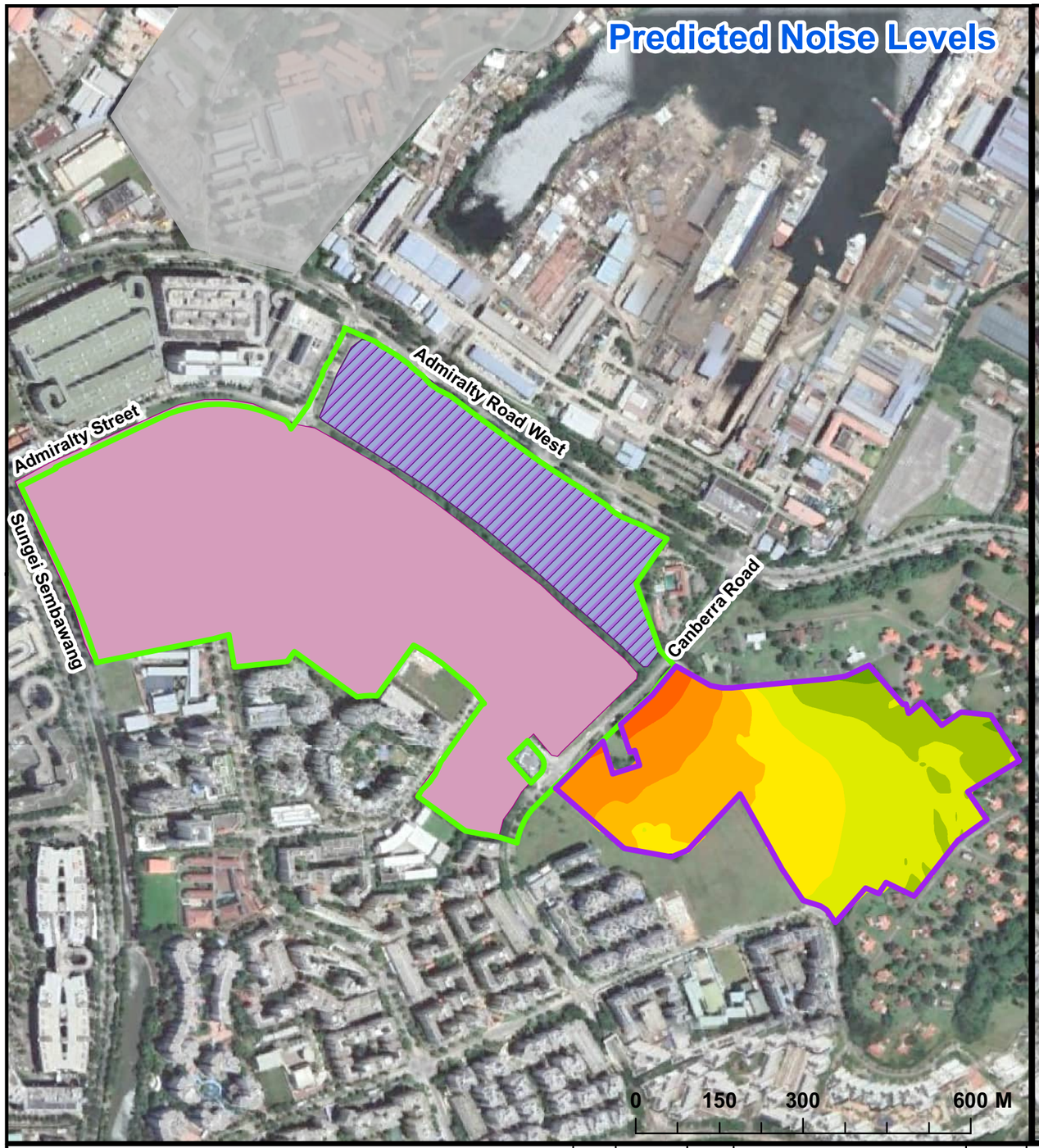
Figure Title :
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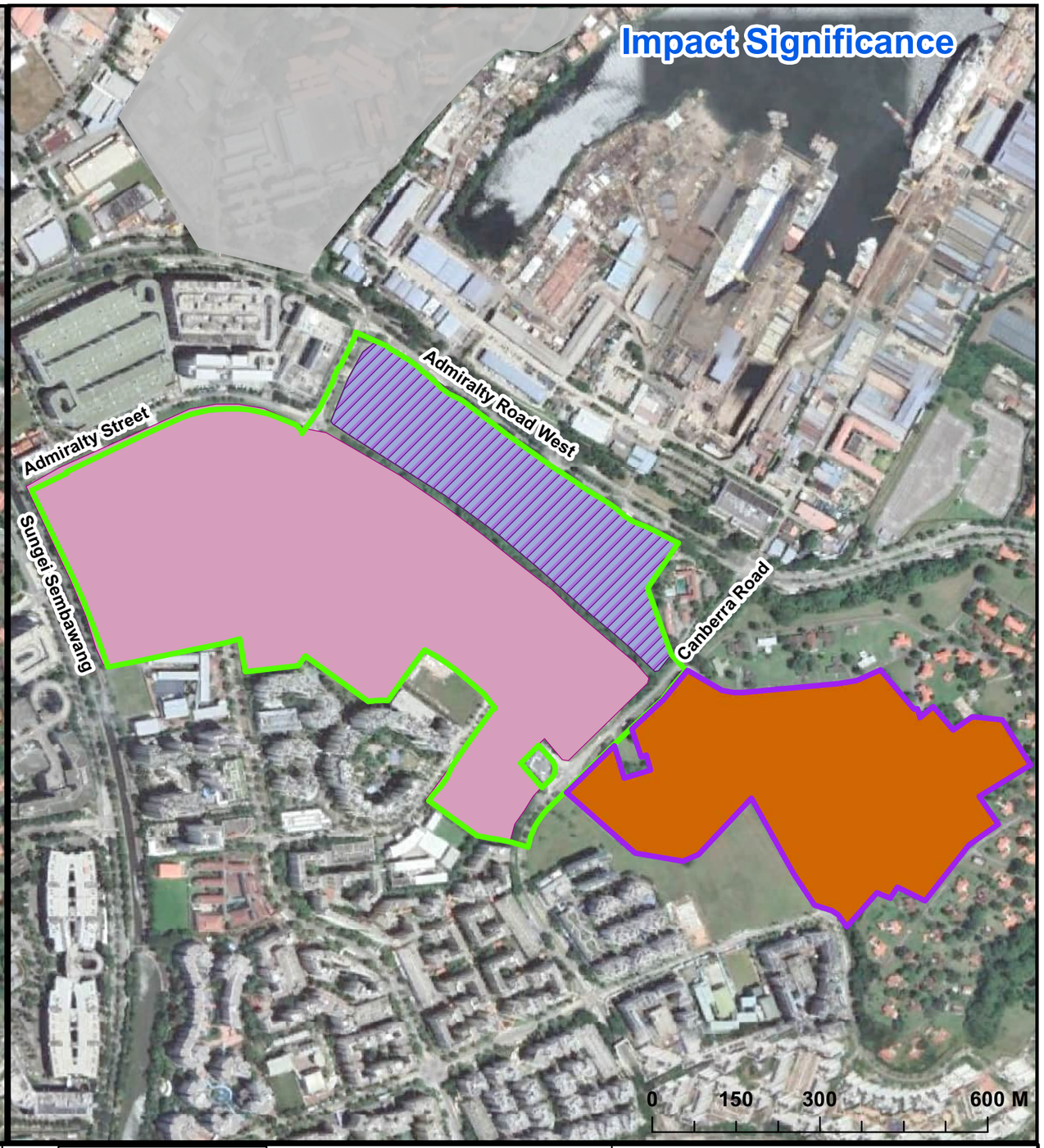
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Predicted Noise Levels



Impact Significance



Legend

- Ecological Receptor
- Project Boundary
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(5 mins), dB

- <48
- 48-51
- 51-54
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Figure Title :
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7.5.3.3 Proposed Mitigation Measures

The wide extent of **Major** noise impacts (10 – 21.2 ha) from unmitigated Scenario 1 & 2 can be attributed largely to the proximity of construction worksite to the ecological receptor N5 forested area, stringent criteria (lower baseline levels at the N5 forested area) and longer working hours (7am to 10pm).

At this Final Report stage, the following mitigation measures are recommended.

7.5.3.3.1.1 Installation of Noise Barriers

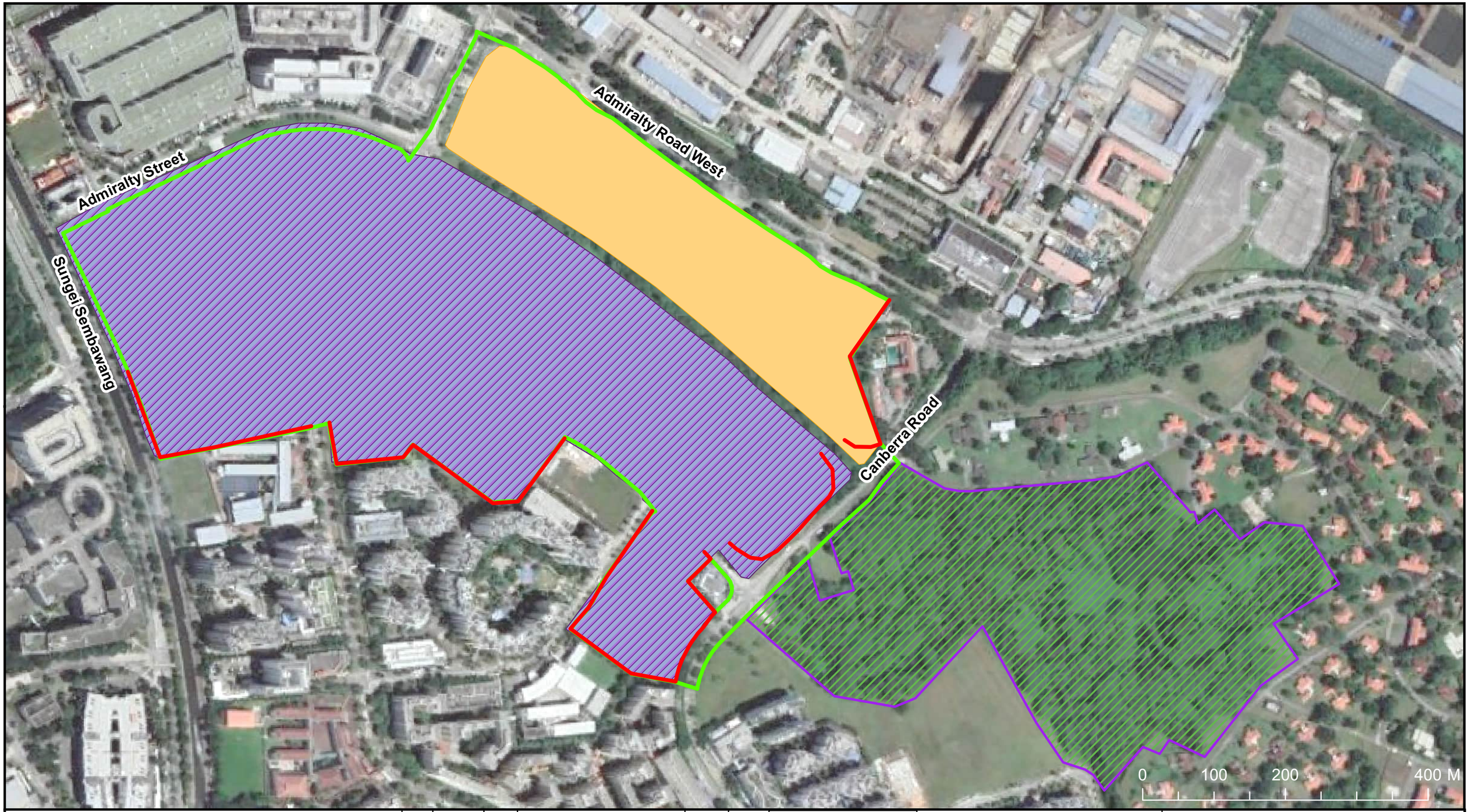
When substitution of noisy equipment is not applicable or feasible, installation of noise barriers should be considered. The barrier height and placement position of a noise barrier are the prime factors in determining its efficiency and are as follows:

- Noise barriers should be placed as close as possible to either the source, or the receiver position for maximum effectiveness; and
- Human Noise sensitive receptors within 150 m from construction worksites excluded from the assessment are not taken into account for noise barriers.

Following the above suggestions, the height of the noise barriers was determined based on the extent of unmitigated impacts experienced by the N5 forested area and the viability of implementation with consideration of space required to stabilise and install the barriers.

Noise barriers of 6 m height and 12 m height were proposed to be installed at locations around the construction worksites facing the ecological receptor (N5) to mitigate noise impacts to as low as reasonably practicable (ALARP). The feasibility on the placement of noise barriers as well as their heights were discussed in detail with HDB and finalised in this Final Report. Multiple rounds of modelling were conducted prior to finalisation of noise barriers. The placement of the noise barriers is visualised in Figure 7.5.13. **It is to be noted that there are internal noise barriers that have been considered in the mitigation. However, these internal noise barriers are not presented in Figure 7.5.13 due to the confidentiality of the information.**

Contractors should note that the installation of noise barriers must not result in additional clearance to vegetation beyond the bounds of the construction worksites area.



Legend

- Project Boundary
- Proposed Noise Barrier
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels
- Ecological Receptor

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1	AUG 2024	LLG	Final Report	SAG	JAG
-	JUL 2024	LLG	Final Report	SAG	JAG
1	JUNE 2024	LLG	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Proposed Noise Barrier

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
TYL	SAG	JAG	7.5.13	1	1 of 1
	Drawn LLG	Date AUG 2024	CAD File Name : NA		A3

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7.5.3.4 Residual Impact Assessment

The residual construction impact assessment assumes two aspects of mitigation: the revised noise equipment inventory and the implementation of proposed noise barriers (6 m and 12 m height) at the construction worksites facing the ecological receptors' area.

Due to the proximity of the noise sources (i.e., construction worksites) to the ecologically sensitive N5 forested area, the proposed noise barrier was found to only be effective in reducing the area of Major noise Impact significance. However, the overall impact intensity remains unchanged with the noise barrier mitigation, and hence the **overall Impact Significance remained Major**.

Although the proposed mitigation measures were not able to eliminate the noise exceedances, a closer look into the comparison of noise contours for the pre-mitigation (unmitigated) and post-mitigation (residual) cases revealed significant reduction in the extent (area) of Major impact significance. It is to be noted that the residual noise impacts have been derived after visiting and implementation of all practicable noise mitigation measures (at this stage).

It is worth emphasising that the residual noise impacts have been calculated following the implementation of all feasible noise mitigation measures, indicating that every practical option has been thoroughly explored and exhausted.AECOM recommends HDB to implement the noise barriers rigidly and plan the timeline of building works strategically to minimise construction activities during night works period, so as to reduce impacts to N5 forested area.

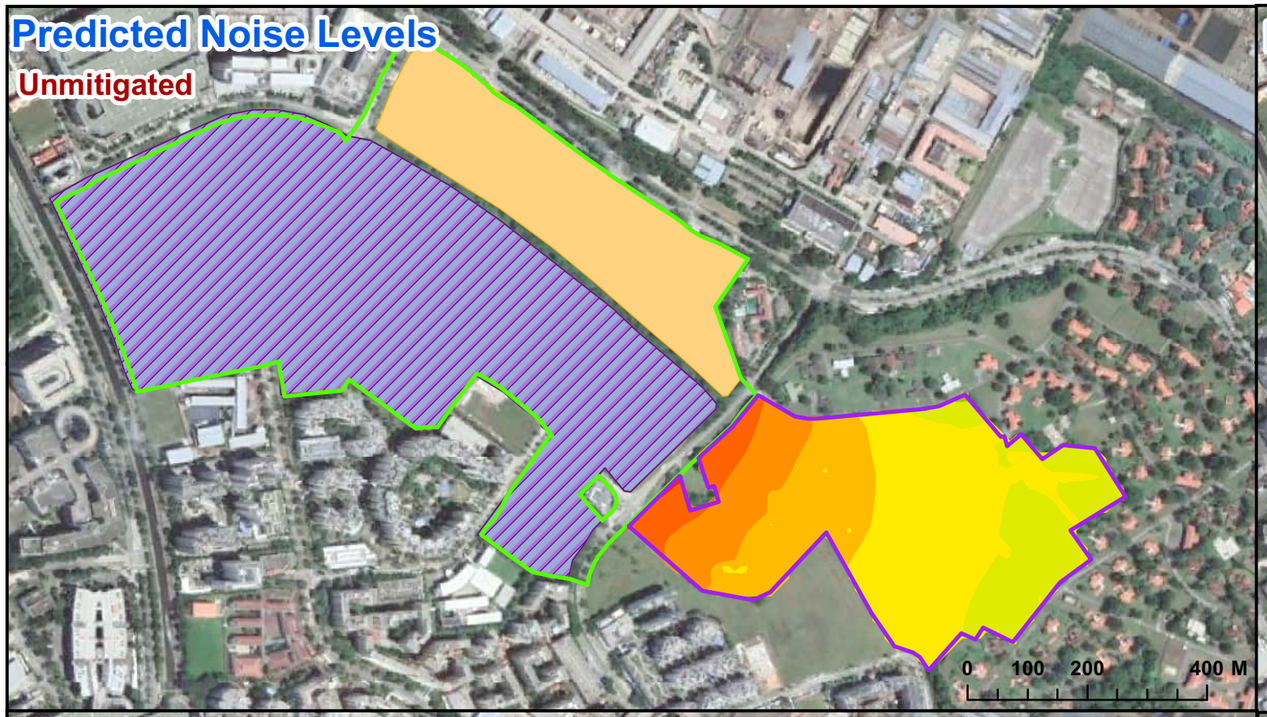
7.5.3.4.1.1 Scenario 1: Foundation works at Southern Parcels + Earthworks at Northern Parcels

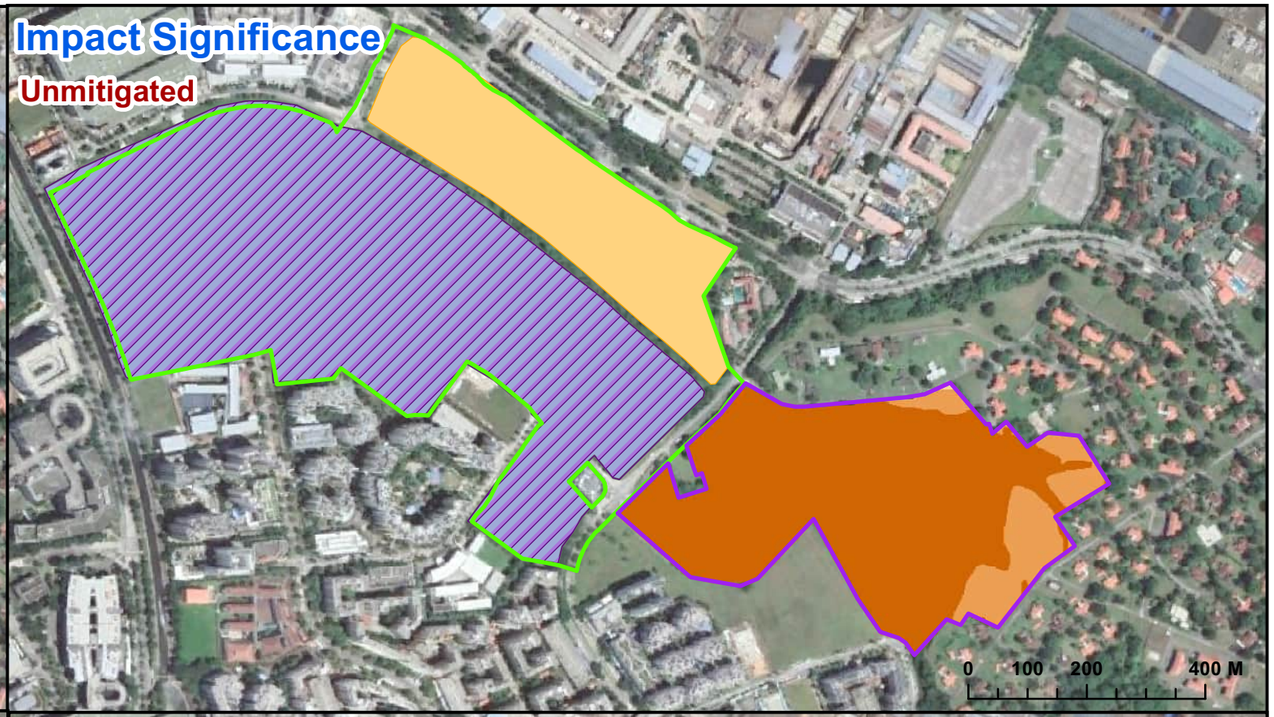
Details on the resultant impact assessment for Scenario 1 are provided in Table 7.28. The resulting residual noise contours representative of both noise barrier options applied for Scenario 1 was predicted and visualised in Figure 7.5.14 to Figure 7.5.18.

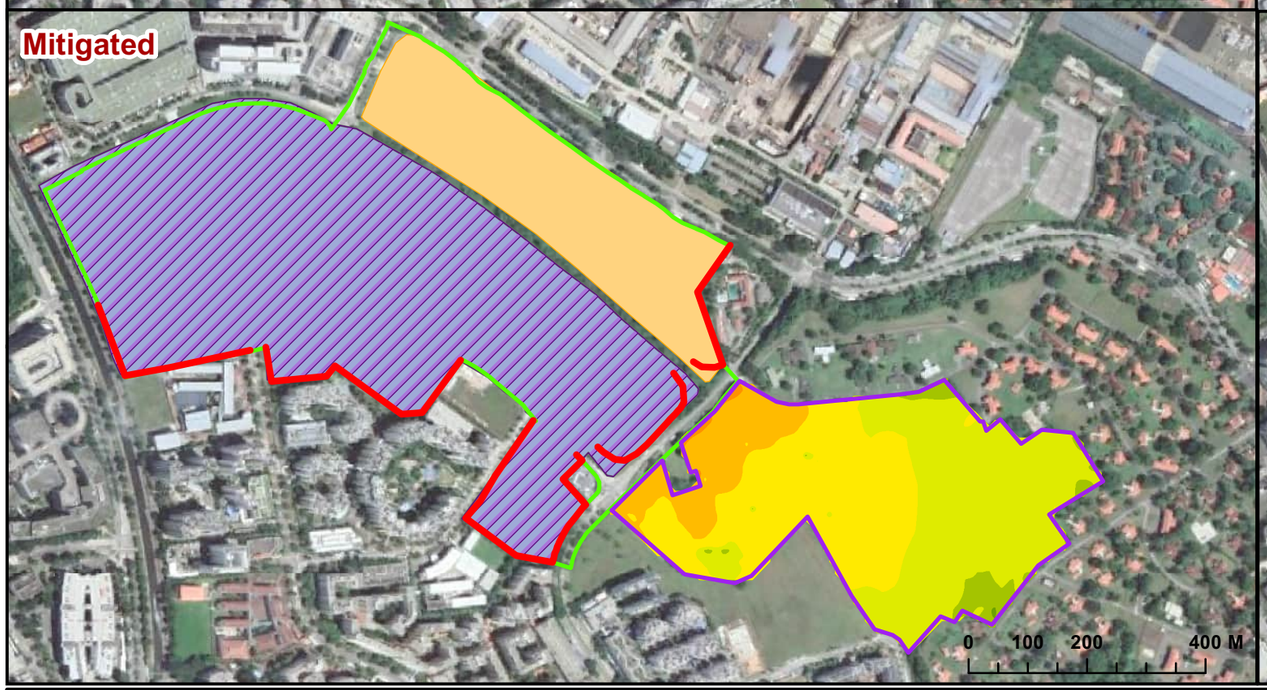
Table 7.27 Preliminary Residual Noise Impacts (Scenario 1)

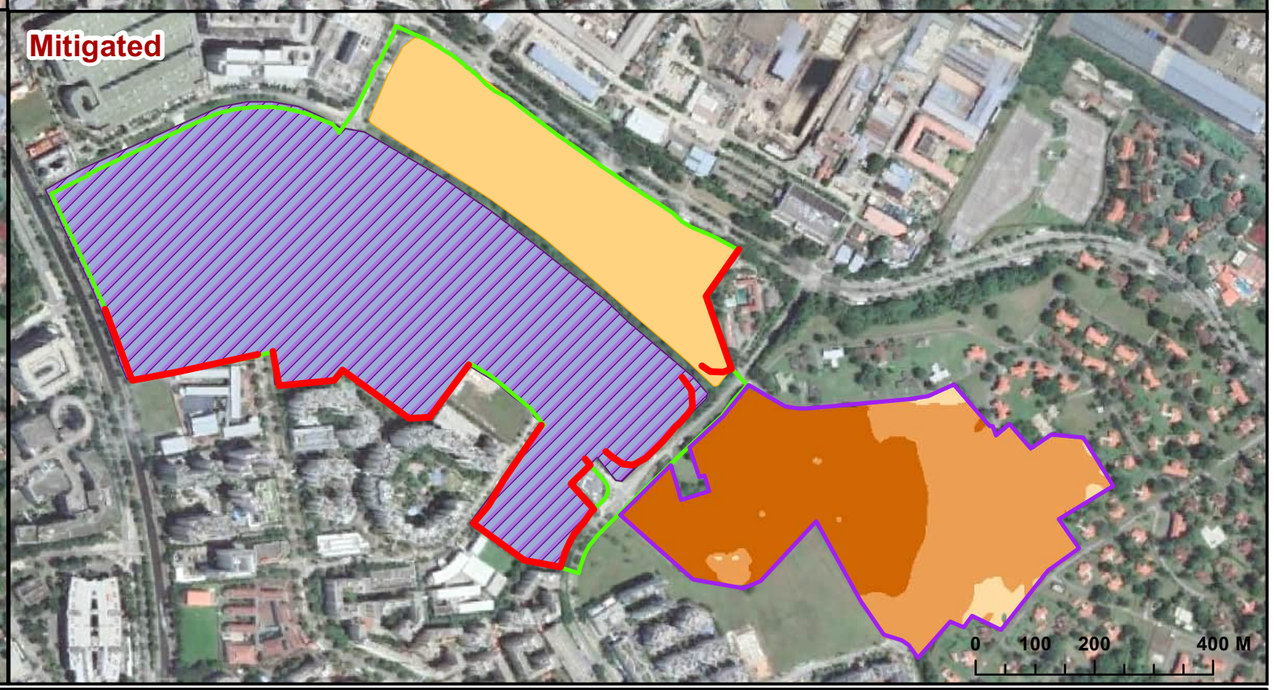
Assessment Scenario(s)	Ecological Receptor Sensitivity	Maximum Predicted Noise Level, dB(A)	Exceedances, dB(A)	Impact Intensity	Impact Consequence	Likelihood of Occurrence	Maximum Overall Significance	Area (ha)	Percentage Distribution (%)
Scenario 1: $L_{Aeq(12hrs)}$, dB(A) 7am to 7pm									
Unmitigated	Priority 1	74	20	High	High	Certain / Continuous	Major	18.1	85.38%
With noise barrier (6 m and 12 m)	Priority 1	68	14	High	High	Certain / Continuous	Major	11	51.89%
Scenario 1: $L_{Aeq(12hrs)}$, dB(A) 7pm to 7am									
Unmitigated	Priority 1	68	24	High	High	Likely / Regular	Major	21.2	100%
With noise barrier (6 m and 12 m)	Priority 1	62	18	High	High	Likely / Regular	Major	21	99.06%
Scenario 1: $L_{Aeq(1hr)}$, dB(A) 7pm to 10pm									
Unmitigated	Priority 1	73	28	High	High	Likely / Regular	Major	21.2	100%
With noise barrier (6 m and 12 m)	Priority 1	66	21	High	High	Likely / Regular	Major	21.18	99.91%
Scenario 1: $L_{Aeq(5min)}$, dB(A) 7am to 7pm									
Unmitigated	Priority 1	74	24	High	High	Certain / Continuous	Major	21.2	100%
With noise barrier (6 m and 12 m)	Priority 1	70	20	High	High	Certain / Continuous	Major	21.2	100%

Assessment Scenario(s)	Ecological Receptor Sensitivity	Maximum Predicted Noise Level, dB(A)	Exceedances, dB(A)	Impact Intensity	Impact Consequence	Likelihood of Occurrence	Maximum Overall Significance	Area (ha)	Percentage Distribution (%)
Scenario 1: $L_{Aeq(5min)}$, dB(A) 7pm to 10pm									
Unmitigated	Priority 1	73	28	High	High	Certain / Continuous	Major	21.2	100%
With noise barrier (6 m and 12 m)	Priority 1	66	21	High	High	Certain / Continuous	Major	21.2	100%









Legend

- Project Boundary
- Ecological Receptor
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels
- Proposed Noise Barrier

Impact Significance

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(12 hours), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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-	JUL 2024	LLG	Final Report	SAG	JAG
1	JUNE 2024	LLG	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :
Ecological Noise Sensitive Receptors - Scenario 1: Site Clearance & Earthworks, Foundation Works and Road Construction Works, LAeq (12 hours), 7am - 7pm (Proposed Noise Barrier Mitigation)

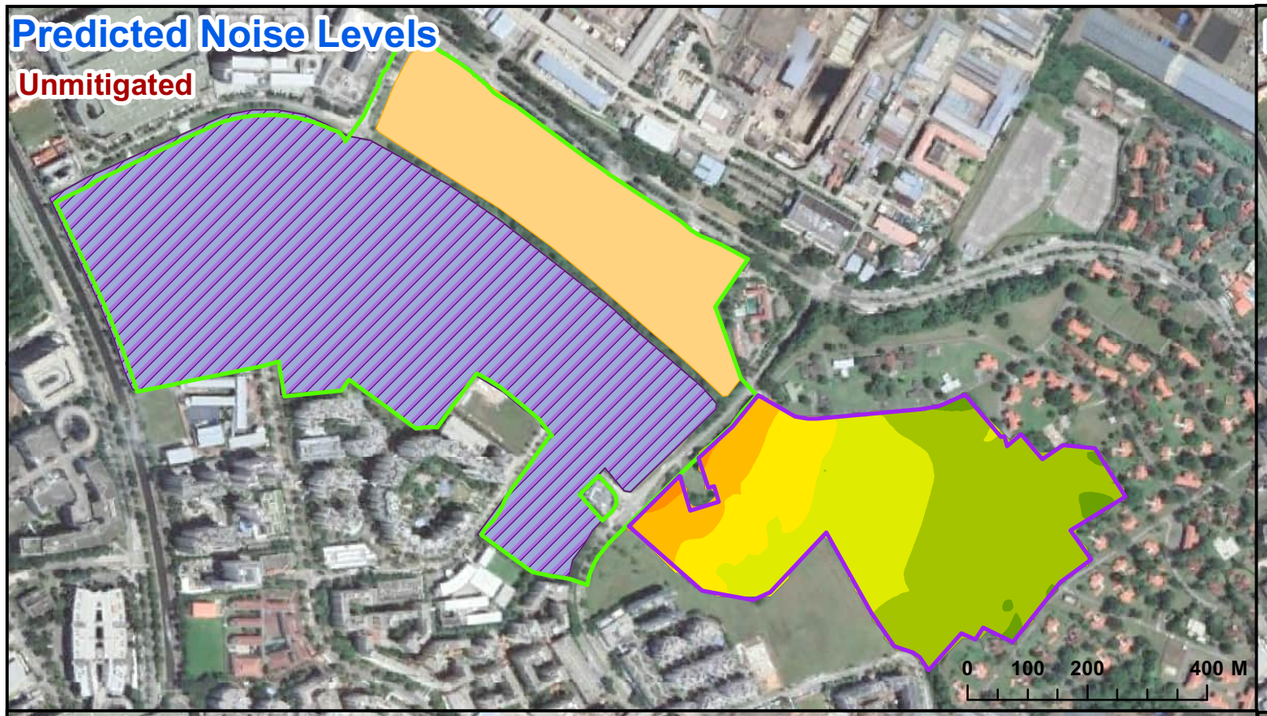
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TYL	SAG	JAG
	Drawn: LLG	Date: AUG 2024

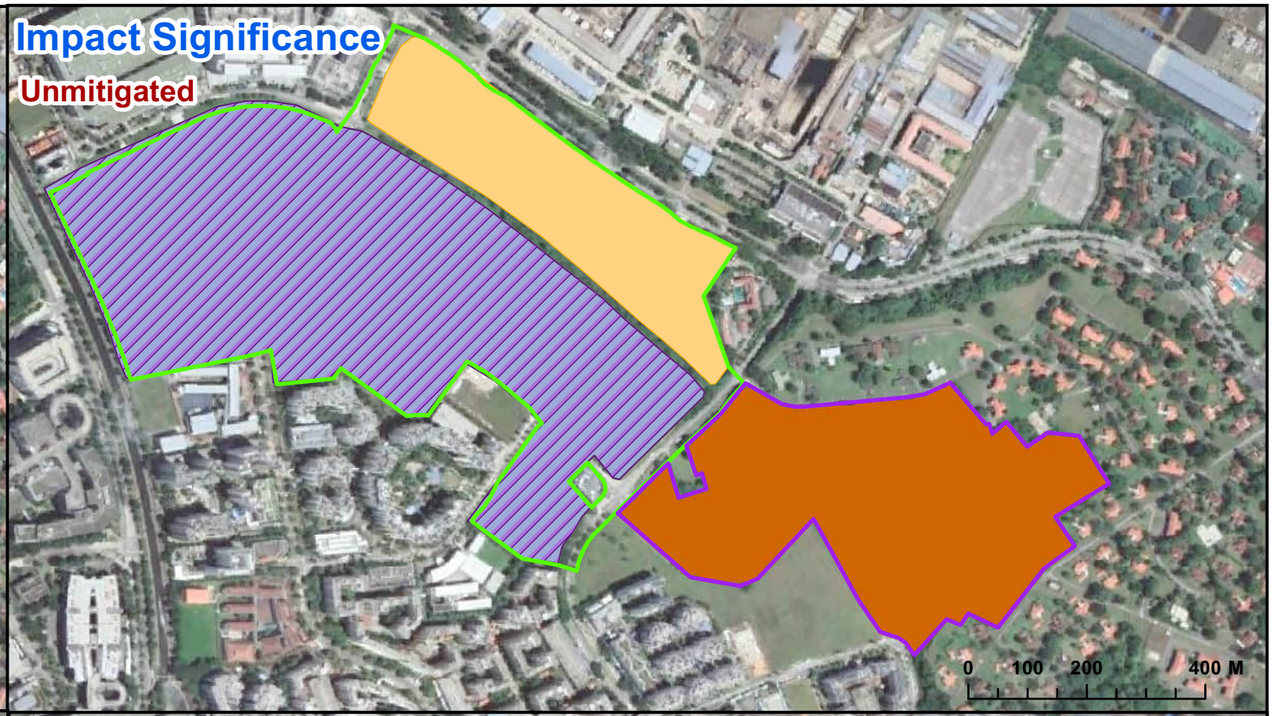
Figure No. :	Rev.	Sheet
7.5.14	1	1 of 1

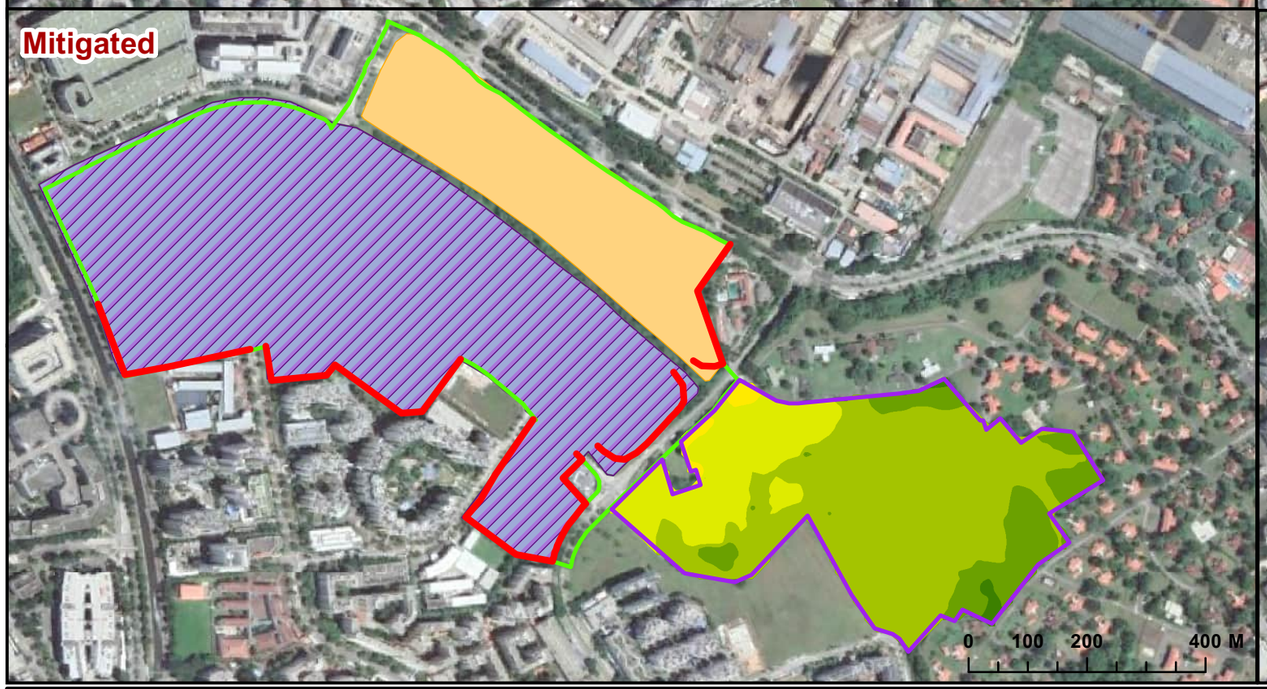
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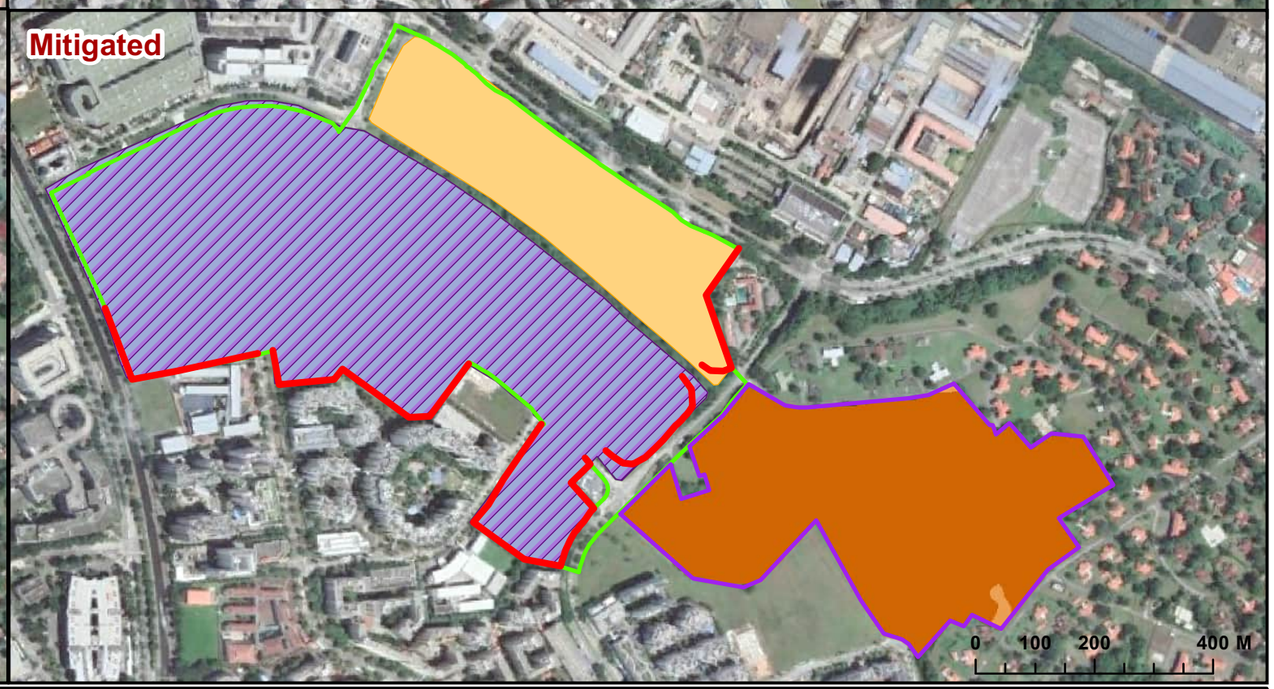
Note: Source of basemap - Google Earth Map

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Legend

- Ecological Receptor
- Project Boundary
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels
- Proposed Noise Barrier

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq (12 hours), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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-	JUL 2024	LLG	Final Report	SAG	JAG
1	JUNE 2024	LLG	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :
Ecological Noise Sensitive Receptors - Scenario 1: Site Clearance & Earthworks, Foundation Works and Road Construction Works, LAeq (12 hours), 7pm - 7am (Proposed Noise Barrier Mitigation)

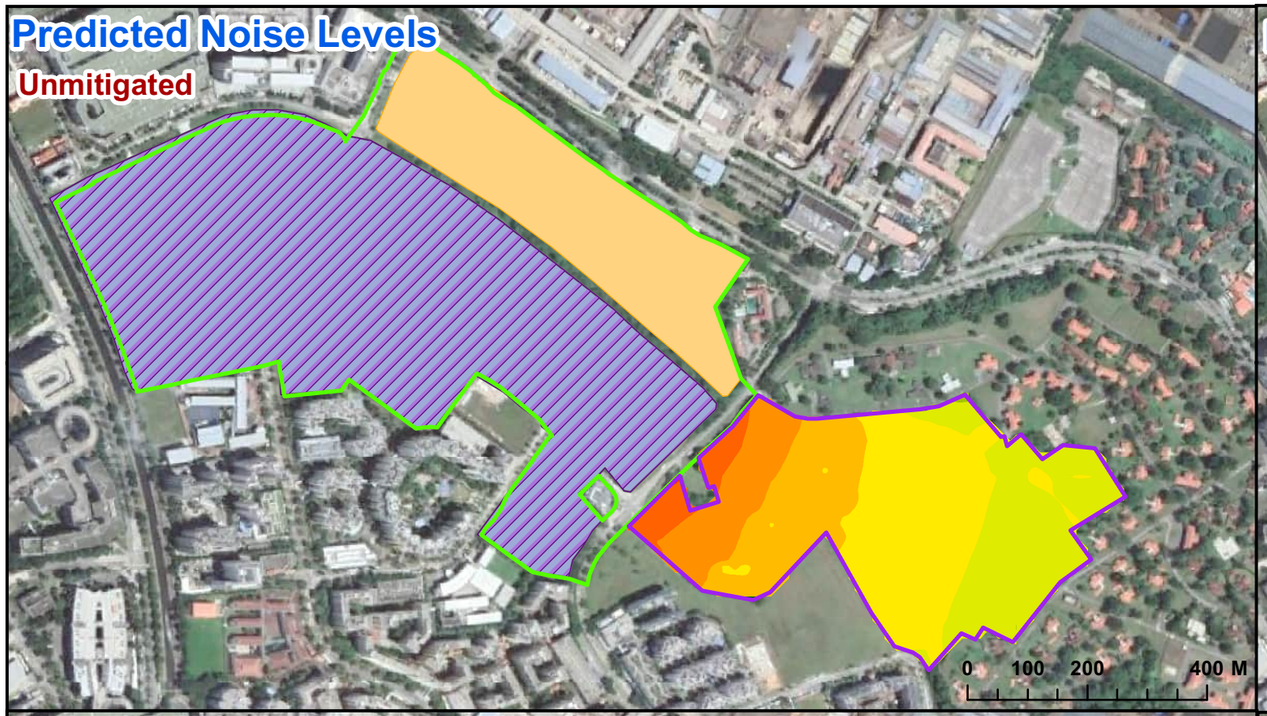
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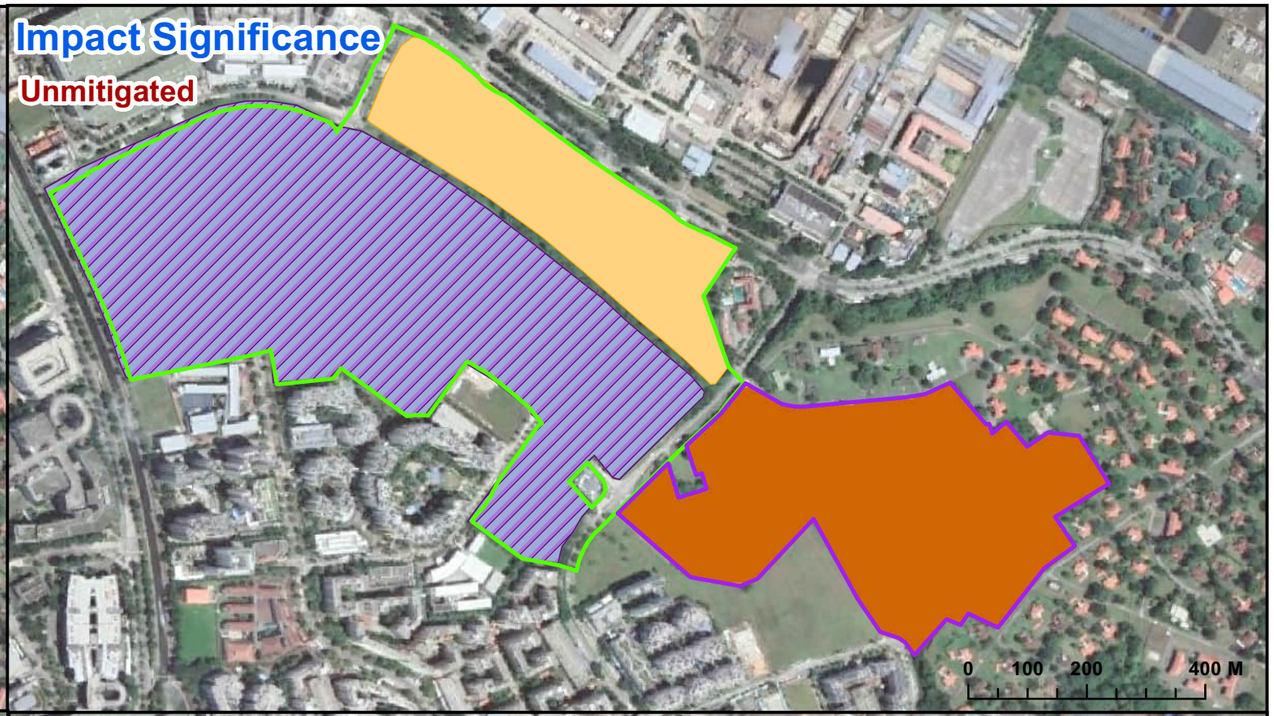
Figure No. : 7.5.15 | Rev. 1 | Sheet 1 of 1

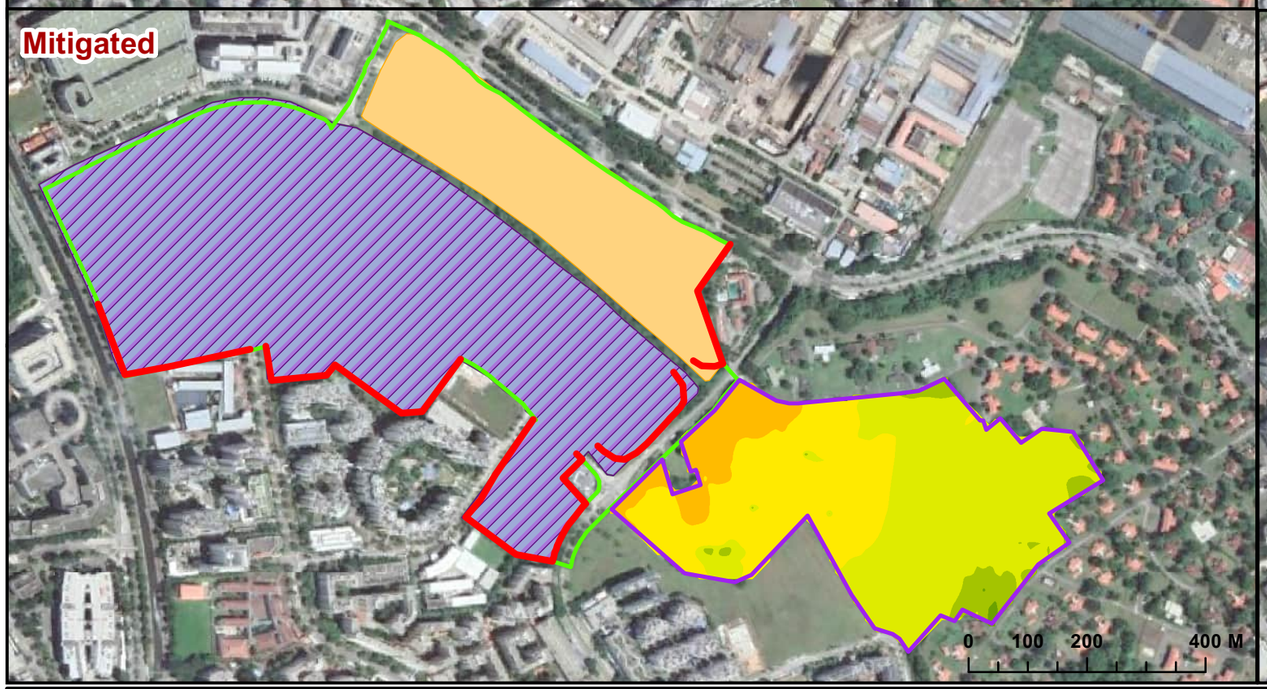
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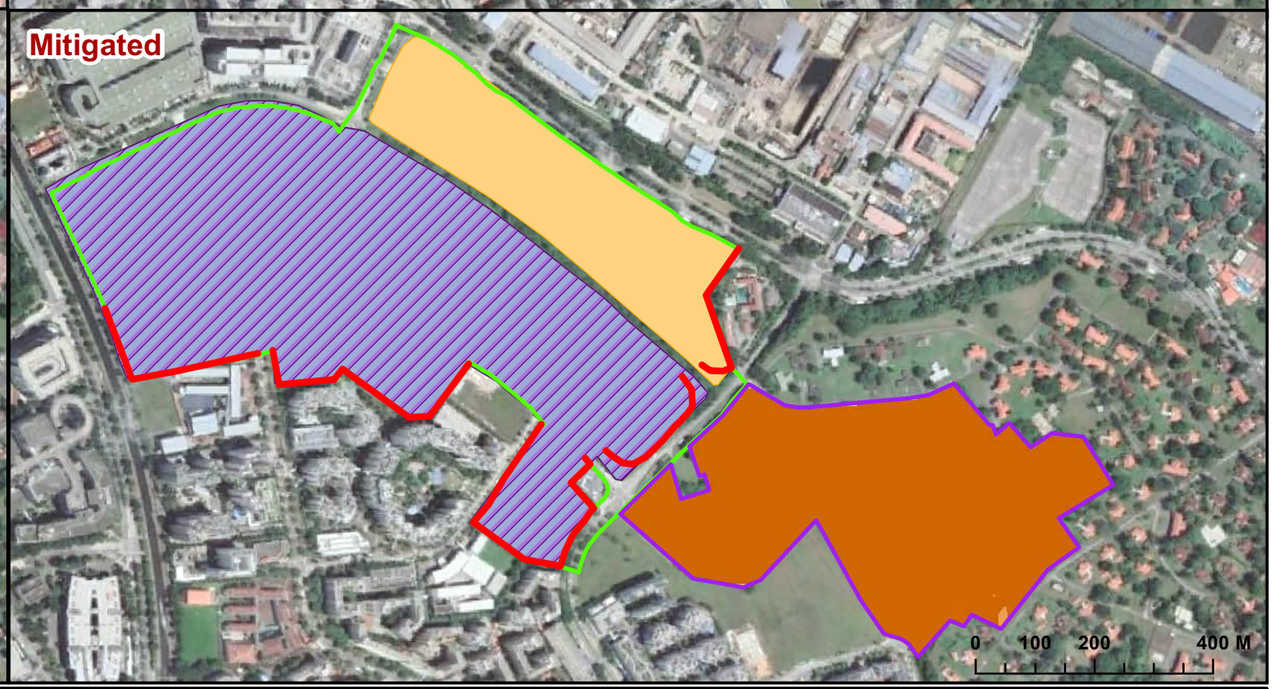
Note: Source of basemap - Google Earth Map

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Legend

- Ecological Receptor
- Project Boundary
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels
- Proposed Noise Barrier

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(1 hour), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	LLG	Final Report	SAG	JAG
-	JUL 2024	LLG	Final Report	SAG	JAG
1	JUNE 2024	LLG	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

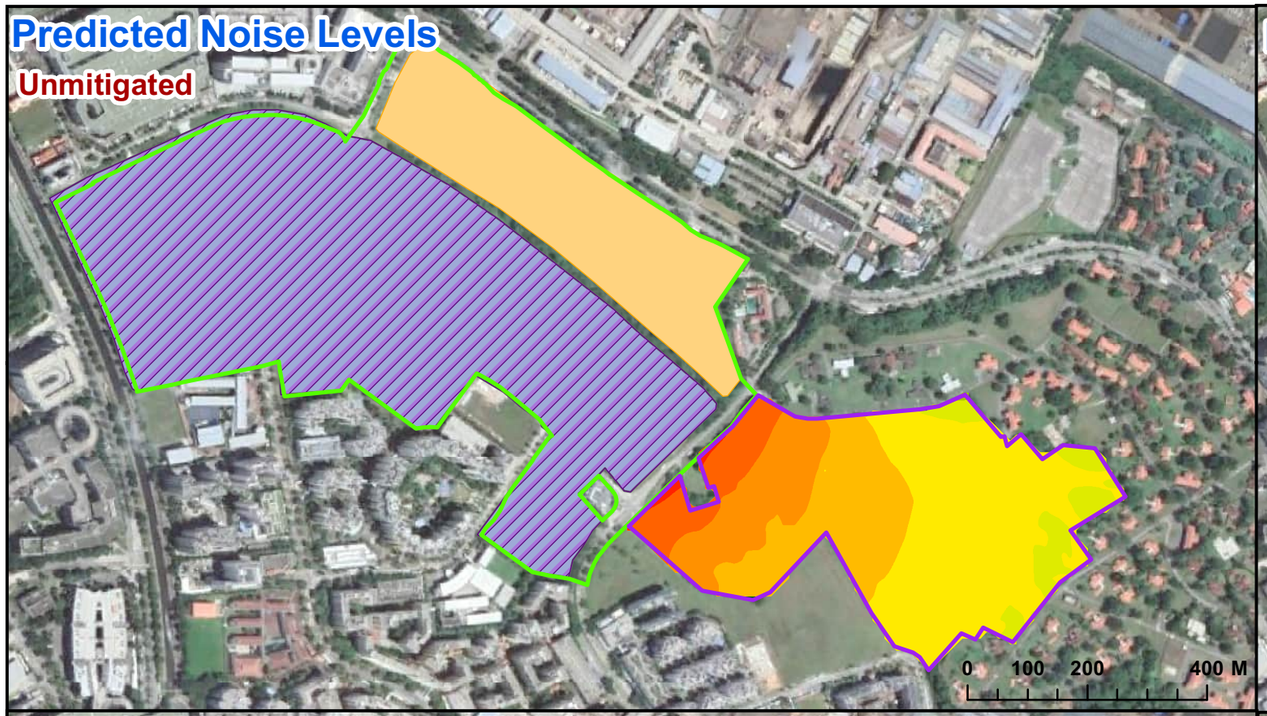
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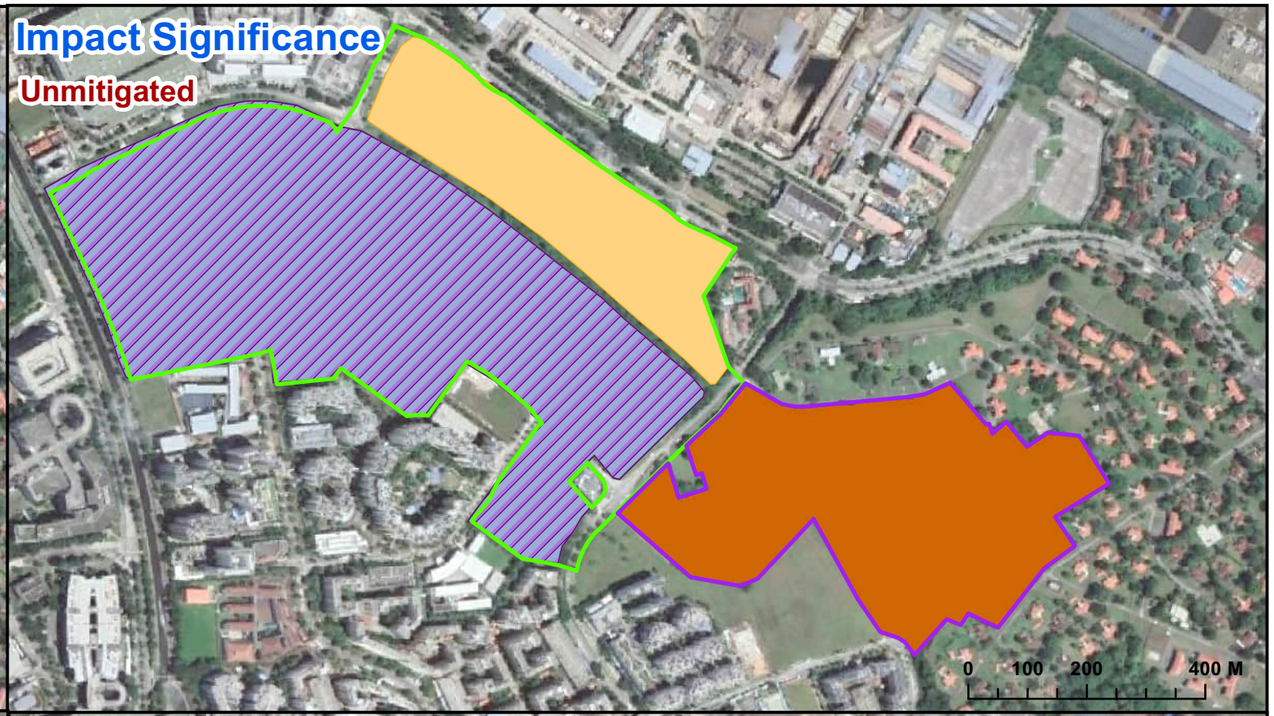
Ecological Noise Sensitive Receptors - Scenario 1: Site Clearance & Earthworks, Foundation Works and Road Construction Works, LAeq (1 hour), 7pm - 10pm (Proposed Noise Barrier Mitigation)

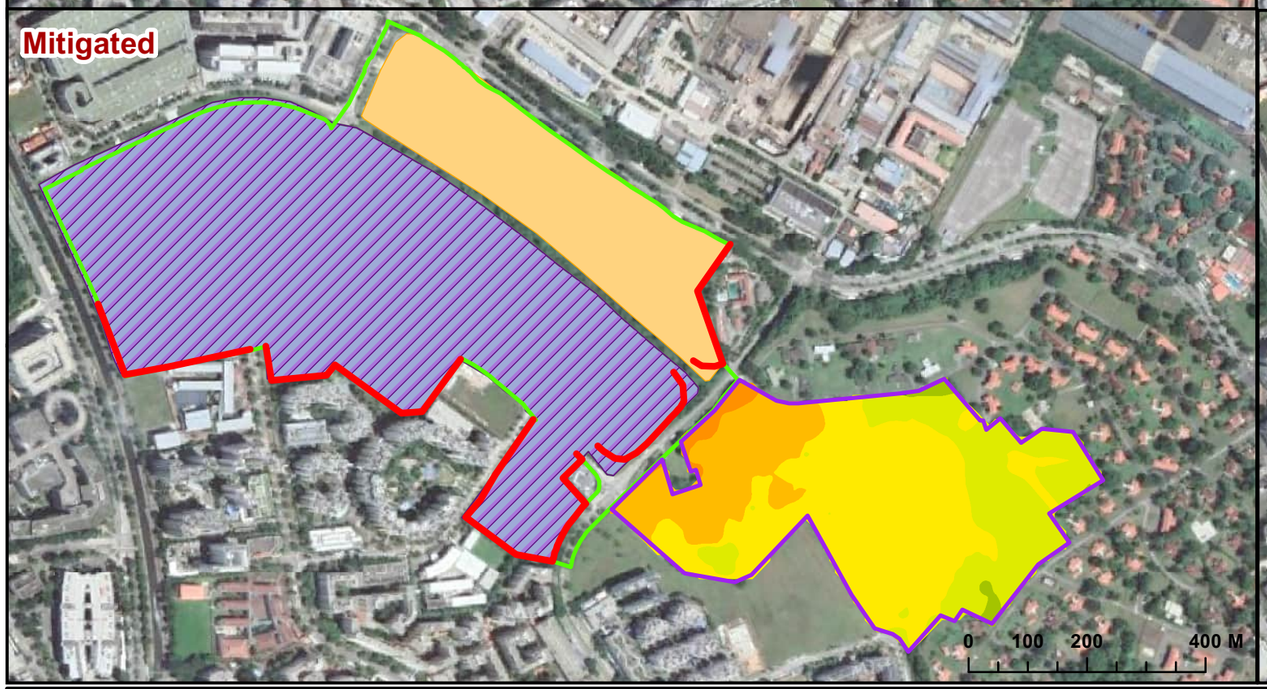
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	Drawn LLG	Date AUG 2024	CAD File Name : NA		A3

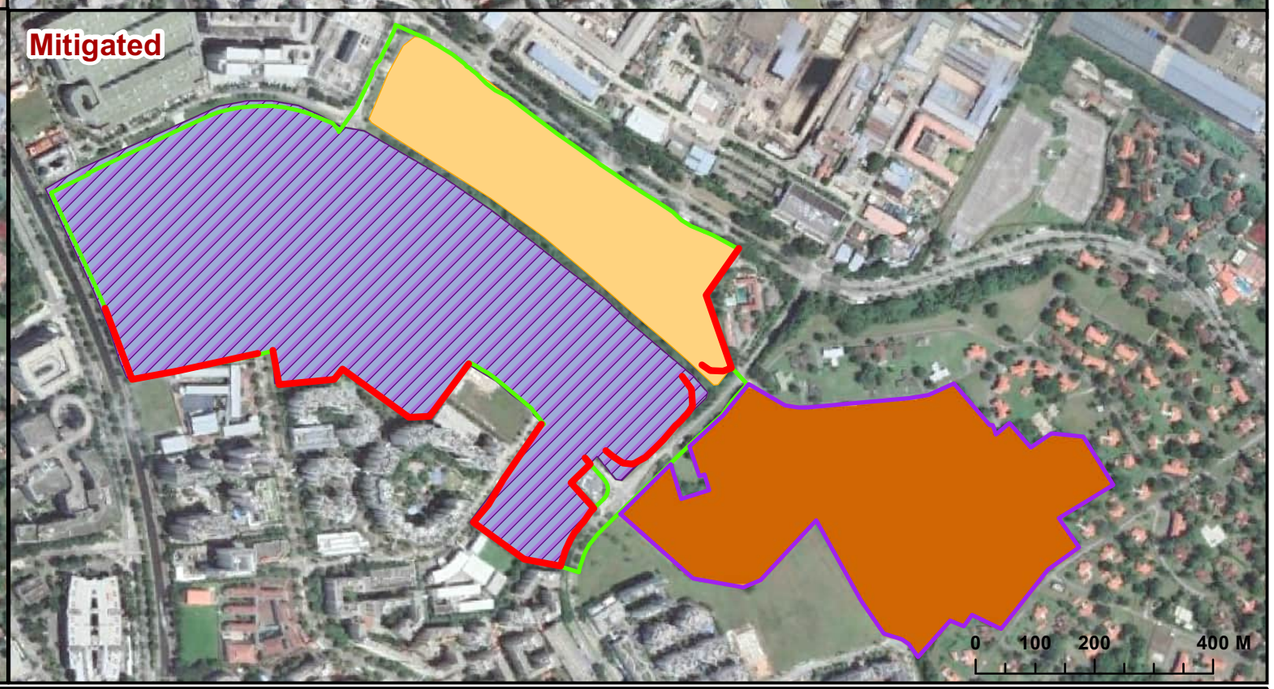
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Legend

- Ecological Receptor
- Project Boundary
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels
- Proposed Noise Barrier

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(5 mins), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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1	AUG 2024	LLG	Final Report	SAG	JAG
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1	JUNE 2024	LLG	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

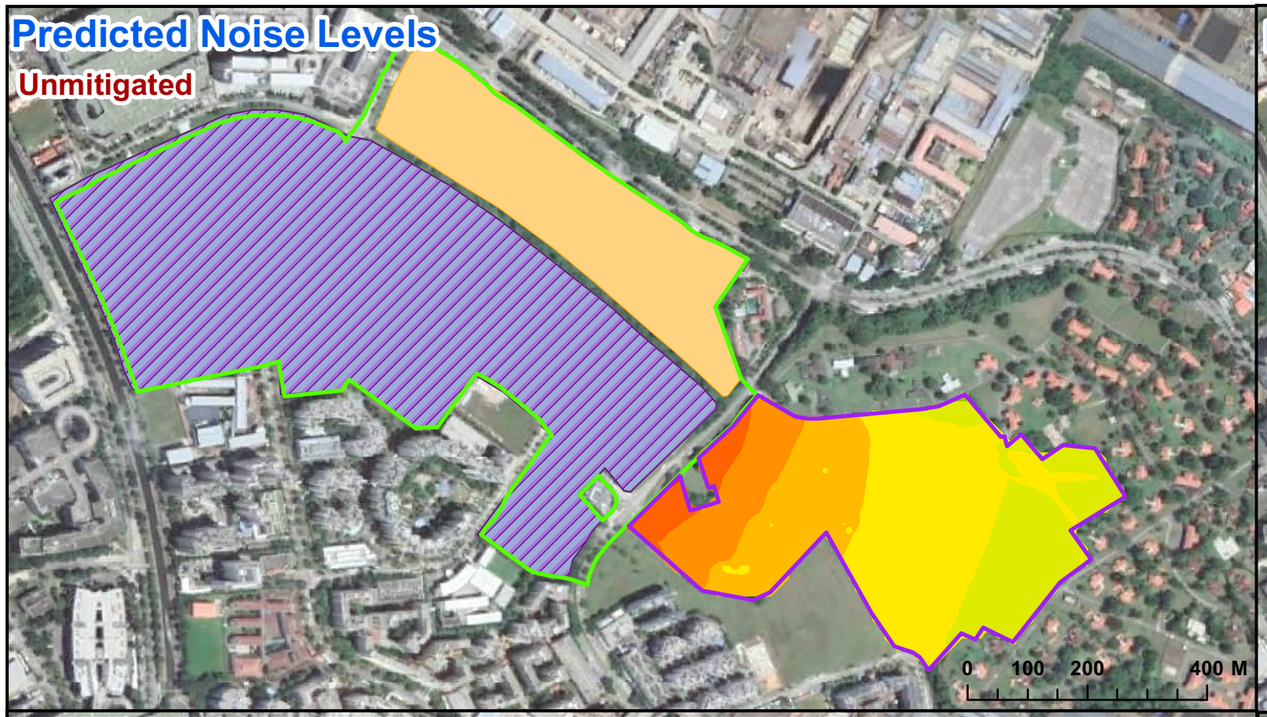
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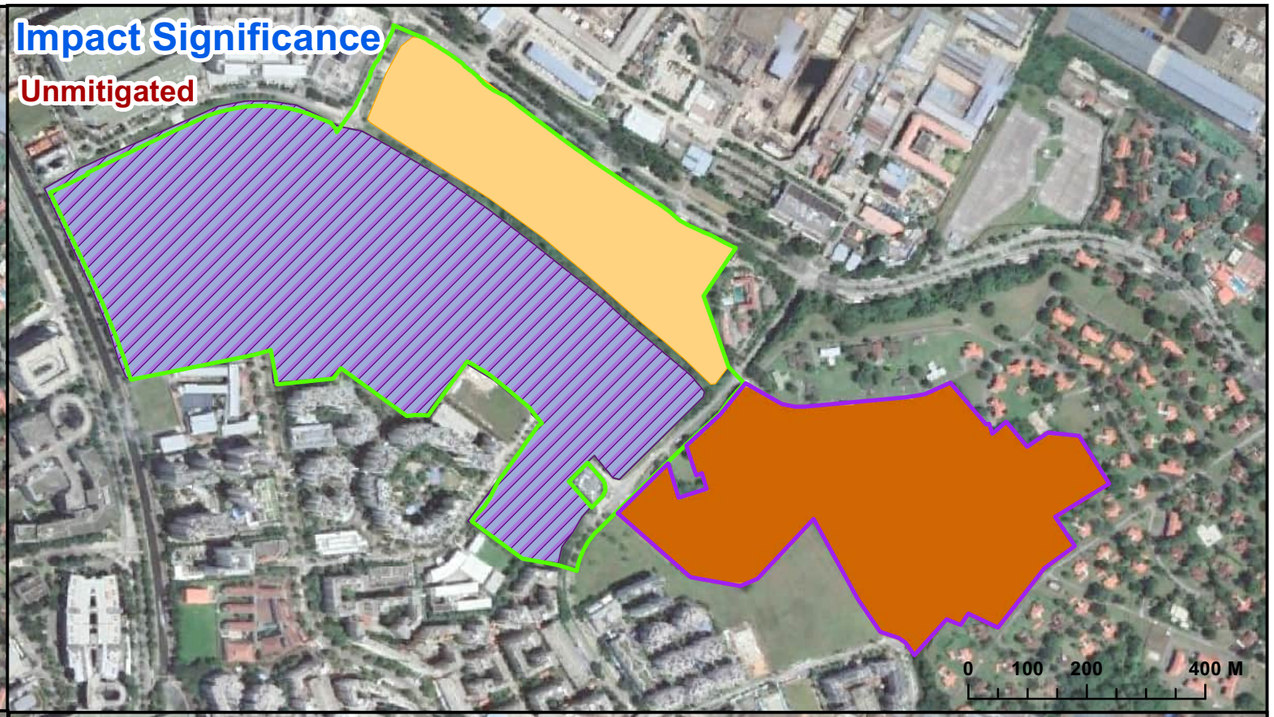
Ecological Noise Sensitive Receptors - Scenario 1: Site Clearance & Earthworks, Foundation Works and Road Construction Works, LAeq (5min), 7am - 7pm (Proposed Noise Barrier Mitigation)

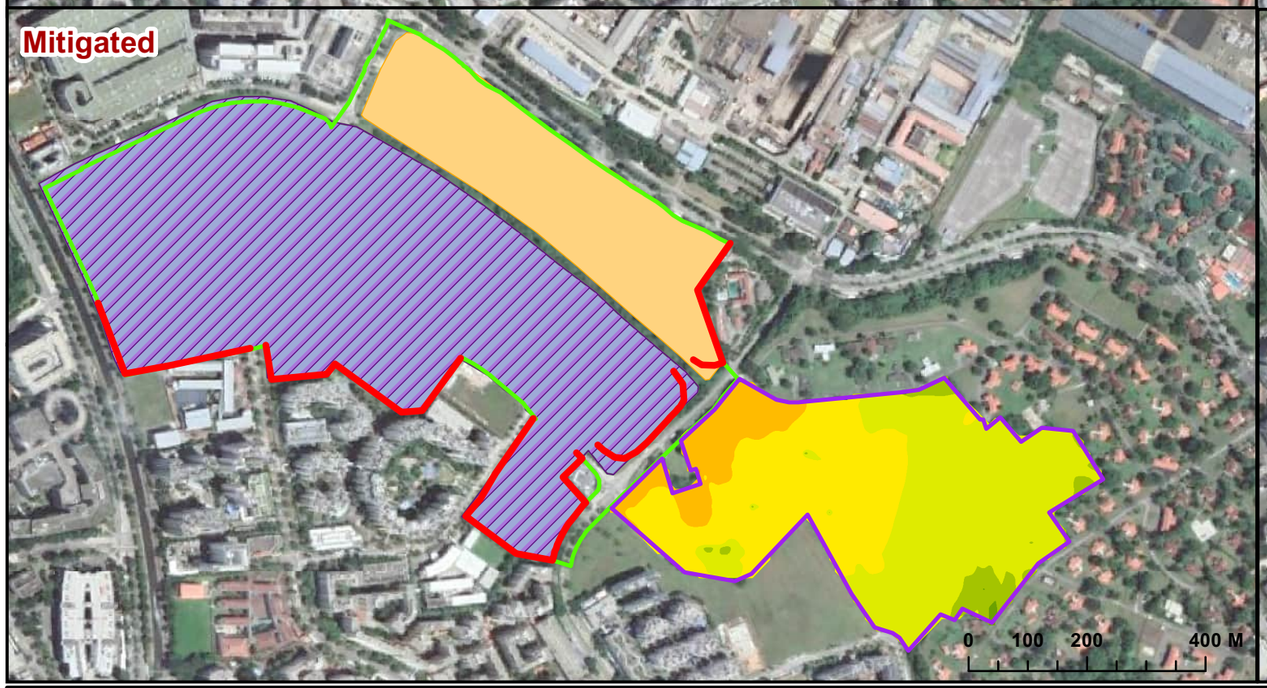
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	Drawn LLG	Date AUG 2024	CAD File Name : NA		A3

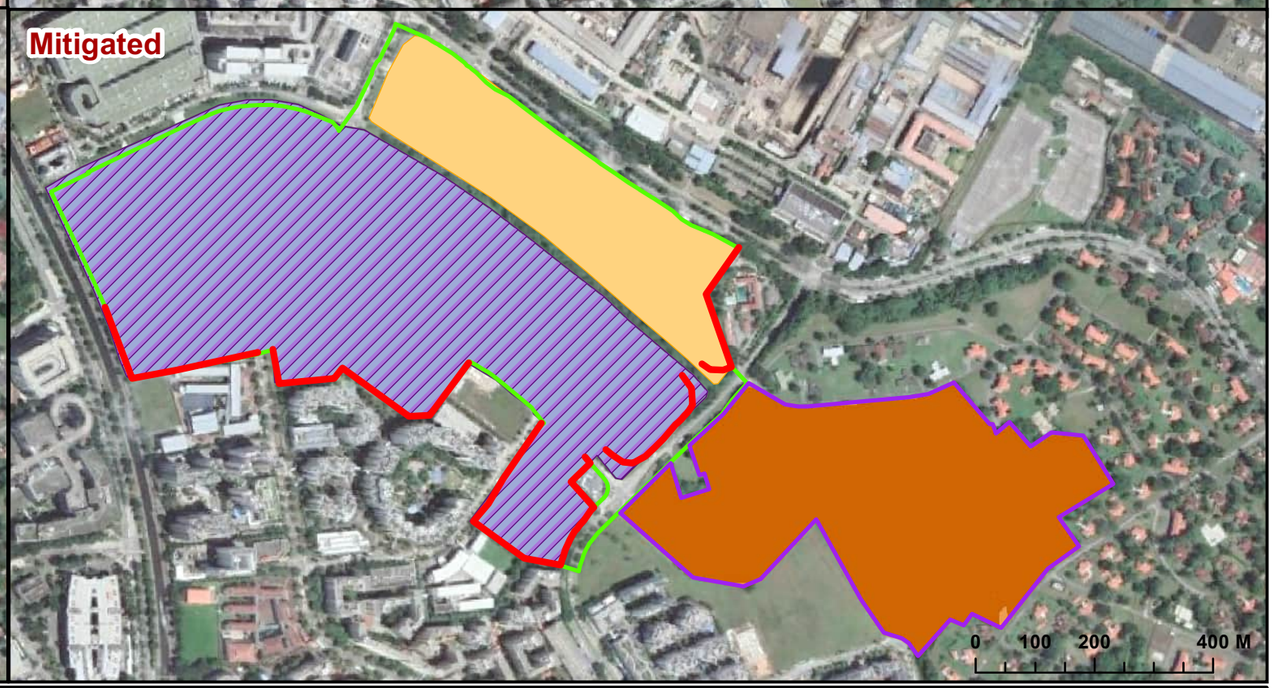
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Legend

- Ecological Receptor
- Project Boundary
- Site Clearance & Earthworks at Northern Parcels
- Foundation Works at Southern Parcels
- Proposed Noise Barrier

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(5 mins), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

Rev.	Date	By	Description	Chk'd	App'd
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-	JUL 2024	LLG	Final Report	SAG	JAG
1	JUNE 2024	LLG	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :
Ecological Noise Sensitive Receptors - Scenario 1: Site Clearance & Earthworks, Foundation Works and Road Construction Works, LAeq (5min), 7pm - 10pm (Proposed Noise Barrier Mitigation)

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
TYL	SAG	JAG	7.5.18	1	1 of 1
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7.5.3.4.1.2 Scenario 2: Foundation works at Northern Parcels + Reinstatement works at Southern Parcels

Details on the resultant impact assessment for Scenario 2 are provided in Table 7.28. The resulting residual noise contours representative of both noise barrier options applied for Scenario 2 was predicted and visualised in Figure 7.5.19 to Figure 7.5.23.

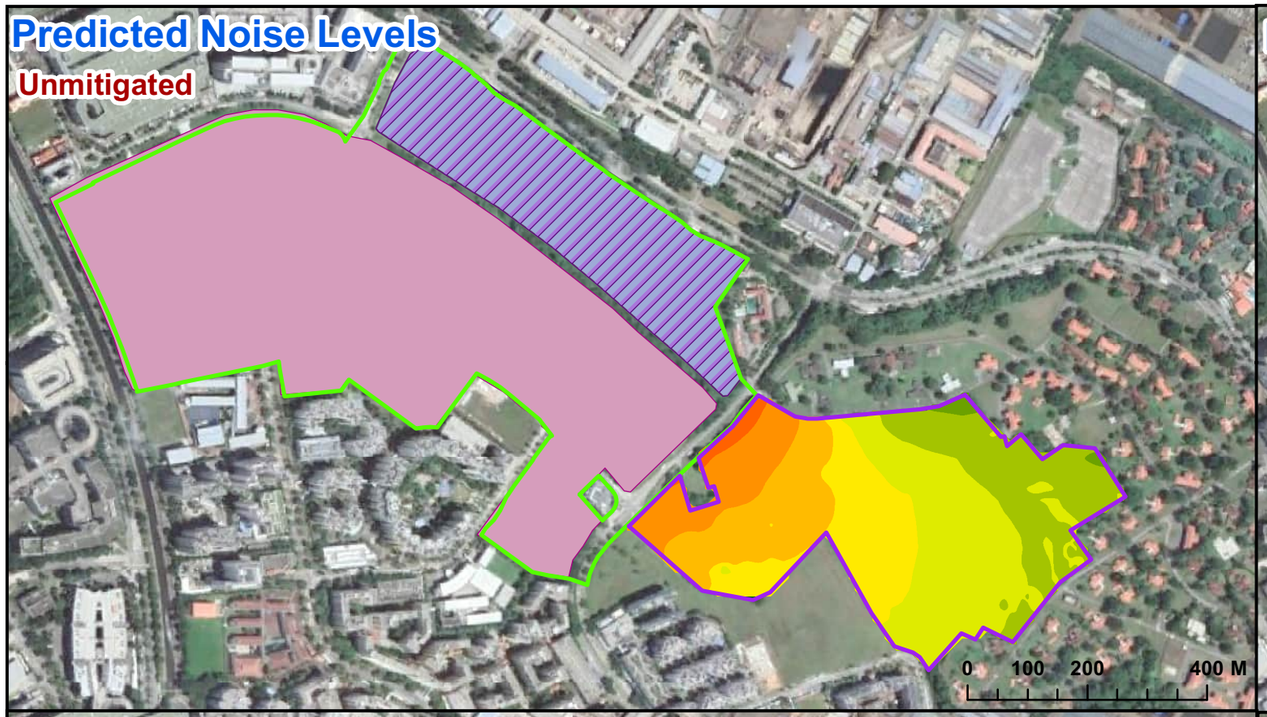
Table 7.28 Preliminary Residual Noise Impacts (Scenario 2)

Assessment Scenario(s)	Ecological Receptor Sensitivity	Maximum Predicted Noise Level, dB(A)	Exceedances, dB(A)	Impact Intensity	Impact Consequence	Likelihood of Occurrence	Maximum Overall Significance	Area (ha)	Percentage Distribution (%)
Scenario 2: $L_{Aeq(12hrs)}$, dB(A) 7am to 7pm									
Unmitigated	Priority 1	71	17	High	High	Certain / Continuous	Major	10	47.17%
With noise barrier (6 m and 12 m)	Priority 1	65	11	High	High	Certain / Continuous	Major	4.7	22.17%
Scenario 2: $L_{Aeq(12hrs)}$, dB(A) 7pm to 7am									
Unmitigated	Priority 1	69	25	High	High	Likely / Regular	Major	21.2	100%
With noise barrier (6 m and 12 m)	Priority 1	62	18	High	High	Likely / Regular	Major	21.194	99.97%
Scenario 2: $L_{Aeq(1hr)}$, dB(A) 7pm to 10pm									
Unmitigated	Priority 1	70	25	High	High	Certain / Continuous	Major	21.2	100%
With noise barrier (6 m and 12 m)	Priority 1	64	19	High	High	Certain / Continuous	Major	21	99.06%
Scenario 2: $L_{Aeq(5min)}$, dB(A) 7am to 7pm									

Assessment Scenario(s)	Ecological Receptor Sensitivity	Maximum Predicted Noise Level, dB(A)	Exceedances, dB(A)	Impact Intensity	Impact Consequence	Likelihood of Occurrence	Maximum Overall Significance	Area (ha)	Percentage Distribution (%)
Unmitigated	Priority 1	72	22	High	High	Certain / Continuous	Major	21	99.06%
With noise barrier (6 m and 12 m)	Priority 1	65	15	High	High	Certain / Continuous	Major	20.5	96.70%
Scenario 2: $L_{Aeq(5min)}$, dB(A) 7pm to 10pm									
Unmitigated	Priority 1	72	27	High	High	Certain / Continuous	Major	21.2	100%
With noise barrier (6 m and 12 m)	Priority 1	65	20	High	High	Certain / Continuous	Major	21.194	99.97%
Note: There are internal noise barriers that have been considered in the mitigation. However, these internal noise barriers are not presented in Figure 7.5.17 due to the confidentiality of the information.									

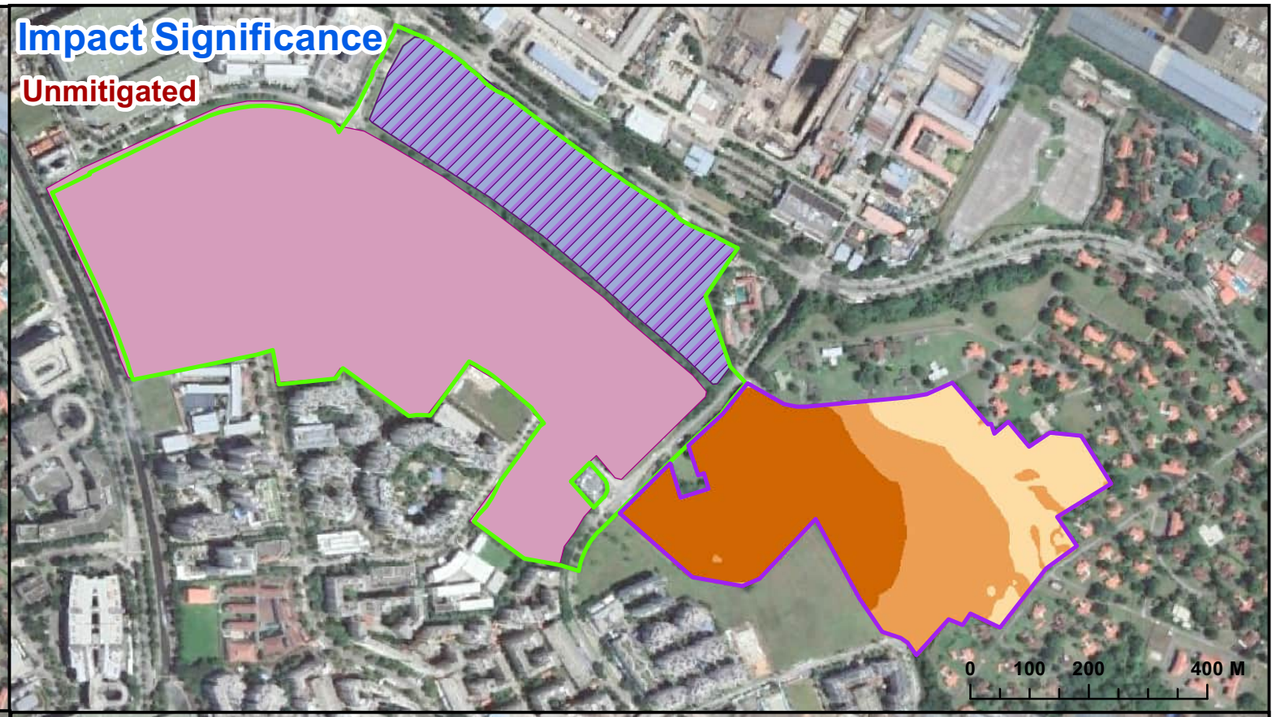
Predicted Noise Levels

Unmitigated

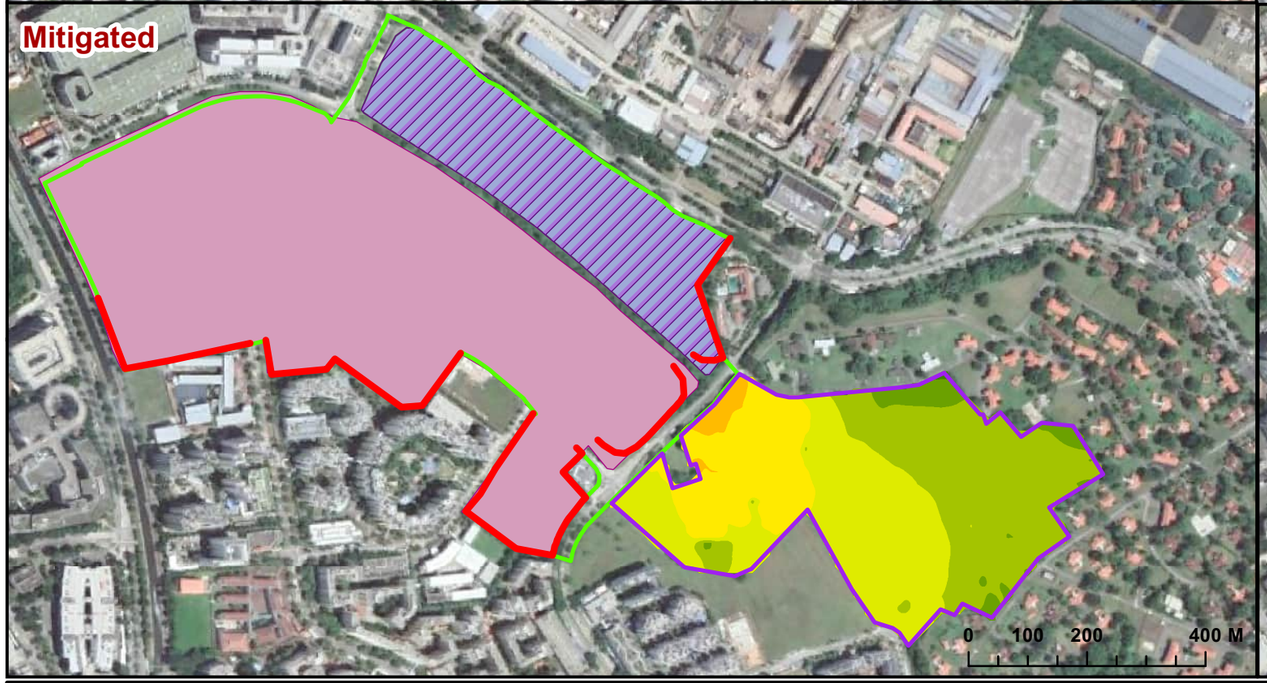


Impact Significance

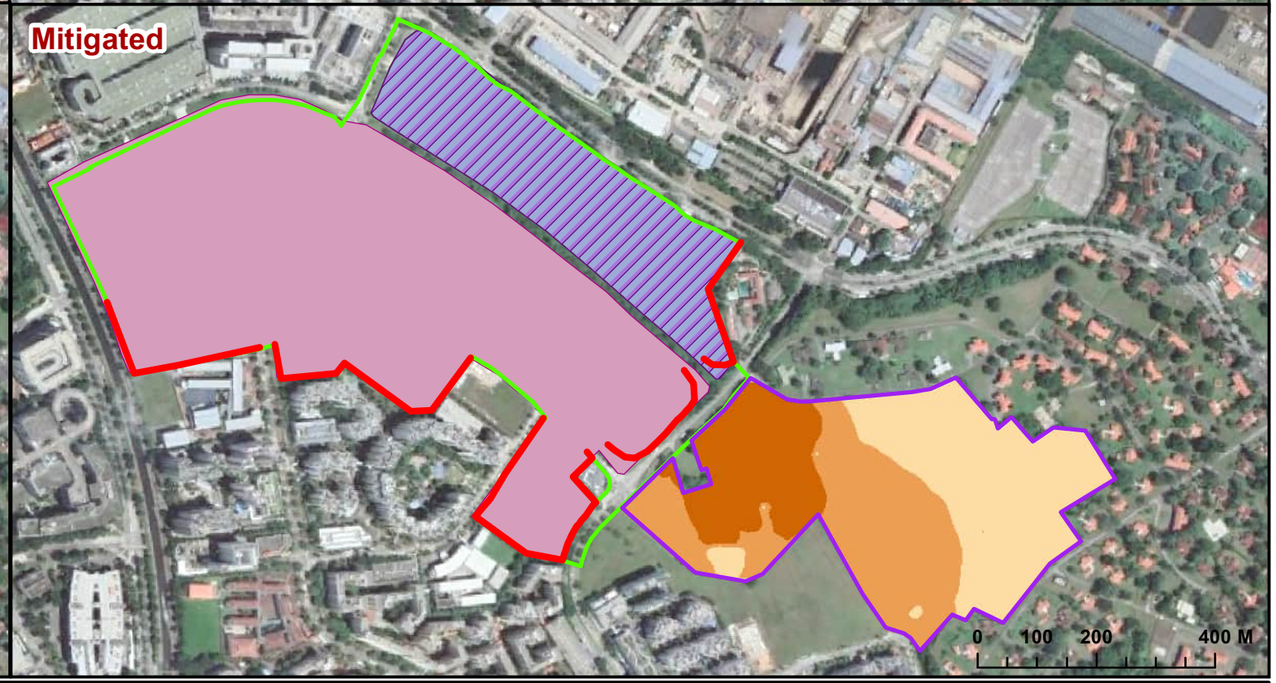
Unmitigated



Mitigated



Mitigated



Legend

- Ecological Receptor
- Project Boundary
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels
- Proposed Noise Barrier

Impact Significance

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(12 hours), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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1	JUNE 2024	LLG	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :
Ecological Noise Sensitive Receptors - Scenario 2: Site Foundation Works at Northern Parcels, Reinstatement and Landscaping Works at Southern Parcels LAeq (12 hours), 7am - 7pm (Proposed Noise Barrier Mitigation)

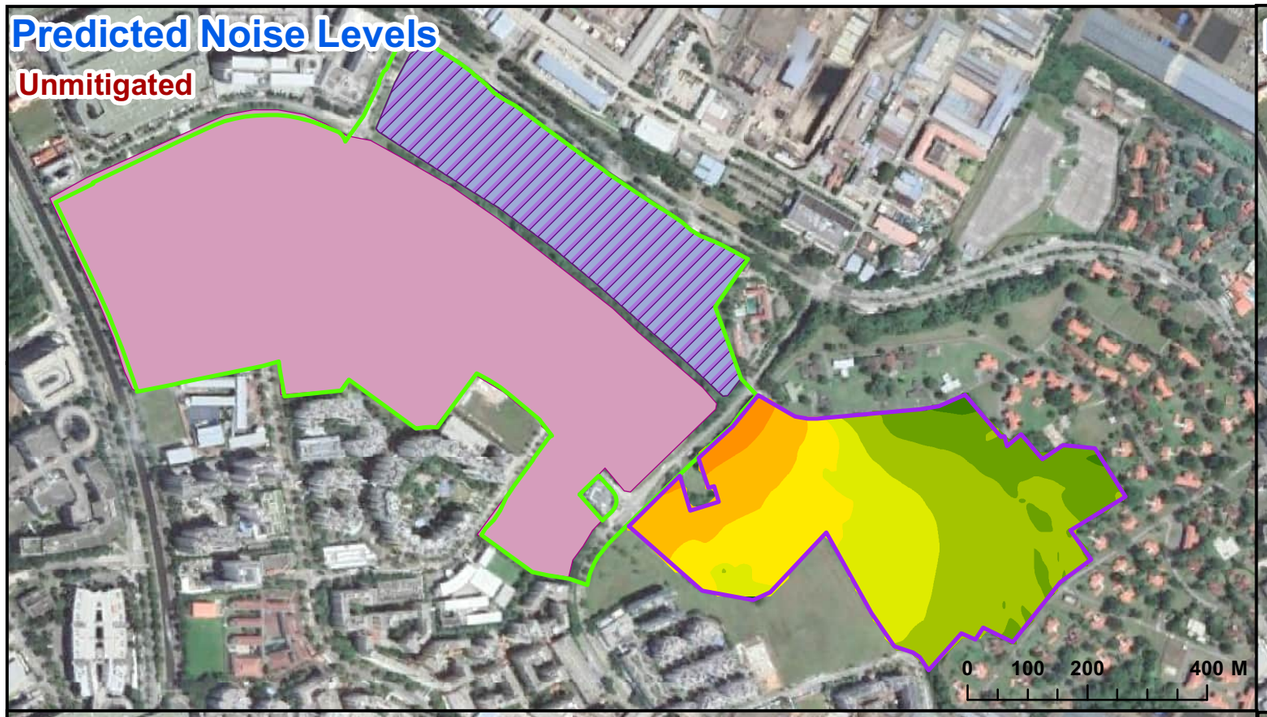
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	Drawn LLG	Date AUG 2024	CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

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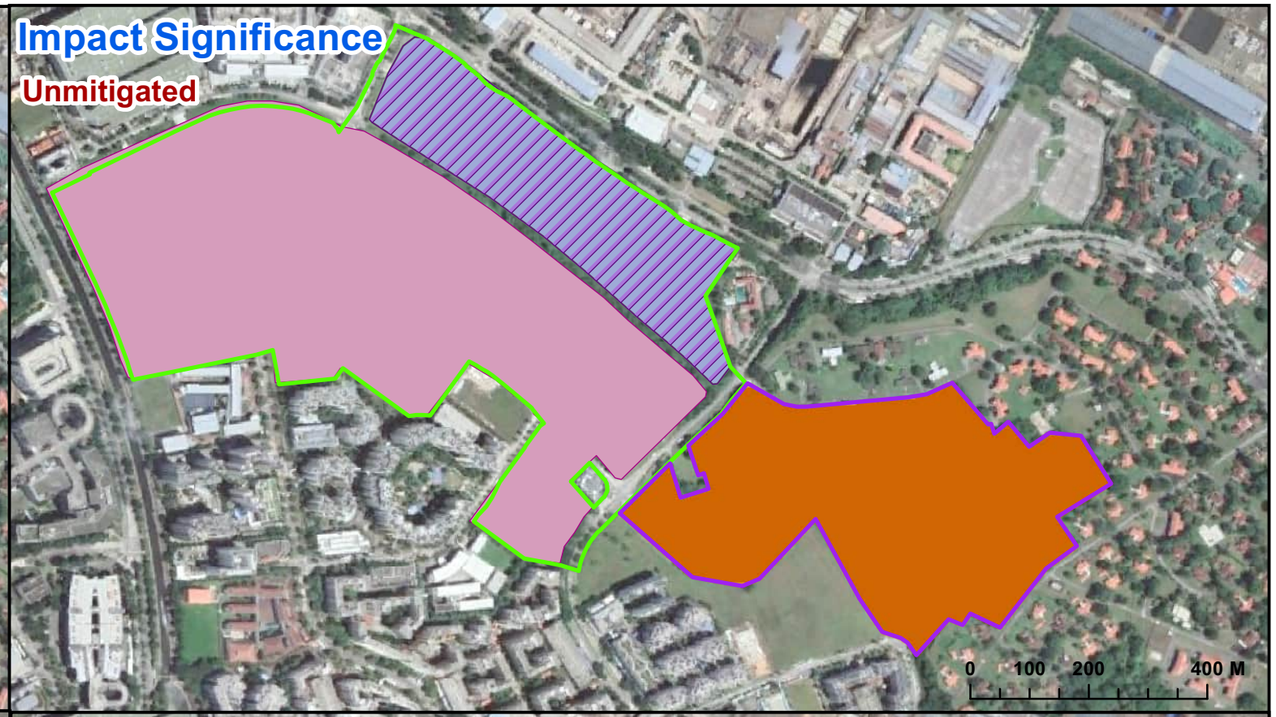
Predicted Noise Levels

Unmitigated

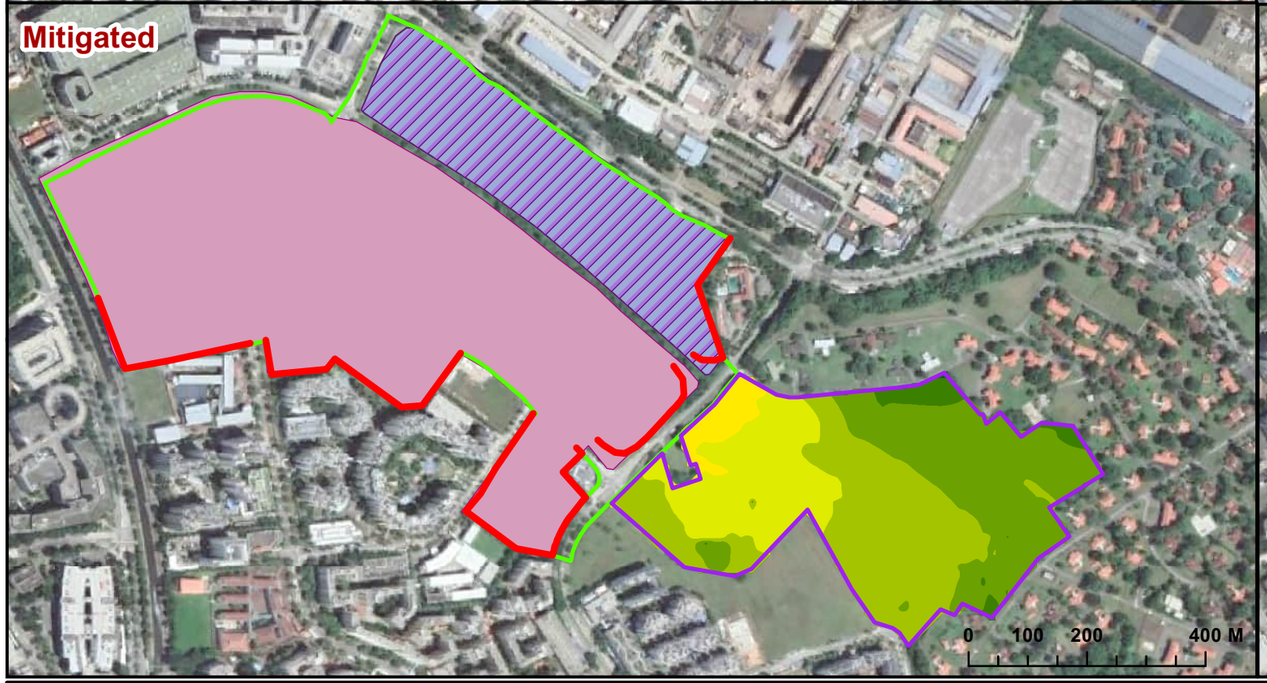


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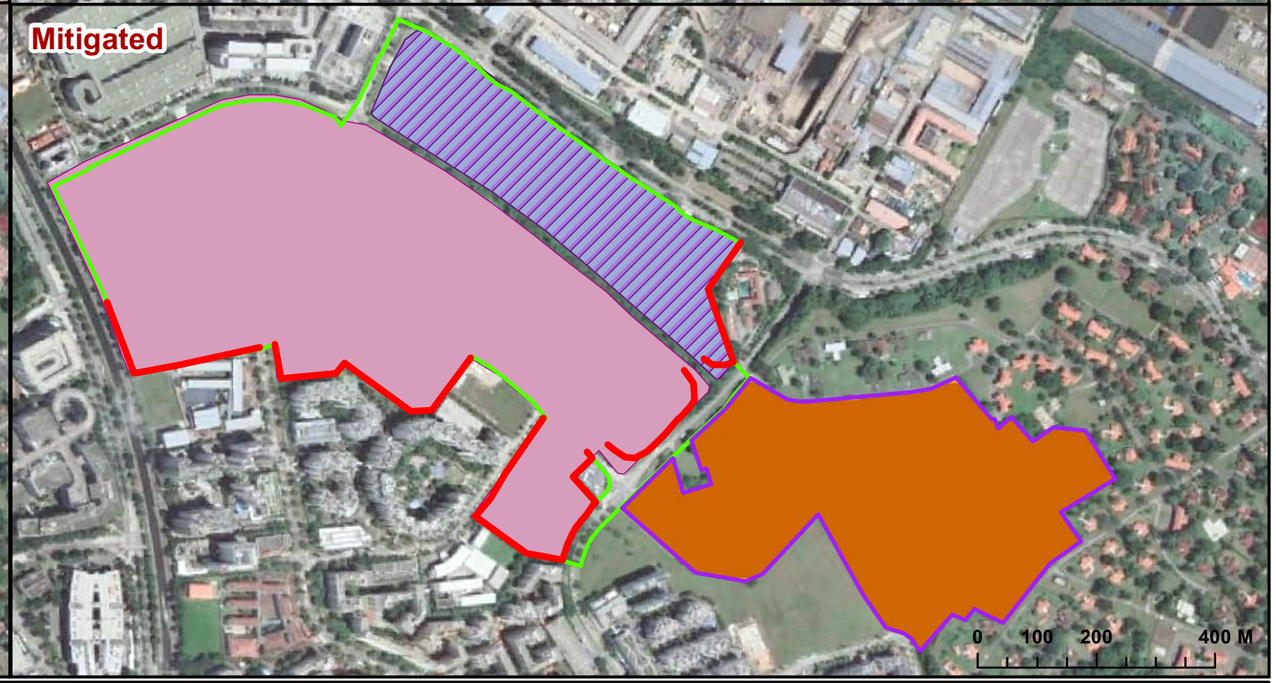
Unmitigated



Mitigated



Mitigated



Legend

- Ecological Receptor
- Project Boundary
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels
- Proposed Noise Barrier

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(12 hours), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	LLG	Final Report	SAG	JAG
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Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :
Ecological Noise Sensitive Receptors - Scenario 2: Site Foundation Works at Northern Parcels, Reinstatement and Landscaping Works at Southern Parcels LAeq (12 hours), 7pm - 7am (Proposed Noise Barrier Mitigation)

Designed	Checked	Approved
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Figure No. : 7.5.20 | Rev. : 1 | Sheet : 1 of 1

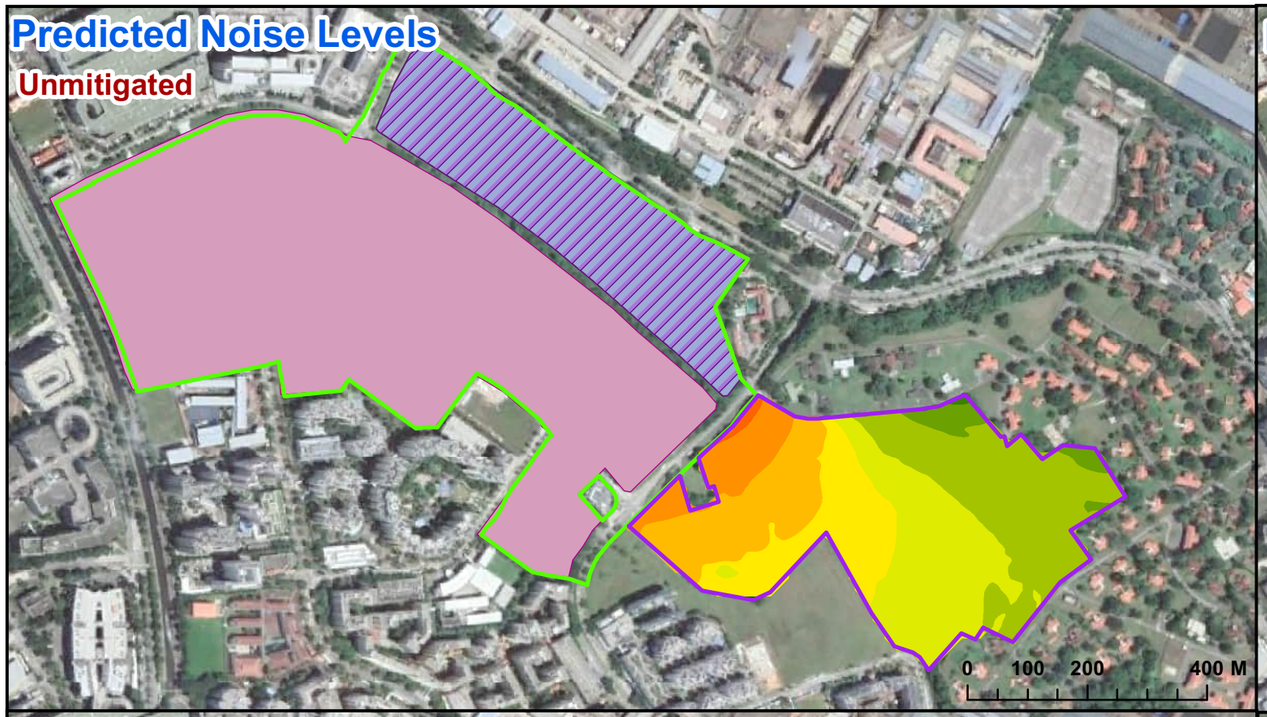
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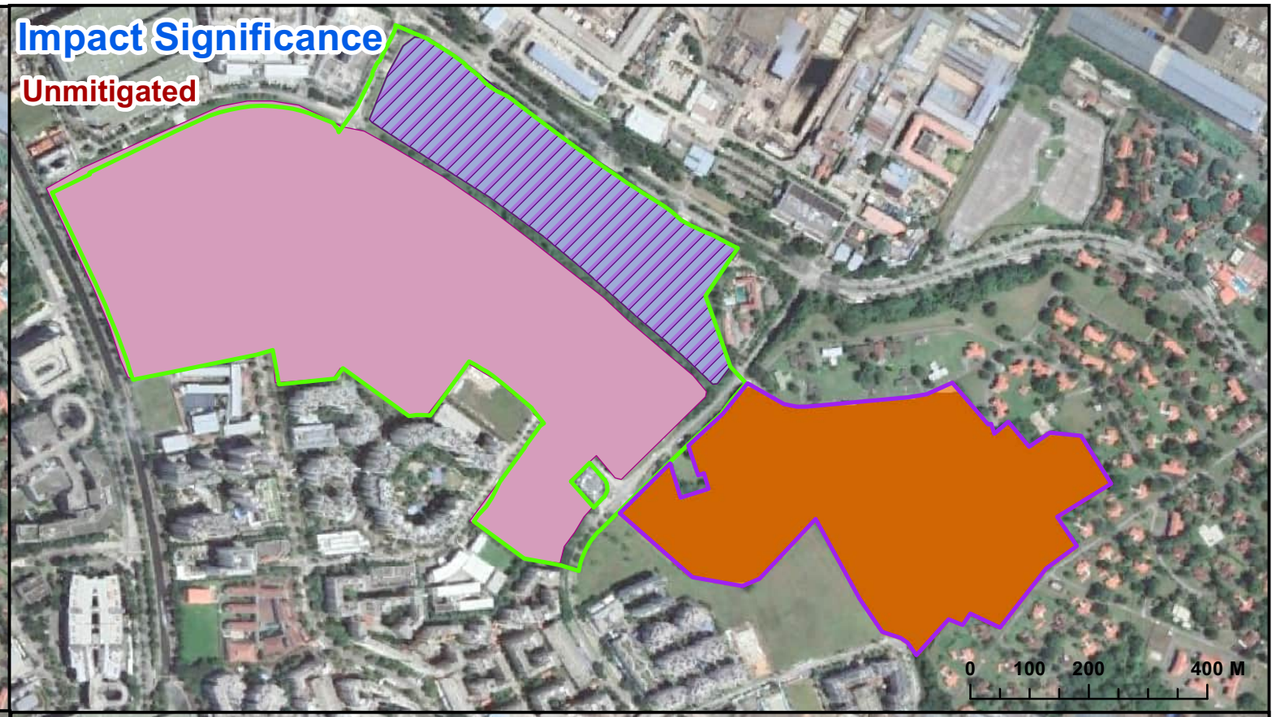
Predicted Noise Levels

Unmitigated

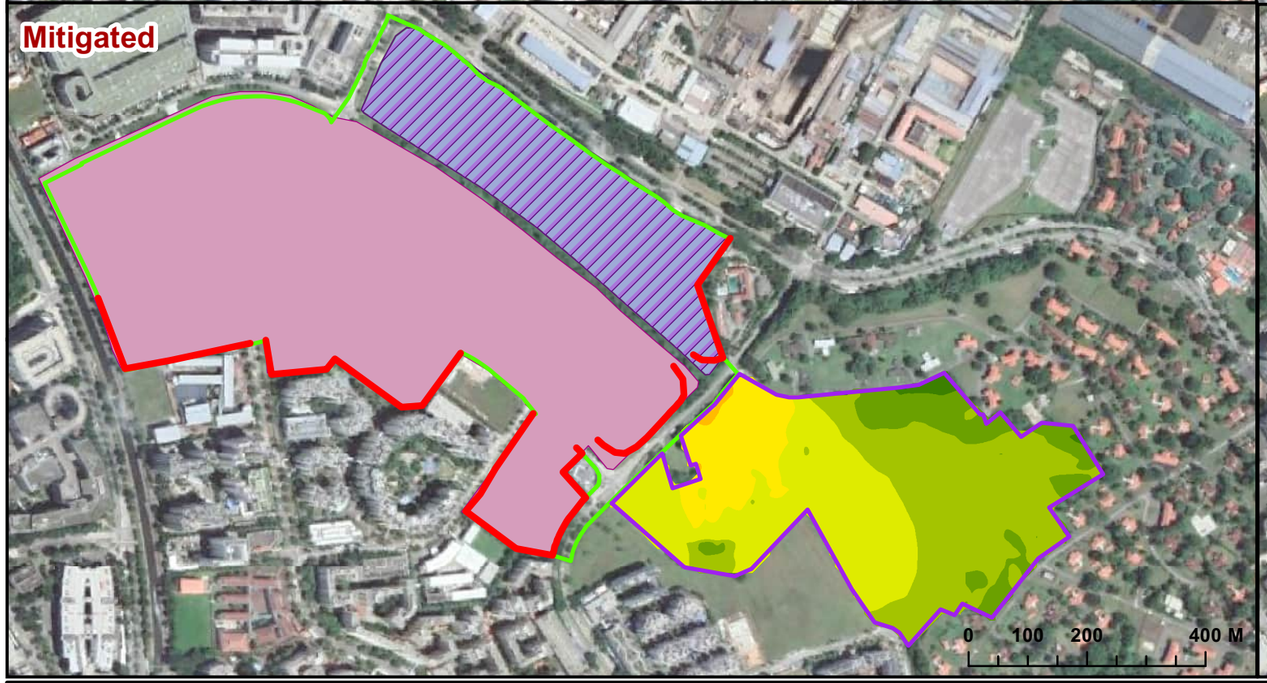


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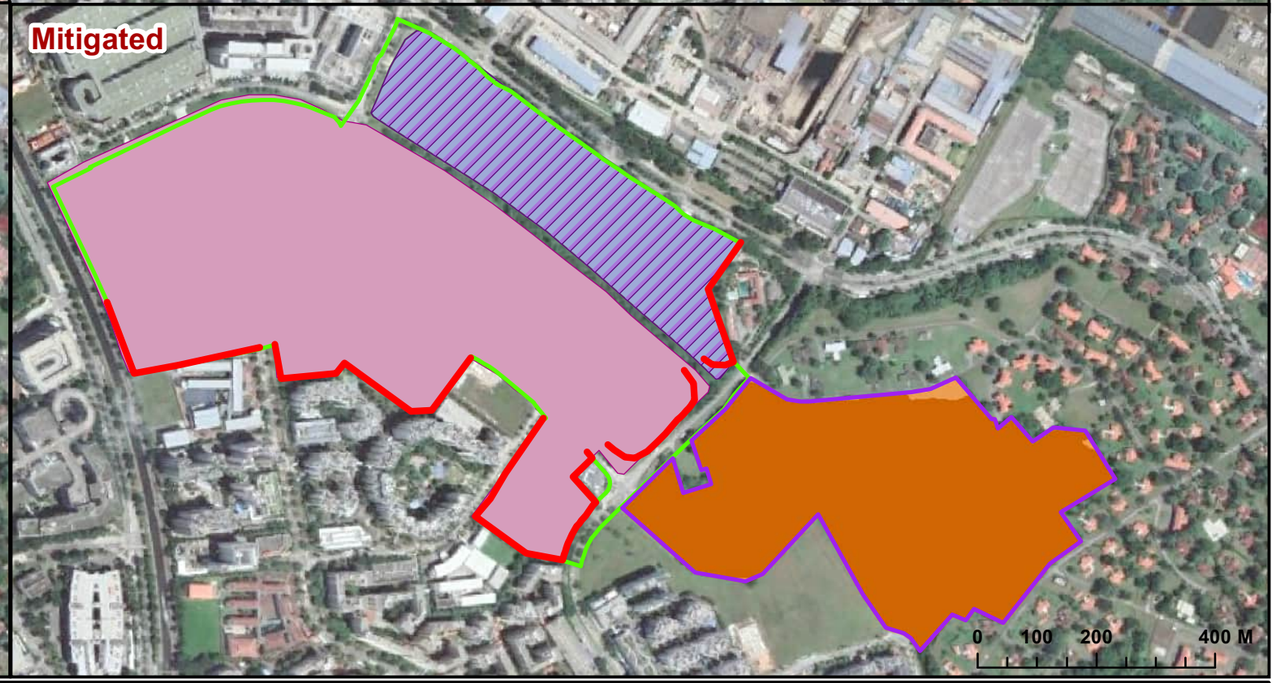
Unmitigated



Mitigated



Mitigated



Legend

- Ecological Receptor
- Project Boundary
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels
- Proposed Noise Barrier

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq (1 hour), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Ecological Noise Sensitive Receptors - Scenario 2: Site Foundation Works at Northern Parcels, Reinstatement and Landscaping Works at Southern Parcels LAeq (1 hour), 7pm - 10pm (Proposed Noise Barrier Mitigation)

Designed	Checked	Approved
TYL	SAG	JAG
	Drawn: LLG	Date: AUG 2024

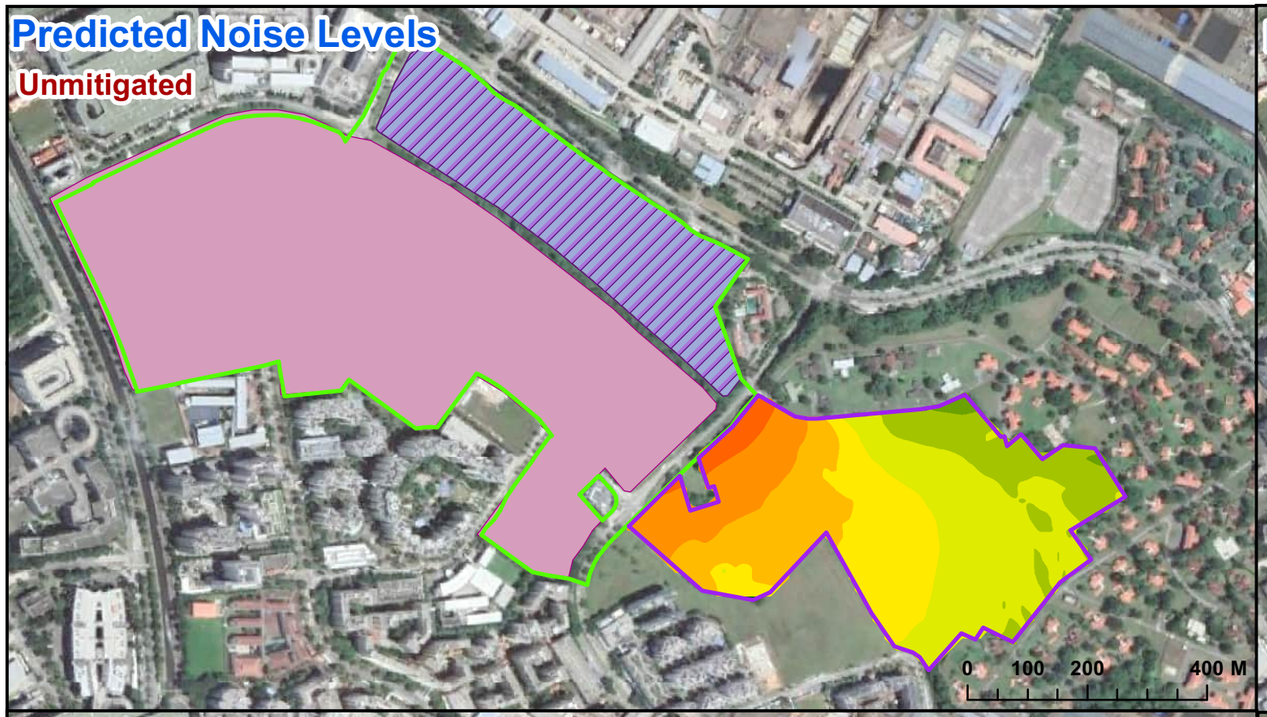
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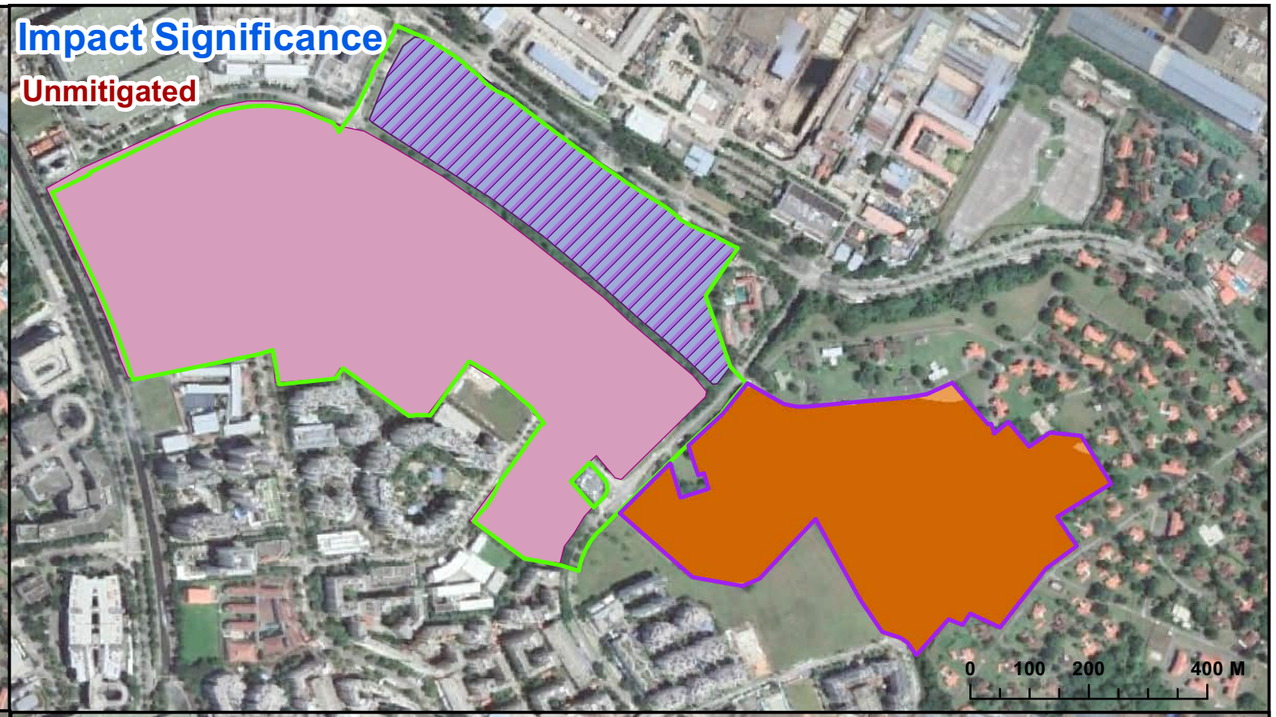
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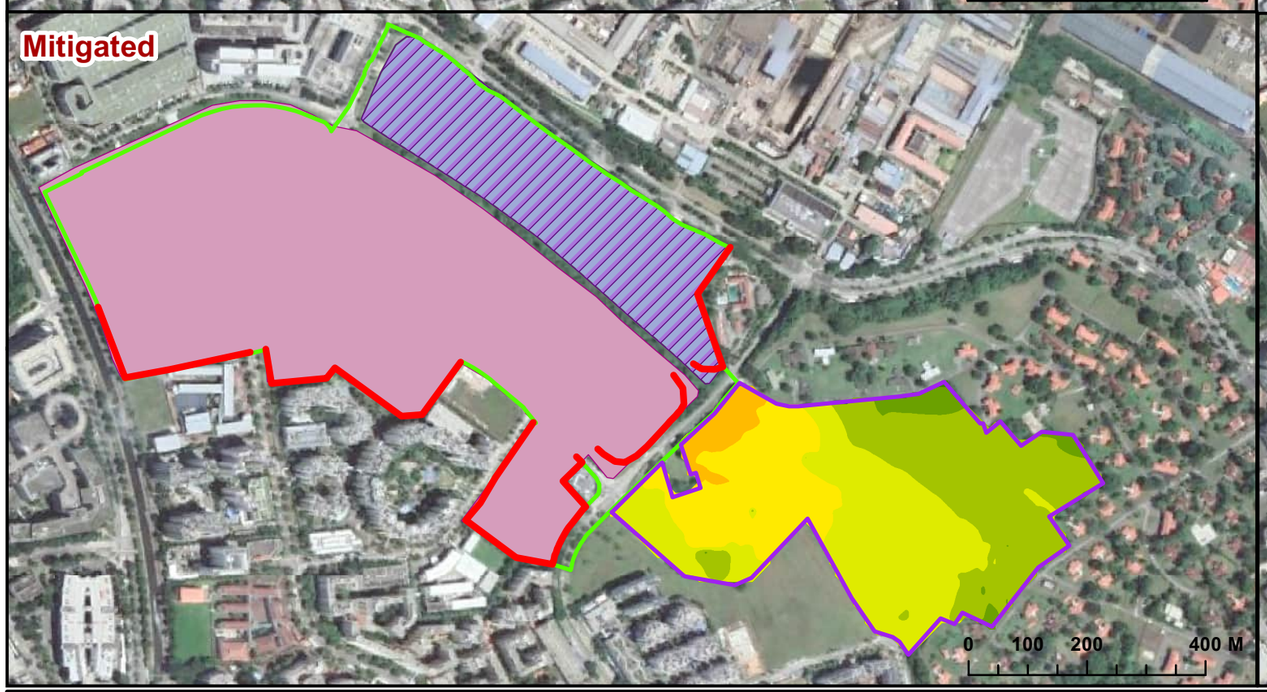
Predicted Noise Levels
Unmitigated



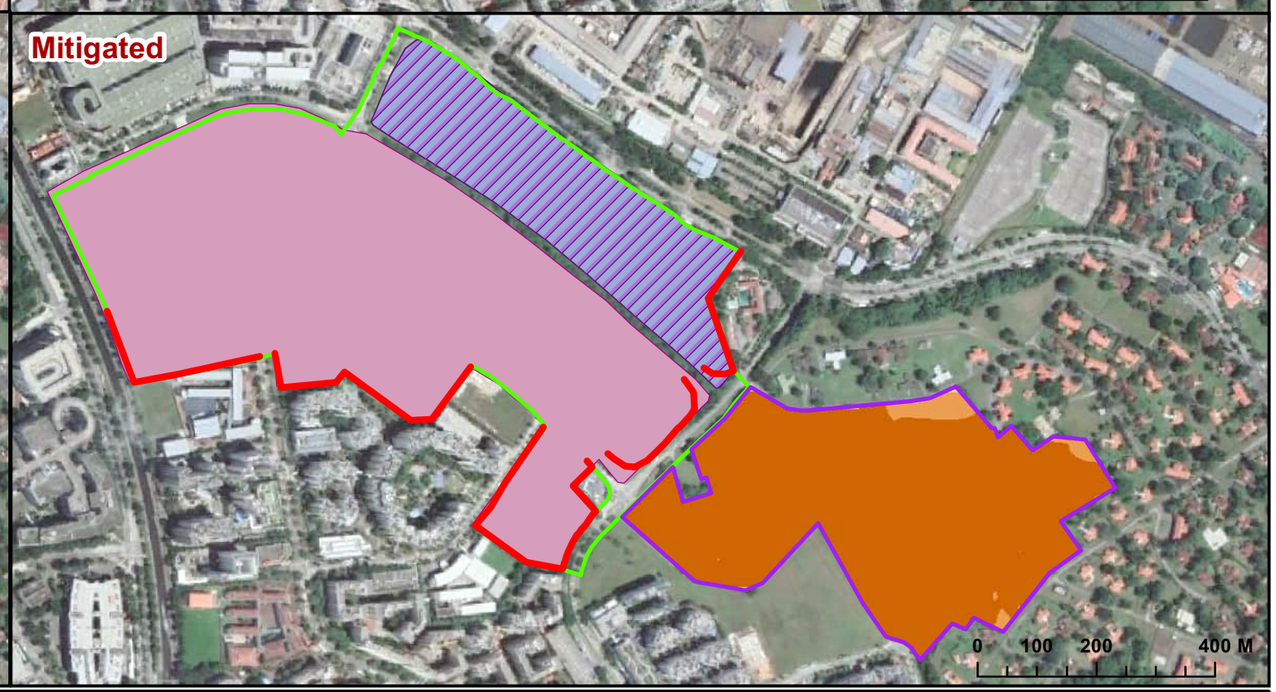
Impact Significance
Unmitigated



Mitigated



Mitigated



Legend

- Ecological Receptor
- Project Boundary
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels
- Proposed Noise Barrier

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(5 mins), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :
SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :
Ecological Noise Sensitive Receptors - Scenario 2: Site Foundation Works at Northern Parcels, Reinstatement and Landscaping Works at Southern Parcels LAeq (5 min), 7am - 7pm (Proposed Noise Barrier Mitigation)

Designed	Checked	Approved
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Figure No. : 7.5.22 | Rev. : 1 | Sheet : 1 of 1

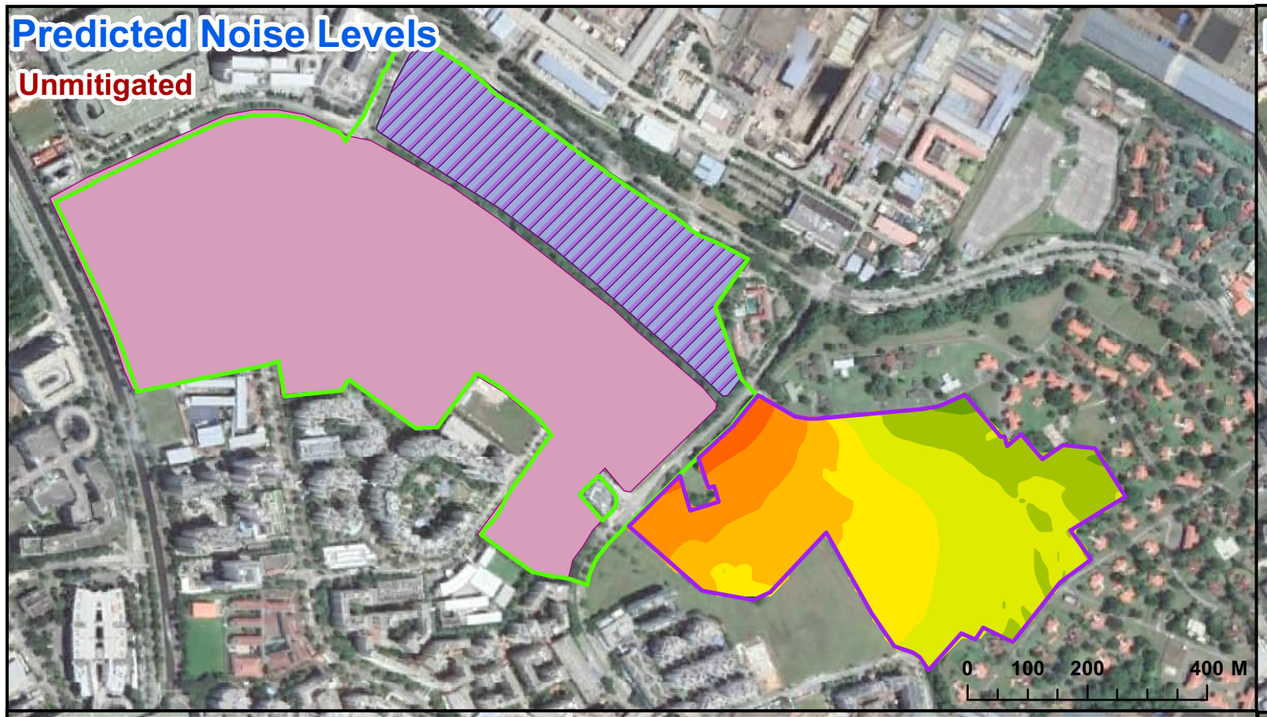
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Note: Source of basemap - Google Earth Map

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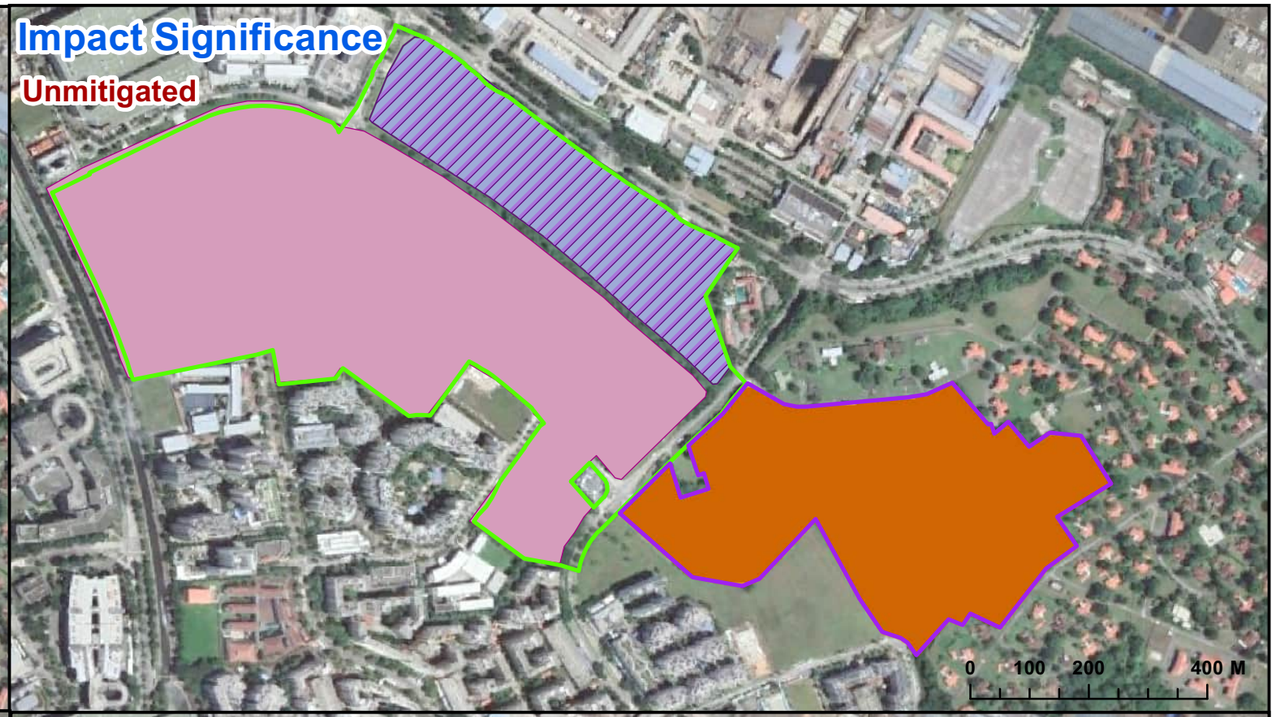
Predicted Noise Levels

Unmitigated

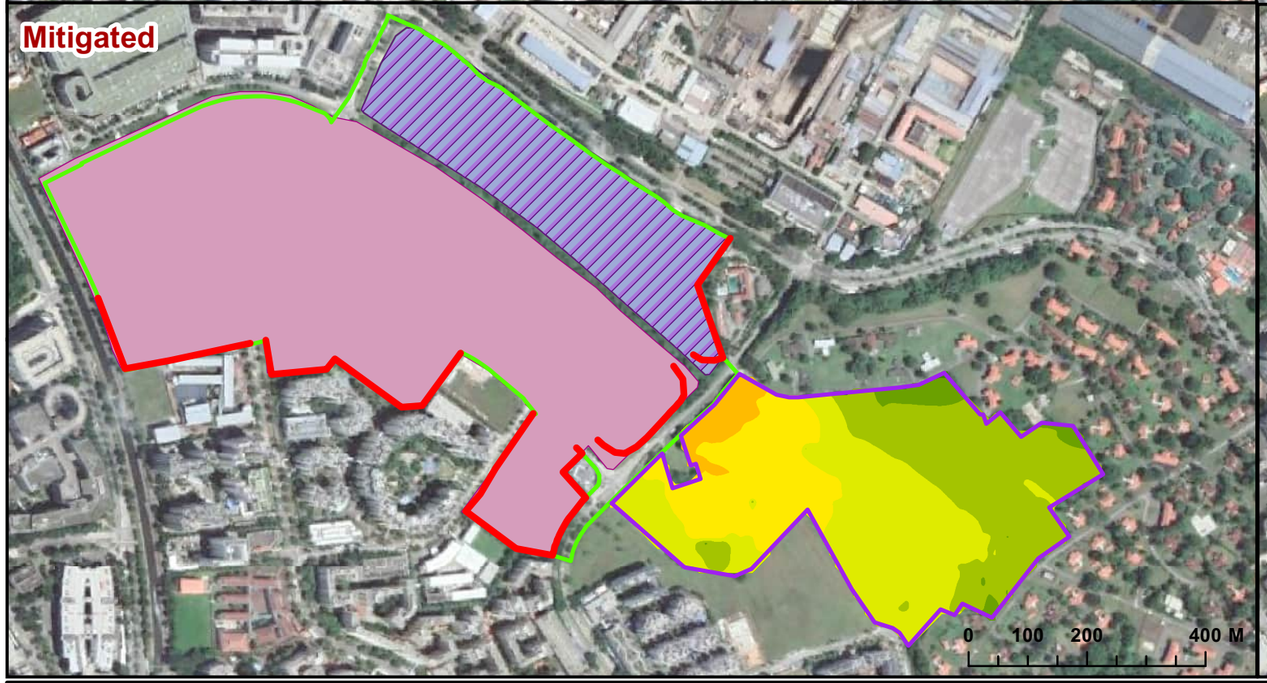


Impact Significance

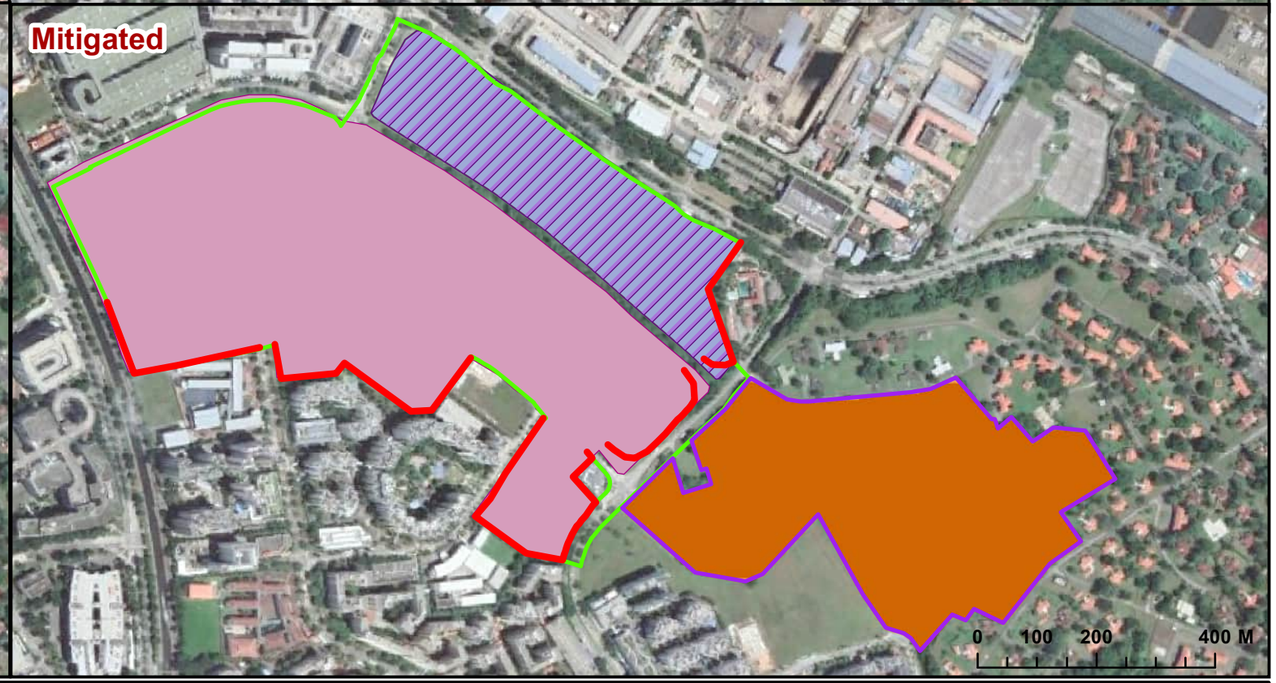
Unmitigated



Mitigated



Mitigated



Legend

- Ecological Receptor
- Project Boundary
- Foundation Works at Northern Parcels
- Reinstatement and Landscaping Works at Southern Parcels
- Proposed Noise Barrier

Impact

- Minor
- Moderate
- Major

Predicted Airborne Noise Levels LAeq(5 mins), dB

- <48
- 48-51
- 51-54
- 54-57
- 57-60
- 60-63
- 63-66
- 66-69
- 69-72
- >72

N

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1	JUNE 2024	LLG	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Ecological Noise Sensitive Receptors - Scenario 2: Site Foundation Works at Northern Parcels, Reinstatement and Landscaping Works at Southern Parcels LAeq (5 min), 7pm - 10pm (Proposed Noise Barrier Mitigation)

Designed	Checked	Approved
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	Drawn: LLG	Date: AUG 2024

Figure No. : 7.5.23 | Rev. : 1 | Sheet : 1 of 1

CAD File Name : NA | A3

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As the overall impact significance of the noise impact assessment remain **Major** after mitigation measures have been considered for the residual impact assessment, the following mitigation measures are recommended for further discussion:

1) Avoid

High Noise Powered Mechanical Equipment

The equipment inventory list was analysed to check the equipment (PMEs) causing high noise levels (higher quantity and/or longer working periods of PMEs can cause higher noise levels). The use of equipment with lower noise level shall be prioritised, as this is the most effective way to mitigate the noise level at the source.

Limit the working hours to only Daytime (7am to 7pm).

Propose to plan the BTO construction of the building near to N5 first so that the buildings may act as natural noise barrier when the construction of the rest of the buildings happen behind these at a later stage. This implies staggering even the commencement of piling for the ones behind after the superstructure of the first layer of buildings have reached say at least 12 m or 3-4 stories high.

2) Minimise

Source Noise Control

As a last resort for engineering control, when noise barriers are also not so effective in mitigating noise, or in order to manage complaints if there are intermittent noisy works, Table 7.29 below provides information on methods of quietening PME to be adopted for further mitigation on construction noise impact.

The maximum reduction in sound power level in Table 7.29 is achievable when all source control measures stated in this table are adopted. Noise enclosures should be used at the locations of the noise generating equipment at the construction site. Acoustic sheds should be provided at the locations of the noise generating activity such as operation of hand-held breaker. Sound pressure levels reduction ranging from 0 – 3 dB can be achieved by using all or combination of the following measures.

Table 7.29 Control of noise source from worksites

Type of Equipment	Equipment	Reduction in Sound Power Level, dB(A) [1]	Description of Source Control
Compressors & Generators	Generators	-20	Acoustic dampening of metal casing of body shell; acoustic enclosure or screen between the generator and receptor. The acoustic casing for the generator shall be proprietary product supplied by the generator manufacturer. The screen, if used, shall be as close as possible to the generator and it shall be of a solid construction (minimum STC 20 or surface density > 20kg/m^2) with no gaps at the bottom or in-between panels.
Hacking major structures	Excavator with Rock Breaker	-15	Use of an acoustic shed with adequate ventilation for the machine and bit.
Earth-moving Plant	Crane	-10	Manufacturers' enclosure panels to be kept closed. The engines of these vehicles shall not be exposed and clad with the manufacturers' enclosure to reduce noise break-out. Manufacturer-supplied silencers for the engine exhausts shall be installed and maintained.
	Dump Truck	-10	
	Excavator with Rock Breaker	-10	
	Excavator	-10	
	Concrete Mix Truck	-10	

Type of Equipment	Equipment	Reduction in Sound Power Level, dB(A) [1]	Description of Source Control
	Lorry	-10	
Pumps	All Pumps	-10 to -20	Use of acoustic enclosure.
Note: [1] The noise reduction level makes reference to BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise			

Based on the Singapore Standards Code of Practice for Noise Control at Construction Sites, 2014 (SS602:2014), the typical materials used for noise barriers and acoustic shed/enclosures is given below:

Acoustic Shed/Enclosure:

A typical machine acoustic enclosure covers the machine as fully as possible (with/without ventilation), providing adequate sound insulation that noise energy does not readily pass through it. In addition, it could also have a sound absorbing material lining, to avoid the build-up of sound energy inside. In general, an acoustic enclosure could include:

- Outer cover material made up of brickwork, fibreboard, or plasterboard. Thickness of the insulating cover depends on the material used;
- Inner lining of sound absorbing material such as glass fibre, mineral wool, straw slabs, wood wool slabs can be used. A thickness of at least 25 mm is to be provided in case of high frequency sound, whereas a 12 mm thick lining would suffice for low frequency sound; and
- Perforated sheet coverings can be used to protect the inner lining material, especially if it is glass wool or mineral wool-based lining.

In the case of a more permanent or substantial machine enclosure or acoustic shed, concrete breezeblock and open textured blockwork can be more effective alternatives as these are known to be durable, inexpensive, and quick to assemble, and provide a useful degree of sound absorption.

3) Administrative Controls to further reduce noise

It is recommended to reduce noise impact to fauna by various administrative controls at the Airborne Noise Study Area. For example, avoid breeding seasons for the activity, or to avoid early morning daytime noisy activities between 7am – 9am as far as possible on site. This may reduce some impacts on this fauna on behavioural aspects and communication.

Other than that, the following administrative control measures should also be observed during the construction stage to further reduce the noise levels:

- Machines (such as trucks) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- Only well-maintained construction plants should be utilised on-site, and construction plants should be serviced regularly during the entire construction period;
- The number of PMEs should be reduced as far as practicable when construction works are carried out at areas close to the noise sensitive receivers;
- Silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction programme;
- Behavioural practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items should be ensured;
- Construction respite: Restrict high noise generating drilling activities only in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block, if possible;
- Periodic noise monitoring by an independent third party, to establish compliance with requirements and to advise on equipment causing concern, and additional potential mitigation measures;

- Minimise construction activities during night works period (i.e. after 6pm) to minimise noise disturbance to nocturnal animals;
- Plan the layout of the site by considering using materials and other large structural equipment as noise barriers;
- Construction plants known to emit noise strongly in one direction should, wherever possible, be orientated so that the noise is directed away from the nearby noise sensitive receptors;
- Material stockpiles and other structures will be effectively utilised, wherever practicable, in screening noise from on-site construction activities;
- All handheld percussive breakers and air compressors used on site will comply with local legislation and requirements;
- Activities may be scheduled to minimise noise generated at certain areas during periods which may be particularly sensitive to noise;
- Works using machines or vehicles that generate noise should be prohibited in the night and the dawn;
- If noise remains an issue even after implementation of recommended mitigation measures such as noise barriers, contractor should consider implementation of proprietary noise barriers of high noise reduction capabilities to further reduce noise to acceptable levels.

In addition to the above measures, an EMMP with airborne noise monitoring program was proposed to assess the effectiveness of minimum control measures and recommended mitigation measures on site during construction phase of the Project, as detailed in Section 9.13.1.

7.5.3.5 Cumulative impacts

As reflected in Section 3.5, there is one expected concurrent project “Demolition works within Sembawang Shipyard” proposed to happen while this Project occurs. At the time of writing the Report, there was limited to no information available on the demolition works planned and the timeline. However, based on a rough timeline comparison, there is higher odds of superstructure construction (pre-fab installation) phase at Sembawang N4 happening concurrently with demolition works within Sembawang shipyard.

Since no substantial details were available at the time of writing this report, this demolition activity was not assessed at this stage. Regardless of the assessment of the demolition activity, as the non-cumulative impacts are predicted to be Major, any cumulative impacts from the demolition works is expected to remain Major.

7.6 Summary of Impacts during Construction Phase of the Project

For habitat receptors, two types of impact were assessed during the construction phase— (1) loss of vegetation and (2) habitat degradation—the impact significance categories are Major and Negligible respectively. All four habitat types occurring in N4 Forested Area will be affected by vegetation clearance (Table 7.16). As the loss of vegetation clearance is inevitable due to the development of Sembawang N4, the residual impact remains the as **Major**. As there is no site clearance in N5 Forested Area included in this Study, the impact significance is **Negligible** for all five habitat types assessed.

Once N4 Forested Area has been cleared, only a small portion (30 m from worksite) of N5 Forested Area will be subjected to habitat degradation. The five remaining affected habitat types (Table 7.11) in the 30 m impact zone from worksite were assessed for habitat degradation and the impact significance for all habitat types is **Negligible**. Improper disposal of construction waste or the accidental release of hazardous materials into the habitat types assessed is Less Likely due to the existing 'setback' provided by Canberra Road.

For floral species receptors, two types of impact were assessed during the construction phase— (1) mortality and (2) decline in plant health and survival—the impact significance categories ranges from Negligible to Major for the former, and Negligible for the latter. Out of the 24 flora species receptors identified, a total of seven species occurring within the N4 Forested Area will be impacted by mortality and the remaining 17 species occurring only in N5 Forested Area will not be impacted by mortality. Transplantation and salvaging are mitigation measures that reduces the Major/Moderate impact of mortality to **Negligible**, if done prior to land clearance.

Within N5 Forested Area, 21 species are not affected directly by mortality are also assessed to be **Negligible** for the decline in plant health and survival. Similar to the impact of habitat degradation assessed for habitat receptors, the existing Canberra Road renders the changes to microclimatic conditions on the rigour of plants remaining plants in N5 Forested Area as **Negligible**.

For fauna receptors, six types of impact were assessed during construction phase— ((1) loss of or reduction in habitats and food sources, (2) human-wildlife conflict, (3) accidental injury or mortality, (4) loss of or reduction in ecological connectivity for faunal movement, (5) light disturbances, and (6) human disturbances The impact significance for the loss of or reduction in habitats and food sources is Major for the majority of the 75 sensitive receptors assessed as the loss of N4 Forested Area amounts up to 23.5% of the entire biodiversity Study Area. Other pre-mitigated impact types assessed range from Moderate to Negligible. After considerations of mitigations measures detailed in Section 7.4.4, the pre-mitigated Moderate/Minor value is being reduced to **Minor/ Negligible**.

During the construction phase, ecological sensitive receptors may also be impacted as a result of changes in environmental baseline conditions of water resources as well as ambient noise. These impacts were also assessed as part of this study.

With regards to hydrological changes (e.g. catchment change, alteration of surface water runoff velocity, inflow distribution, reduced seepage of water into the soil, etc.), temporary and/ or permanent land use change and groundwater extraction during soil dewatering were identified as key potential sources of impact. If changed significantly, such hydrological changes may cause disturbances in aquatic habitats due to altered dry and/ or wet weather conditions and localised flooding of surrounding areas. Impacts on Sungei Sembawang and EJS and their associated habitats (Priority 1 receptors) due to hydrological changes were assessed to be **Negligible**. This was assessed based on the assumption that recommended minimum controls will be implemented on the site, and also given that the catchment areas of these waterbodies are significantly larger than the site's catchment area and hence likely to be less disturbed by potential changes. With regards to potential impacts due to changes in water quality, impacts were assessed to be **Minor**. Therefore, no additional mitigation measures were proposed.

With regards to airborne noise impacts on the ecological receptors, fauna species of Conservation Significance (CS) and with high auditory sensitivity was observed in major portions of N5 forested area and it was deemed as Priority 1 receptor. The various stages of construction, their equipment inventory, timeline (sequence) of works and their cumulative Sound Power Levels (SWLs) were studied in detail and two worst case "time periods" were chosen for noise assessment. Unmitigated noise predictions show that the N5 forested area is expected to experience **Major** impacts. This was attributed to proximity of worksite to N5 area and stringent noise criteria (no

worse-off from baseline levels). Further examination of equipment inventory was conducted with HDB, simultaneously noise barrier options at 6 m height and 12 m height was proposed, yet the residual impact remained **Major** with a reduced area of impact spread. AECOM recommends HDB to implement the noise barriers rigidly, and plan the timeline of building works strategically to minimise construction activities during night works period, so as to reduce impacts to N5 forested area.

Table 7.30 Summary of impacts on ecological receptors due to the changes in other environmental parameters during construction phase of the Project

Impact	Source of Impact	Sensitive Receptor	Receptor Sensitivity	Impact Intensity	Impact Consequence	Impact Likelihood	Impact Significance
Water Resources (Hydrology)							
• Disturbances in habitat and/ or reduction in size of species population due to altered dry and wet weather conditions • Localised flooding of habitats adjacent to watercourses	Temporary and/ or permanent land use change	Sungei Sembawang and associated habitats	Priority 1	Low	Low	Unlikely	Negligible
		East Johor Straits (EJS) and associated habitats	Priority 1	Low	Low	Unlikely	Negligible
	Groundwater extraction and discharge	Sungei Sembawang	Priority 1	N/A	N/A	Unlikely	Negligible
		East Johor Straits (EJS)	Priority 1	N/A	N/A	Unlikely	Negligible
Water Resources (Surface Water Quality)							
Disturbances in habitat and/ or reduction in size of species population due to contamination of receiving watercourses	Silty effluent originating from the site from exposed soil	Sungei Sembawang and associated aquatic habitats	Priority 1	Medium	Medium	Less Likely/ Rare	Minor
		EJS and associated aquatic habitats	Priority 1	Medium	Medium	Less Likely/ Rare	Minor
	Other liquid effluents and construction wastewater generated as by-product of	Sungei Sembawang and associated aquatic habitats	Priority 1	Medium	Medium	Less Likely/ Rare	Minor

Impact	Source of Impact	Sensitive Receptor	Receptor Sensitivity	Impact Intensity	Impact Consequence	Impact Likelihood	Impact Significance
	proposed activities	EJS and associated aquatic habitats	Priority 1	Medium	Medium	Less Likely/ Rare	Minor
	Leachate of pollutants from solid waste managed on site	Sungei Sembawang and associated aquatic habitats	Priority 1	Medium	Medium	Less Likely/ Rare	Minor
		EJS and associated aquatic habitats	Priority 1	Medium	Medium	Less Likely/ Rare	Minor
	Accidental spills and leaks of pollutants due to improper management of chemicals and toxic waste	Sungei Sembawang and associated aquatic habitats	Priority 1	Medium	Medium	Less Likely/ Rare	Minor
		EJS and associated aquatic habitats	Priority 1	Medium	Medium	Less Likely/ Rare	Minor
Airborne Noise							
Noise impacts from construction activities to the fauna species in N5 forested area	Foundation works at Southern parcels. Site Clearance and Earthworks at Northern parcels	N5 Forested Area	Priority 1	High	High	Certain / Continuous	Major

8 Prediction and Evaluation of Impacts During Operational Phase

8.1 Potential Sources of Impact

As mentioned earlier, the development of N4 will occur in phases – starting with the southern portion of the site, followed by the northern portion. For the purposes of this study, operational phase will refer to the period once the N4 is fully developed (both southern and northern portions). At the operational phase, residential buildings are expected to be adjacent to N5 Forested Area. N5 Forested Area is a sensitive receptor with ecological significance because it functions as a stepping-stone habitat amongst other reasons detailed in Section 6.4.3. Human traffic is expected to increase significantly. Increase in human traffic would inevitably increase disturbance to surrounding biodiversity in the form of noise and light generated. Increase in waste in the form of rubbish/ litter or wastewater discharge could also potentially become an impact, if not properly managed.

While faunal species remains to be assessed, the impacts during operational phase were separately assessed for habitats and floral and detailed in Section 8.4. There are two main categories in which the impacts fall into, namely, (1) direct, i.e., impacts to habitats and species within the worksites; and (2) indirect, i.e., impacts to habitats and species outside the worksites but within the impact zone. **Impact zones** for habitat and species receptors are defined as areas within 30 m from worksites of the proposed development.

8.1.1 Impacts on Biodiversity

The list of potential environmental impacts during operational phase is summarised in Table 8.1.

Table 8.1 Potential impacts on biodiversity during operational phase

Receptor	Impact type	Description	Impact category
Operational Phase			
Habitat	Habitat degradation	<u>Terrestrial habitat</u> Trampling on vegetation or pollution (e.g., litter) from increased human activities <u>Aquatic and intertidal habitat</u> Changes in surface water quality	Indirect
	Changes in microclimatic conditions	Changes in microclimatic conditions (such as temperature, light and humidity) of the habitat due to operational activities and/ or micro urban heat island from the adjacent development.	Indirect
Faunal species	Accidental injury or mortality	Navigation failures into the wrong areas and entrapment in facility structures, including bird collision into buildings (distorted perceptions of reflective surfaces on buildings as flyways, greenery, and/or water) and roadkill.	Direct/ Indirect
	Human-wildlife conflict	Negative consequences of human-wildlife interactions, such as deliberate killing and depopulation of faunal species perceived as nuisances or threats by members of the public	Direct
	Loss of ecological connectivity for faunal movement	<u>Terrestrial habitat</u> Impediment to faunal movement by presence of buildings, infrastructure, and human activity <u>Aquatic habitat</u> Changes that impedes connectivity of waterbody	Indirect
	Light disturbances	Increase in light levels from development	Indirect
	Human disturbances	Increase in human traffic flow, such as residents and visitors	Indirect

8.1.2 Impacts on Biodiversity due to Changes in Other Environmental Parameters

The list of potential impacts on biodiversity during operational phase of the Project due to changes in baseline hydrology, surface water quality and airborne noise is summarised in the Table 8.2 below.

Table 8.2 Potential impacts on biodiversity during operational phase

Environmental Parameter	Potential Source(s) of Impacts	Potential Associated Impact on Environmental Parameter	Potential Associated Impacts on Ecological Receptors
Water Resources (Hydrology)	Permanent land use change with more impervious surfaces due to proposed developments	• Increased stormwater peak flow contributions to the receiving watercourses (e.g. newly proposed Drain within N4, Sungei Sembawang) which can lead to increased water levels and flooding of areas adjacent to watercourses • Permanent decrease in groundwater level due to reduced seepage of surface water into the soil	• Disturbances in aquatic habitats due to altered dry and wet weather conditions • Localised flooding may have adverse impacts on surrounding terrestrial habitats
Water Resources (Surface Water Quality)	• Discharge of potentially contaminated surface water runoff, especially during storm events in the new development area • Improper management of liquid and solid wastes generated within the site	• Elevated levels of suspended solids (e.g. silt) and anthropogenic pollutants in receiving watercourses • Solid waste can block the watercourses and lead to contamination • Inappropriate discharge of liquid wastes to the watercourses may result in contamination	• Changes in surface water quality could have adverse impacts on aquatic habitats and species • Contamination may spread to downstream watercourses, affecting downstream habitats
Airborne Noise*	Traffic noise due to increase in vehicular volume	Increase in baseline airborne noise levels	Potential impacts due to the increase in noise level includes noise disturbance to fauna affecting ecological foraging behaviour, intra-species and inter-species communication.

**Note: Air-conditioning and mechanical ventilation noise is not considered as N5 forested area is not adjacent to N4 or HDB parcels.*

8.2 Identification of Sensitive Receptors

8.2.1 Habitats

Only the habitat types remaining within the 30 m impact zone in N5 Forested Area during the operational phase will be assessed for indirect impacts. Within the aforementioned impact zone, there are five different habitat types; namely abandoned-land forest, exotic-dominated land forest, scrubland, grassland and urban vegetation (turf) which occur in N5 Forested Area.

8.2.2 Flora

There are no operational impact types to be assessed for floral species receptors remaining in N5 Forested Area.

8.2.3 Fauna

Faunal species receptors assessed in the operational phase are the same as the species assessed in construction phase.

8.3 Minimum Control Measures

This section proposes minimum controls or standard practices commonly implemented in Singapore for the purposes of impact assessment during operational phase.

8.3.1 Biodiversity

This section lists biodiversity-specific minimum control measures that are commonly implemented in Singapore for operational activities. These are assumed to be implemented for the purpose of the impact assessment and should be proposed in tandem with the measures proposed for other environmental receptors (e.g., hydrology, surface water quality, airborne noise). Minimum controls for each potential impact occurring from the operational phase is listed in Table 8.3.

Table 8.3 Minimum control measures for the operational phase

Work activities	Minimum controls for operational phase
General	• Ensure noise levels are within approved limits (refer to Section 8.5 under airborne noise-related impacts) • Ensure dust levels are within approved limits as defined by NEA's regulated Environmental Protection and Management Act and its regulations.

8.3.2 Water Resources

Table 8.4 has a non-exhaustive list of minimum controls for each potential impact identified in Section 8.1.2 for operational phase.

Table 8.4 Minimum control measures during operational phase applicable for water resources

Potentially Affected Environmental Parameter	Potential Source(s) of Impact	Minimum Control Measures
Water Resources (Hydrology)	Permanent land use change with more impervious surfaces due to proposed developments	• Ensure the future drainage system is designed in accordance with PUB COP to ensure appropriate water conveyance within the proposed future development and to prevent flooding of adjacent areas. • Geotechnical aspect of site's slope stability (such as Earth Retaining Stabilising Structure [ERSS]) will be included in detailed design engineering for the operational phase. • Providing more softscape area should be considered in the design of the development which will help to reduce the peak flow and reduce flood risk at downstream area. ABC Water design approach can be considered to reduce the peak flow. • Provide more pervious areas to increase the seepage of surface water into the soil. • Installation of recharge wells, if necessary.

Potentially Affected Environmental Parameter	Potential Source(s) of Impact	Minimum Control Measures
Water Resources (Surface Water Quality)	Heavy rain and stormwater wash-off pollutants built-up in the new development area and discharge to the surrounding watercourses	• Adequate drainage, piping and/ or channelling of stormwater runoff to be assured through detailed design [e.g. ABC Water design approach] for capturing and treatment before discharge into receiving watercourses. • Regular and dedicated procedures for the inspection and maintenance of stormwater collection, storage, and treatment infrastructure, such as pipes, oil water separation and silt screens etc. • Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of 'clean' water to surface waters, including associated measures required to prevent high sediment concentration stormwater drainage to surface waters.
	• Accidental spill and leaks (e.g. during storm event) • Improper handling, transfer, and storage of solid and liquid wastes (e.g. rubbish collection and sewage disposal);	• Prepare sufficient disposal bins surrounding the Project to avoid improper disposal of waste. • Conduct regular inspection on wastes' storage system of the Project. • Monitor the proposed watercourses and its surroundings with CCTV surveillance regularly to ensure no contamination occurred. • Develop an Emergency Response Plan and conduct adequate training to maintenance workers to cope the accidental contamination of water. • Raise awareness of various stakeholders with community/ stakeholder engagement (e.g. signage boards, warning signs, etc.). • No vehicles allowed within the future managed vegetation (i.e. proposed park) at development area.

8.3.3 Airborne Noise

Mechanical ventilation would be designed and sited appropriately during detailed design phases to ensure that boundary noise levels are in compliance with the adjusted boundary noise limits to be derived by an appointed Noise Consultant by HDB/ Contractor contracted by HDB as part of quantitative operational noise impact assessment as mandated by law. Some noise sources might be located close to the boundary and might require special attention for boundary noise limits compliance, and if necessary, be equipped with additional mitigation measures. These are to be provided upon assessment of noise arising from the operational phase.

Minimum control measures for noise emissions arising from the operational phase such as originating from land traffic are listed below. This list is non-exhaustive and should be practised as minimum control to reduce noise levels during the operational phase of the Project:

- Use of low-noise pavement mix for sections of new road networks near existing residential buildings shall be considered

8.4 Impacts on Biodiversity

The definitions for impact intensity and likelihood for habitat receptors at operational phase are presented in Table 8.5 and Table 8.6 respectively.

Identified biodiversity sensitive receptors were evaluated based on impact intensity and likelihood, which eventually gives the impact significance. The impact intensity and likelihood of each impact type during

operational phase are defined for habitats (Table 8.5 and Table 8.6), and fauna species (Table 8.7 and Table 8.8) receptors below.

Table 8.5 Definitions of each level of impact intensity for impact types during operational phase for habitat receptors

Impact type	Negligible	Low	Medium	High
Habitat degradation	Terrestrial habitat The habitat type does not overlap with areas 30 m from the development Aquatic habitat No change in surface water quality	Terrestrial habitat ≤ 10% of the habitat type overlaps with areas 30 m from the development Aquatic habitat Some changes in surface water quality	Terrestrial habitat 10–40% of the habitat type overlaps with areas 30 m from the development Aquatic habitat Considerable changes in surface water quality	Terrestrial habitat > 40% of the habitat type overlaps with areas 30 m from the development Aquatic habitat Extensive changes in surface water quality
Changes in microclimatic conditions	The habitat type does not overlap with areas 30 m from the development	≤ 10% of the habitat type overlaps with areas 30 m from the development	10–40% of the habitat type overlaps with areas 30 m from the development	> 40% of the habitat type overlaps with areas 30 m from the development

Table 8.6 Definitions of each level of likelihood for impact types during operational for habitat receptors

Likelihood	Habitat Degradation	Changes in microclimatic conditions
Unlikely/ Remote	Developed area is not accessible to public. Surrounding natural habitats are not accessible to public	Development is largely green and human activity is limited (e.g., Thomson Nature Park)
Less likely/ Rare	Developed area is designed with the intention for the public to use or visit. Surrounding natural habitats are accessible but public use is restricted/ controlled	Development involves the building of urban structures but will be heavily landscaped (e.g., Gardens by the Bay)
Possible/ Occasional	Developed area is designed for members of the public to visit. Surrounding natural habitats are accessible and have infrastructure for the public to use, such as boardwalks (but people can still stray off track)	Development involves the building of structures that are designed to release heat, light, noise or dust (e.g., ventilation shafts)
Likely/ Regular	Developed area and surroundings are designed for large groups of people to live or work in the long run. Surrounding natural habitats are easily accessible and do not have infrastructure for the public to use, such as boardwalks (thus public are off track)	Development involves the building of extensive pavements, structures, and other infrastructure with surfaces that absorb and retain heat, constantly produce dust and noise disturbances (e.g., residential estate)
Certain/ Continuous	N.A.	N.A

Table 8.7 Definitions of each level of impact intensity for all five impact types during operational phase for faunal species receptors

Impact type	Negligible	Low	Medium	High
Accidental injury or mortality*	Species with negligible susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings: – Birds with low	Species that are mobile but possibly susceptible to accidental injury/mortality from operation activities and roadkills, and collision with buildings: – Birds that are	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings: – Birds with high

Impact type	Negligible	Low	Medium	High
		susceptibility to collision with buildings – Volant species (e.g., odonates, butterflies, raptors and bats) – Aquatic species (most fishes, crabs, shrimps)	possibly susceptible to collision with buildings (e.g., resident species with known records of bird-building collisions – All amphibians – Some mammals (e.g., squirrels, shrews)	susceptibility to collision with buildings (e.g., forest-edge frugivores, migratory species) – Reptiles – Some mammals (e.g., Sunda pangolin, long-tailed macaque, smooth-coated otter)
Human-wildlife conflict	Species that are not perceived as nuisances or threats by members of the public: – Odonates – Butterflies – Most birds – Aquatic species	Species that are possibly perceived as both nuisances and threats by members of the public, less tolerant of human presence and urban environments: – Some reptiles – Most amphibians – Most bats	Species that are typically perceived as nuisances and possibly as threats by members of the public, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict: – Smooth-coated otter – Red junglefowl – Aculeate hymenopterans	Species that are typically perceived as both nuisances and threats by members of the public, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict: – Long-tailed macaque – Some snakes
Loss of/ reduction in ecological connectivity for faunal movement (within site)	<u>Terrestrial habitat</u> Not dependent on connected habitats for dispersal and able to traverse urban infrastructure <u>Aquatic habitat</u> No change to waterbody	<u>Terrestrial habitat</u> Slightly dependent on connected habitats for dispersal and adaptable to traverse urban infrastructures if needed <u>Aquatic habitat</u> Minimal changes in waterbody that may affect connectivity for aquatic species	<u>Terrestrial habitat</u> Dependent on connected habitats for dispersal <u>Aquatic habitat</u> Some changes in waterbody that may affect connectivity for aquatic species	<u>Terrestrial habitat</u> Highly dependent on connected habitats for dispersal <u>Aquatic habitat</u> Considerable changes in waterbody that may affect connectivity for aquatic species
Light disturbances	Species that are not sensitive to changes in light levels: aculeate hymenopterans, aquatic and marine species	Species that are slightly sensitive to changes in light levels: odonates, butterflies	Species that are sensitive to changes in light levels: diurnal birds, reptiles, and mammals	Species that are highly sensitive to changes in light levels: nocturnal, crepuscular fauna
Human disturbances	Species that are not sensitive to human presence	Species that are slightly sensitive to human presence	Species that are possibly sensitive to human presence	Species that are sensitive to human presence

*Not applicable for aquatic species

Table 8.8 Definitions of each level of likelihood for all impact types during operational phase for faunal species receptors

Likelihood	Accidental injury or Mortality	Human-Wildlife Conflict	Loss of/ Reduction in Ecological Connectivity for Faunal Movement	Light Disturbances	Human Disturbances
Unlikely/ Remote	Impact is not expected to happen during the operational phase of the project				
Less Likely/ Rare	Impact is not likely to happen during the operational phase of the project				
Possible/ Occasional	Impact could possibly happen or known to occur during the operational phase of the project				
Likely/ Regular	Impact is a common occurrence during the operational phase of the project				
Certain/ Continuous	Impact is a continual or repeated process during the operational phase of the project				

8.4.1 Habitats

Five remaining habitat types in the operational phase, located within the 30 m impact zone were assessed for two types of impacts– (1) habitat degradation and (2) change in microclimatic conditions. The impact significance for all habitat types is **Negligible**. Further details of impacts to habitats during operational phase are shown here in Table 8.9. The detailed evaluation for each habitat is provided in Appendix L.

Habitat degradation

N5 Forested Area is not accessible to public as it is a state land. Moreover, the remaining habitat types occurring 30 m from the worksite will not be made more accessible than it already is in the pre-construction stage, and hence habitat degradation by humans is not likely to further increased. Impact intensity of all the remaining five habitat types is expected to be Low. The likelihood for this impact type is Unlikely and the resulting impact significance is Negligible for all remaining habitat types.

Changes in microclimatic condition

The existing Canberra Road bisects N4 and N5 Forested Area suggesting that habitats within 30 m of the working boundary of N5 Forested Area have already been exposed to forest edge conditions. However, there may be an increase in micro urban heat island effect from residential areas that will be developed in N4 Forested Area. Impact intensity for all the remaining five habitat types is expected to be Low. The likelihood for this impact type is Unlikely and the resulting impact significance is Negligible for all remaining habitat types.

Table 8.9 Impact significance of biodiversity habitat receptors affected during the operational phase

Impact type	Impact Significance			
	Major	Moderate	Minor	Negligible
Habitat degradation	-	-	-	• Abandoned-land forest • Exotic-dominated secondary forest • Grassland • Scrubland • Urban vegetation

Impact type	Impact Significance			
Changes in microclimatic condition	-	-	-	• Abandoned-land forest • Exotic-dominated secondary forest • Grassland • Scrubland • Urban vegetation

8.4.2 Fauna

Four operational phase impacts were identified and assessed for faunal receptors: (1) light disturbances, (2) accidental injury or mortality, (3) human-wildlife conflict, and (4) human disturbances. Impact significance was assessed for the faunal receptors identified in Section 8.2.3. The resulting impact significance ranges from Negligible to Moderate. The more substantial impacts arising from each impact type are briefly summarised below. A summary of the impacts to fauna receptors is given in Table 8.10 and detailed assessment in Appendix M.

Light disturbances

Though this impact was assessed on the assumption that there will be no additional street lightings along Canberra Road, artificial lights from high-rise buildings can cause light disturbances during to N5 Forested Area during operational stages.

Diurnal birds such as the recorded changeable hawk eagle (*Nisaetus cirrhatus*) and the probable crested serpent eagle (*Spilornis cheela*), and diurnal mammals such as the recorded smooth-coated otter (*Lutrogale perspicillata*) and long-tailed macaque (*Macaca fascicularis*), are species that are sensitive to light changes. Species that are on the higher end of the susceptibility scale are those with nocturnal and crepuscular behaviours. Example of such species include the recorded Sunda pangolin (*Manis javanica*), buffy fish owl (*Ketupa ketupu*), black-crowned night heron (*Nycticorax nycticorax*) and bats. The likelihood for these species is Possible yielding an impact significance value of Moderate.

Most bees and wasps are not susceptible to light disturbances and are hence deemed as Negligible, while other insects such as butterflies and odonates are slightly sensitive to light disturbances and were deemed as Minor.

Accidental injury and mortality

Due to the road widening works at Canberra Road, it is expected that the flow of traffic will increase which in turn increases the risk of roadkill to ground-dwelling animals, mainly non-volant mammals, snakes and turtle. Newly built residential buildings will also expose birds to the risk of crashing into windows, often resulting in death. The impact significance ranges from Minor to Moderate for species that are susceptible to aforementioned risks.

Human-wildlife conflict

Future residential buildings and amenities in the Project site will narrow the space between human and wildlife, thereby increasing the risks of conflicts, especially if proper education is not delivered to residents.

It is Possible for mammals such as the smooth-coated otter (*Lutrogale perspicillata*) and long-tailed macaque (*Macaca fascicularis*) that are less deterred by presence of human, to be susceptible to human-wildlife conflict. The long-tailed macaque is of a greater concern as the species is known to thrive in forest edges and human-inhabited areas. Other animals such as snakes, bees and wasps are also Possible candidates of such conflict. For all these species, the impact significance is Moderate.

Species that are not deemed a nuisance or threat, such as birds, butterflies and odonates are Unlikely to contribute to human-wildlife conflict cases and hence resulted in impact significance of Negligible. Others are accorded an impact significance of Minor because they are Less Likely candidates for human-wildlife conflicts. However, unwanted conflicts with these said candidates are not entirely impossible— some bat species may be perceived as nuisance or threat to the residents. For example, the cave nectar bat (*Eonycteris spelaea*) can venture into residential areas if there are fruiting/flowering trees around the streetscape. Another noteworthy

example is the record of the forest-associated species— naked bulldog bat (*Cheiromeles torquatus*)—that was found in a residential apartment at Sembawang Vista (P-74).

Human disturbances

N5 Forested Area at its baseline configuration is already set-backed by Canberra Road. However, human disturbances is still a likely impact as the new residential developments increases human traffic to the surrounding area. For all species assessed, the likelihood is Less Likely and the impact significance were deemed as Negligible and Minor.

Table 8.10 Summary of operational phase impacts to fauna receptors in biodiversity Study Area

Impact Type	Impact Significance / No. of Species			
	Major	Moderate	Minor	Negligible
Light disturbances	0	48	22	5
Accidental injury or mortality	0	33	42	0
Human-wildlife conflict	0	8	5	62
Human disturbances	0	0	70	5

8.4.3 Recommended Mitigation Measures

8.4.3.1 Design Phase

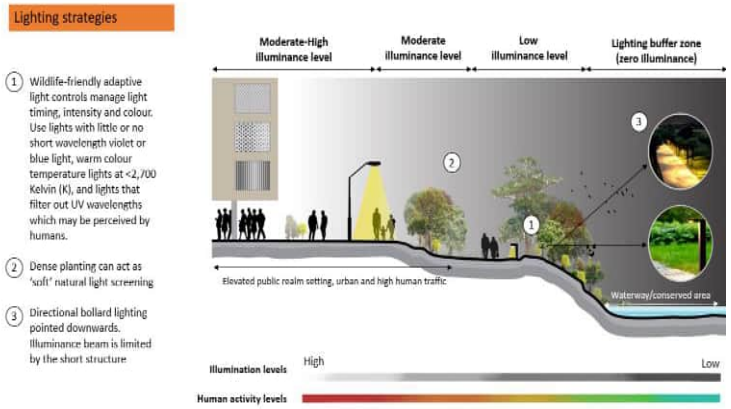
The design of the Sembawang N4 development should be considered first in the mitigation plan as it has the potential to influence the extent and types of impacts that can influence any sensitive ecological receptors at the operational phase.

8.4.3.1.1 Minimise

The key mitigation measures to minimise biodiversity impacts through the design of the proposed development at Sembawang N4 are summarised in Table 8.11 below.

Table 8.11 Key recommended design measures to minimise biodiversity during design phase

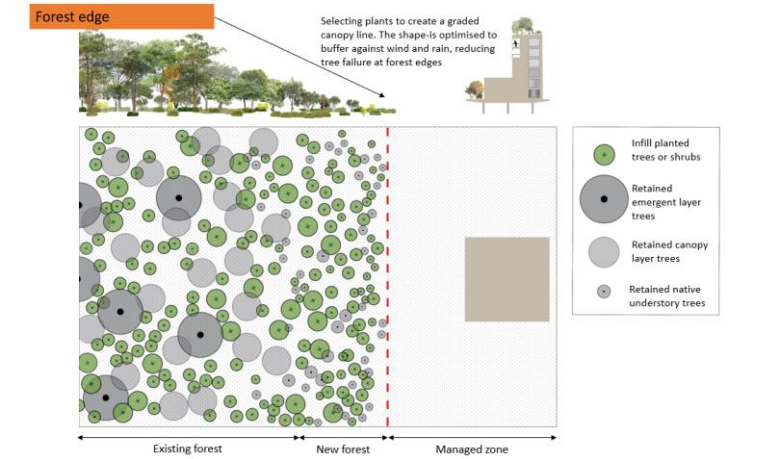
Receptors	Impact Types	Mitigation Measures
Faunal species	Accidental injury and mortality	• Erect signages to educate the public on possible fauna crossing along Canberra Road • NPark's Bird-Safe Building Guidelines (2022) detail innovative and simple strategies that can be integrated into the building's design to reduce the incidents of bird-building collisions. An example of such strategies includes installation of ultraviolet glass that do not compromise the aesthetic of the building's glass while also being beneficial to birds e.g. Guardian Bird1stTM UV (W-25) • Use of ledge to reduce reflection from windows • North-south facing windows are preferred, where possible. • Minimise light spills by orienting light downwards and using lux levels just sufficient for the activity. Tan et al. (2024) recommended to attenuate blue light levels by "deploying LED streetlights with lower colour temperature (~2700-3000K) which emit warmer, more red-shifted light, instead of LEDs with higher colour temperature (~4000-5000K), which emit cooler light with higher blue fraction (Tan et al., 2024)

Receptors	Impact Types	Mitigation Measures
	Light disturbances	Artificial lighting at night (ALAN) can disorient birds, bats, and insects and alter their behaviour causing them to be more vulnerable to predation and other risks. ALAN is also known to disrupt patterns of foraging and mating, as well as the circadian rhythm (P-76). For example, ALAN may deter light-averse bats from lit areas and restrict their use of commuting or feeding space. Moderate impacts owing to light disturbances are expected during the operational phase. *Illustration of general lighting strategies*:  • Use adaptive light controls to manage light's timing, intensity, and colour e.g. smart controlled LED lights • Minimise the use of lights during hours just before dawn and after dusk when crepuscular and nocturnal animals are the most active • Minimise light spills by mounting luminaries horizontally, controlling the light output below 90° with no upward tilt. Accessories such as baffles, hoods or louvres can be integrated to reduce light spill and direct the light to only where it is needed [P-76; P-77] • Use a minimal number of luminaires while achieving the necessary lighting levels • Use low-glare lighting and lights with reduced or filtered blue, violet, and ultraviolet wavelengths [P-77]: • Use warm colour temperature light sources to be preferably at <2,700 Kelvin • Provide physical screening through landscaping or hard structures (e.g., walls, fences, bunds), especially at areas near the residential estate. An example of the physical screening is installing fences that can be planted with climbers to soften the appearance. This method should be considered together with other lighting strategies.

8.4.3.1.2 Compensatory Measures

The key mitigation measures to rehabilitate/restore biodiversity impacts through the design of the proposed development at Sembawang N4 are summarised in Table 8.17 below.

Table 8.12 Key recommended design measures to compensate for biodiversity impacts during design phase

Receptors	Impact Types	Mitigation Measures
Habitats	Loss of habitats	• Habitat creation using dense native species planting palate in proposed common green area within the development *Illustration of general guideline for in-fill planting*:
Faunal Species	Loss of/reduction in habitats and food sources	 • Habitat creation of rain gardens, butterfly gardens and swales within the proposed vegetated area to attract biodiversity e.g., butterflies, odonates and birds, can be considered. It is also important to note that integrating biodiversity-attracting features into future residential areas should first consider lighting strategies and bird-building collision strategies detailed in Table 8.11.

8.4.3.2 Operational Phase

Mitigation measures stated here should be relevant for the Project site and enforced if applicable. However, most of the strategies for enhancement should have been considered during the design phase. Minimisation, restoration, and compensation measures would be the most applicable at the operational phase.

8.4.3.2.1 Minimise/ Rehabilitate

Table 8.13 Key recommended measures to minimise/rehabilitate biodiversity impacts during operational phase

Receptors	Impact Types	Mitigation Measures
Faunal species	Human-wildlife conflict Human disturbances Light disturbances	• Education sign boards can be displayed near HDB's lift lobbies or near-by bus stops to educate the residents on how to identify, interact with, and respond to wildlife. Sign boards should include information on rescue hotline i.e., ACRES or NParks • Singapore Land Authority's (SLA) 'No Access' sign board should be displayed along the forest edge of N5 Forested Area parallel to Canberra Road; where it is clear and visible to the future HDB residents in Sembawang N4 • Proper trash management measures should be implemented such as wildlife-proof bins especially in food and beverages amenities e.g., hawker centres • Strategies to reduce light pollution into N5 Forest Area, minimise impact of roadkill and bird strike incidences are detailed in Section 8.4.3.1

8.4.4 Residual Impact

8.4.4.1 Habitats

Pre-mitigated impact significance for habitat degradation and changes in microclimatic conditions were deemed to be Negligible for all habitat types within the 30 m impact zone of N5 Forested Area. With the implementation of mitigation measures, the impact significance remains as Negligible, as it is the lowest could practically be.

8.4.4.2 Fauna

Similar to the pre-mitigation impact assessment, all 75 faunal species receptors are assessed for four ecological impact types. The assessment considers mitigation measures for operational phase detailed in Section 8.4.3. A summary of residual impacts to fauna receptors is given in Table 8.14 and detailed in Appendix M.

Accidental injury or mortality, human-wildlife conflict, light disturbances and human disturbances

The likelihood of accidental injury or mortality, human-wildlife conflict, and human disturbance can be reduced if mitigation measures recommended in Section 8.4.3 are followed, thus reducing the impact significance from Moderate to Minor. Mitigation measures to reduce these impacts include lighting management strategies, road-calming measures, integrating bird-friendly designs in residential areas and install signage along the forest edge of N5 Forested Area adjacent to Canberra Road.

Table 8.14 Summary of operational phase residual impacts to fauna receptors in biodiversity Study Area

Impact Type	Impact Significance / No. of Species			
	Major	Moderate	Minor	Negligible
Light disturbances	0	0	48	27
Accidental injury or mortality	0	0	33	42
Human-wildlife conflict	0	0	8	67
Human disturbances	0	0	0	75

8.5 Impacts on Biodiversity due to Changes in Other Environmental Parameters

8.5.1 Impacts due to Hydrological Changes

According to the Project schedule available at this stage of the study, southern parcels within N4 are planned to become operational first, starting in 2029, while the northern parcels are expected to become operational in 2034 (refer to Section 3 for more details). With reference to proposed developments within Project site, it can be observed that the majority of the site is intended to be redeveloped into residential area and accompanying infrastructure/ facilities. This permanent land use change with more impervious surfaces is likely to cause surface water to move differently compared to the current water overland movements, increase peak surface water runoff (especially during the heavy storm events), and reduce the seepage of water into the soil.

The following sub-sections provide qualitative assessment and evaluation of impacts on ecological receptors due to hydrological changes during the operational phase of the Project. As the development of the Project site will be in phases (i.e. southern parcels, followed by northern parcels), the impact assessment will focus on the long-term impacts after the whole Project site has been developed (i.e. both southern and northern parcels in operational phase). Potential impacts of northern parcels' construction activities on the operational phase of southern parcels were discussed within cumulative impacts.

8.5.1.1 Identification of Sensitive Receptors

Screening of potential ecological sensitive receptors with regards to potential hydrological changes was conducted taking into consideration proposed future land use plans. Subsequently, sensitivity of identified ecological receptors was assigned based on the criteria detailed in Table 5.2.

During the operational phase of the Project, the majority of the Project site will be developed into residential area, with accompanying infrastructure (e.g. roads) and developments such as educational institution, place of worship and civic and community institution. Table below summarises the sensitive receptors and their description for the operational phase of the Project.

Table 8.15 Classification of potential sensitive receptors identified within the Study Area for operational phase with respect to hydrological changes

Sensitive Receptor	Receptors Description	Receptor Classification
Sungei Sembawang and associated habitats	• Tidally-influenced manmade concrete watercourse • Upper reaches of this watercourses (i.e. upstream of the Project site) support mangrove habitats • Eventually, water from Sungei Sembawang gets discharged into the sea (i.e. Straits of Johor) • As Sungei Sembawang supports biocenosis of potentially high ecological value (e.g. mangroves), accompanying habitat could potentially be disturbed by the changes in surface water quality	Priority 1
East Johor Straits (EJS) and associated habitats	• International strait, located between Singapore and peninsular Malaysia • Supports marine habitats and accompanying flora and fauna	Priority 1

8.5.1.2 Impact Assessment

As mentioned previously, the key hydrological impact during the operational phase of the Project is expected to occur due to the permanent land use change. Higher percentage of urbanised areas could potentially have impact on surface water both in quantity and quality. Based on the future land use, the majority of the area within the Project site will be covered with impervious surfaces. This consequently will cause reduced seepage of water into the soil and increase of runoff peaks, especially during the heavy storm events. If not managed properly, the

higher peak flows could lead to elevated water levels in future drainage system and potentially causing flooding to the surrounding areas.

Although the distribution of water flow within the Project site may change due to the proposed urban drainage network in the development area, the overall quantities of water eventually discharging into Sungei Sembawang and subsequently to EJS are expected to remain the same. This is because based on the proposed land use plan, the overall catchment area within the site is not expected to increase/ decrease. It should also be noted that the future urban drainage network (including the proposed new drain to replace currently present semi-naturalised drain (D2)) within the development area should be designed complying with PUB COP and needs to assure the effective conveyance of the surface water runoff outside of the Project site, not impacting the surrounding area. Based on the previous considerations and considering the size of the overall catchment area of Sungei Sembawang (significantly larger than the Project site – in comparison Sungei Sembawang has catchment area of at least 200 ha, while the overall development area is approx. 53 ha) and its tidally-influenced nature, it is **Unlikely** that the hydrological changes within the site will alter the current flow and hydrology of Sungei Sembawang and consequently EJS. Therefore, the overall impact consequence is expected to be **Negligible** to aquatic habitats associated with these waterbodies (i.e. Sungei Sembawang and EJS).

8.5.1.3 Proposed Mitigation Measures

No additional mitigation measures aside from the proposed minimum controls were proposed to further minimise the adverse impacts on the water resources as none of the impacts on the ecological sensitive receptors have been assessed Moderate to Major.

8.5.1.4 Residual Impact Assessment

No residual impact assessment has been undertaken as no Moderate or Major impact significance on the ecological receptors were assessed.

8.5.1.5 Cumulative Impacts

As mentioned earlier, based on the Project schedule, operational phase of the southern parcels may coincide with construction phase of the northern parcels. It is assumed that construction activities within northern parcel will comply with the construction standards and environmental management and control. Therefore, it is not expected that the construction activities within northern parcels will increase the impacts on water resources due to hydrological changes.

8.5.2 Impacts due Surface Water Quality Changes

During the operational phase, it is expected that the human activities within the development will increase. Potential impacts on the water resources due to these foreseen activities have been discussed in the following sub-sections.

8.5.2.1 Identification of Sensitive Receptors

Based on the proposed land use plan, the majority of the existing habitats and structures within the Project site will be permanently removed and the area will be redeveloped into residential area, infrastructure and accompanying facilities. The habitats within N5 Forested Area, while zoned for “Residential” and will be developed in the future, had no available details on its development at the time of writing this Report. Its development was not included in this Study. Table below summarises the potential ecological receptors for the operational phase of the Project, with regards to potential changes in surface water quality.

Table 8.16 Classification of potential sensitive receptors identified within the Study Area for operational phase with respect to surface water quality changes

Sensitive Receptor	Receptors Description	Receptor Classification
Sungei Sembawang and associated habitats	• Tidally-influenced manmade concrete watercourse • Upper reaches of this watercourses (i.e. upstream of the Project site) support mangrove habitats • Eventually, water from Sungei Sembawang gets	Priority 1

Sensitive Receptor	Receptors Description	Receptor Classification
	discharged into the sea (i.e. Straits of Johor) • As Sungei Sembawang supports biocenosis of potentially high ecological value (e.g. mangroves), accompanying habitat could potentially be disturbed by the changes in surface water quality	
East Johor Straits (EJS) and associated habitats	• International strait, located between Singapore and peninsular Malaysia • Supports marine habitats and accompanying flora and fauna	Priority 1

8.5.2.2 Impact Assessment

The key surface water quality impacts associated with operational phase of the Project include the discharge of stormwater runoff potentially contaminated with pollutant build-up from urbanised areas and discharge of contaminants into the watercourses and soil due to inappropriate disposal and storage of liquid and solid wastes generated within the site.

Potentially Contaminated Stormwater Runoff

As the majority of the Project site will eventually become urbanised, imperviousness of the site will significantly increase. Consequently, potential pollutants that may fall onto the ground (e.g. domestic waste, chemicals due to accidental spills, etc.) will remain on the surfaces until removed (by dedicated procedures) or flashed out via stormwater. If these pollutants reach the downstream watercourses, they have a potential to alter existing water quality conditions, consequently affecting associated habitats. Although the runoff may be significantly contaminated with various pollutants, taking into consideration the volume of water present within Sungei Sembawang and dilution effects, impact intensity was assessed to be **Medium**. As the habitats associated with both waterbodies (i.e. Sungei Sembawang and EJS) were categorised as Priority 1 sensitive receptors, impact consequence was assessed to be **Medium** (as per Impact Consequence Matrix, as shown in Table 5.17). Under the assumption that the minimum control measures are put in place and appropriate stormwater and drainage management system within the future development is successfully design and implemented, it is not expected that such discharges and wash off would be in large quantities, if occur at all. Given the **Less Likely** likelihood of such discharges, the overall significance of this impact on Sungei Sembawang and EJS and their associated habitats was assessed to be **Minor**.

Direct Discharge of Contaminants into Soil and/ or Watercourses due to Inappropriate Disposal and Storage of Liquid and Solid Wastes

During the operational phase, solid and liquid waste will be generated frequently by the residents in the proposed development (e.g. domestic waste, car wash wastewater, etc.). In addition, as the site will be highly urbanised, there is a potential for point discharge of contaminants due to accidental spillages and leakages of chemicals (e.g. car oil, faulty car parts, etc.), implying that there could be a great variety of chemicals to enter the environment. Adequate waste management practices are expected to be successfully implemented within the Project site (e.g. sufficient disposal bins, regular inspection of waste storage systems, etc.) which is expected to significantly reduce the likelihood of discharge of contaminants into the surrounding area. Localised point discharges due to human errors (e.g. accidental spillages) and/ or use of faulty vehicles are more difficult to prevent, even with the implemented minimum controls (e.g. emergency response plan, raising awareness of stakeholders, etc.). In addition, as per information provided by HDB, a future Category 3 road is planned to be built over Sungei Sembawang, connecting the future developments with the area on the other side of the watercourse. This could potentially be additional source of direct contamination of Sungei Sembawang. However, given the small quantities of such discharges and dilution effect by the time they reach watercourses (if they reach), impact intensity was assessed to be **Low**. As both Sungei Sembawang and EJS were categorised as Priority 1 receptors, the impact consequence was assessed to be **Low**. As the uncontrolled discharges are expected to occur due to human errors which are not expected to happen often under the assumption that the minimum control measures have been implemented, the likelihood of this impact was assessed to be **Rare**, hence the overall significance was assessed to be **Minor**.

8.5.2.3 Proposed Mitigation Measures

No additional mitigation measures aside from the proposed minimum controls were proposed to further minimise the adverse impacts on the water resources as none of the impacts on the ecological sensitive receptors have been assessed Moderate to Major.

8.5.2.4 Residual Impact Assessment

No residual impact assessment has been undertaken as no Moderate or Major impact significance on the ecological receptors were assessed.

8.5.2.5 Cumulative Impacts

Based on the Project schedule, operational phase of the southern parcels may coincide with construction phase of the northern parcels. It is assumed that construction activities within northern parcel will comply with the construction standards and environmental management and control. Therefore, it is not expected that the construction activities within northern parcels will increase the impacts on water resources due to surface water quality changes.

8.5.3 Impacts due to Land Traffic Noise Impact

The typical potential noise sources during the operational phase of the Project is land traffic noise. Traffic noise is a source due to increase in vehicular volume and road networks due to the development of the Project and in the vicinity of the Airborne Noise Study Area.

Operational noise arising from land traffic noise emissions are expected to follow traffic trends, peaking during traffic peak hours. The potential impacts due to the increase in noise levels from the above-mentioned sources includes noise disturbance to ecological receptors (i.e., fauna species) found within/ near the Project site such as potential impacts to affecting ecological foraging behaviour, and intra-species and inter-species communication.

It should be noted that at the current design stage, only the proposed developments within the Project site have been established. Due to the lack of detailed design information required for the assessment of operational noise impacts relating to land traffic noise, the potential operational noise sources cannot be accurately defined in this EIA. As such, AECOM recommends that the potential sources of operational noise impacts be defined at the later detailed design stage by Noise Consultant(s) appointed by HDB/ the contractor contracted by HDB to procure an accurate understanding of the Study Area for operational noise impacts.

8.5.3.1 Identification of Sensitive Receptors

Ecological receptors considered for assessment of noise impacts arising from the operational phase shall consider similar ecological receptors identified for the construction phase as discussed in Section 7.5.3. With necessary and adequate mitigation measures implemented for the construction phase to reduce noise impacts on the ecological receptors, similar fauna species identified surrounding the proposed construction worksites and within/ surrounding the Project site prior to construction works, should continue to inhabit the surrounding areas.

It is advised that faunistic survey and baseline noise monitoring be conducted upon completion of the construction phase and commencement of the operational phase to determine the new baseline conditions and fauna species that remain in the vicinity of the proposed construction worksites to determine actual operational noise impacts.

8.5.3.2 Impact Assessment

8.5.3.2.1 Land Traffic Noise Impact

Studies on land traffic noise impact on fauna species have found that traffic noise indirectly impacts habitat quality and can alter how fauna species use their primary sensory systems to detect or recognise important cues such as the ability to forage, communicate, find mates, and avoid predators. Species diversity, occupancy, reproductive stress, and survival can also be affected through masking induced by traffic noise of both territorial and predatory calls, eliciting avoidance behaviour and stress response [P-55, P-56].

In regard to the land traffic noise impacts arising from the operations of the proposed development will not significantly increase. Therefore, the Impact Intensity for ecological receptors subjected to operational noise from

land traffic are deduced as **Low** (refer to Table 5.16) with a corresponding Impact Consequence of **Low** (refer to Table 5.17) depending on the sensitivity of the receptor. With a Likelihood of Occurrence of noise emissions affecting the ecological receptors being **Possible**/ **Occasional** (see Table 5.18) with the mobile ecological receptors being able to retreat deeper into the nearby biodiversity Study Area during hours of peak traffic, the overall Impact Significance can be qualitatively assessed to range from **Minor** (refer to Table 5.19) for operational noise impacts arising from land traffic.

Table 8.17 Summary of operational noise impacts – ecological receptors

Auditory Sensitivity	Impact Intensity	Impact Consequence	Likelihood	Impact Significance
Land Traffic Noise Impact				
Priority 1	Low	Low	Possible/ Occasional	Minor

8.5.3.3 Proposed Mitigation Measures

At this stage, following preliminary mitigation measures have been proposed for consideration as reflected in Table 8.18 below.

Table 8.18 Proposed preliminary mitigation measures - operational phase

Potential Noise Sources	Proposed Mitigation Measures
Additional road traffic noise from new road networks	Consider the provision of park areas/ ecological setback in between new road networks if in proximity to areas with NSRs.

Due to the lack of literature regarding the possible operational noise impacts arising from increased traffic noise on ecological receptors, the approach to mitigate operational noise impacts on human receptors have also been adopted to mitigate noise impacts on the ecological receptors. The approach to mitigate noise arising from increased land traffic as per Table 8.18 is recommended to be employed to mitigate operational noise where possible.

Noise monitoring programme for the operational phase have not been proposed as information required regarding traffic volumes are unavailable. Usually conducted by an appointed Noise Consultant(s) during the detailed design stage, AECOM recommends the works for Traffic Noise Impact Assessment be conducted in the later stages of the development in accordance with NEA Technical Guideline for Land Traffic Noise Impact Assessment, 2016 [R-41].

8.5.3.4 Residual Impact Assessment

The residual operational noise impact assessment assumes that mitigation measures proposed within Section 8.5.3.3 have been implemented at developments identified as potential sources of operational noise. The Impact Intensity at the receptors are expected to be reduced with measures to reduce traffic noise by introducing speed postings, humps, and speed limit signages to slow down traffic.

Since the initial impact assessment with minimum controls was considered insignificant (**Minor**), no residual impact assessment was undertaken, hence the impact significance remained the same.

Table 8.19 Summary of residual operational noise impacts – ecological receptors

Auditory Sensitivity	Impact Intensity	Impact Consequence	Likelihood	Impact Significance
Land Traffic Noise Impact				
Priority 1	Low	Low	Possible/ Occasional	Minor

8.6 Summary of Impacts during Operational Phase of the Project

For habitat receptors, two types of impacts were assessed during the operational phase— (1) Habitat degradation and (2) Changes in microclimatic conditions–the impact significance is **Negligible** for both impact types. The habitat receptors assessed for these impact types consist of five habitat types existing within the 30 m impact zone from worksite (Table 8.9). The existing Canberra Road reduces the likelihood of an increase in habitat degradation by illegal encroachment or any changes in microclimatic conditions of the forest edge of N5 parallel to the said road.

For fauna receptors, four types of impact were assessed during operational phase— (1) light disturbances, (2) accidental injury or mortality, (3) human-wildlife conflict, and (4) human disturbances. Moderate/Minor impacts are expected to arise from light disturbance produced by future high-rise residential buildings, accidental injury and mortality from increased vehicular traffic and bird crashes on windows, and human-wildlife conflict incidents. After consideration of the recommended mitigation measures in both design and operational phase (see Section 8.4.3), the impacts can be reduced to **Minor/Negligible**.

With regards to hydrological changes, permanent land use change with more impervious surfaces were identified as key potential sources of impact. Such hydrological changes have potential to alter the hydrology of receiving waterbodies and consequently impacting associated habitats. Under the assumption that minimum control measures were successfully implemented, the overall impact significance of hydrological changes to Sungei Sembawang and EJS were assessed to be **Negligible**. Surface water quality could potentially change as a result of discharge of potentially contaminated stormwater runoff as well as direct discharge of contaminants into watercourses due to inappropriate disposal and storage of liquid and solid waste. Based on the carried-out impact assessment, significance of these impacts were assessed to be **Minor** to Sungei Sembawang and EJS.

With regards to airborne noise impacts on the ecological receptors, fauna species of Conservation Significance (CS) and with high auditory sensitivity was observed in N5 forested area and deemed as Priority 1 receptor. Land traffic noise is considered for the noise impact assessment due to the proposed road networks and widening of the existing Canberra Road. Considering the existing land traffic noise exposure from Canberra Road, the operational noise impact is expected to be **Minor**. The approach to mitigate noise arising from increased land traffic as per Table 8.18 is recommended to be employed to mitigate operational noise from land traffic, where possible. Usually conducted by an appointed Noise Consultant, AECOM recommends that the works for land traffic noise impact assessment be conducted as part of the detailed design process of the Project in accordance with the NEA guidelines as discussed in Section 8.5.3.3.

Table 8.20 Summary of impacts on ecological receptors due to the changes in other environmental parameters during operational phase of the Project

Impact	Source of Impact	Sensitive Receptor	Receptor Sensitivity	Impact Intensity	Impact Consequence	Impact Likelihood	Impact Significance
Water Resources (Hydrology)							
• Disturbances in habitat and/ or reduction in size of species population due to altered dry and wet weather conditions • Localised flooding may have adverse impacts on surrounding terrestrial habitats	Permanent land use change with more impervious surfaces	Sungei Sembawang and associated habitats	Priority 1	N/A	N/A	Unlikely	Negligible
		EJS and associated habitats	Priority 1	N/A	N/A	Unlikely	Negligible
Water Resources (Surface Water Quality)							
Disturbances in habitat and/ or reduction in size of species population due to contamination of receiving watercourses	Discharge of potentially contaminated surface water runoff	Sungei Sembawang and associated habitats	Priority 1	Medium	Medium	Less Likely/ Rare	Minor
		EJS and associated habitats	Priority 1	Medium	Medium	Less Likely/ Rare	Minor

Impact	Source of Impact	Sensitive Receptor	Receptor Sensitivity	Impact Intensity	Impact Consequence	Impact Likelihood	Impact Significance
	Direct discharge of contaminants into soil and/ or watercourses due to inappropriate disposal and storage of liquid and solid wastes	Sungei Sembawang and associated habitats	Priority 1	Low	Low	Less Likely/ Rare	Minor
		EJS and associated habitats	Priority 1	Low	Low	Less Likely/ Rare	Minor
Airborne Noise							
Land Traffic Noise	Traffic noise due to increase in vehicular volume. Potential impacts due to the increase in noise level includes noise disturbance to fauna affecting ecological foraging behaviour, intra-species, and inter-species communication.	Ecological habitats within N5 Forested Area	Priority 1	Low	Low	Possible/Occasional	Minor

9 Preliminary EMMP

The proposed Environmental Management and Monitoring Plan (EMMP) is prepared for environmental impacts of the construction and operational phases associated with the Project, and that were assessed in this EIA study, namely biodiversity, water resources (hydrology, surface water quality, groundwater quality and level), air quality and airborne noise. The EMMP details how the recommended mitigation measures prepared for the impact assessment are to be implemented and specifies recommended monitoring measures to assess the effectiveness of the mitigation measures. This document is also intended to provide a broad framework for the Environmental Control Officer (ECO) to develop a more contract-specific EMMP, as per their responsibilities in Section 9.4.5. Since the Project will evolve over time, the EMMP is an adaptive document meant to be amended where necessary. Copies of the EMMP must be kept on-site for reference at all times.

This section outlines the objectives of the EMMP, the Project organisation, describes the roles and responsibilities relevant to implementation of the EMMP, and summarises the EMMP requirements for each discipline.

9.1 EMMP Objectives

The EMMP details the implementation and deliverables of the recommended mitigation measures identified from the impact assessment for each technical discipline. The EMMP progressively scrutinises pre-construction, construction and operational activities as they ensue and applies flexible monitoring and management procedures to protect the Project's environmental values throughout the construction and operational phases. The objective of the EMMP is twofold:

1. Environmental monitoring focuses on overseeing that impacts to the Project's environmental values from construction and operation are within the anticipated level and tackle unforeseen impacts that may arise
2. It also tracks the effectiveness of the recommended mitigation measures to allow amendment or review of the mitigation measures to better address any issues faced during construction and operation of the Project

Environmental management employs a more active approach to ensure that impacts to flora and fauna are directly avoided through documentation, auditing and enforcement.

9.2 Project Organisation During the Construction Phase

The roles and responsibilities of the various parties responsible for implementing the EMMP during the construction phase are outlined below. The proposed Project organization and lines of communication with respect to environmental protection works are presented in Figure 9.2.1.

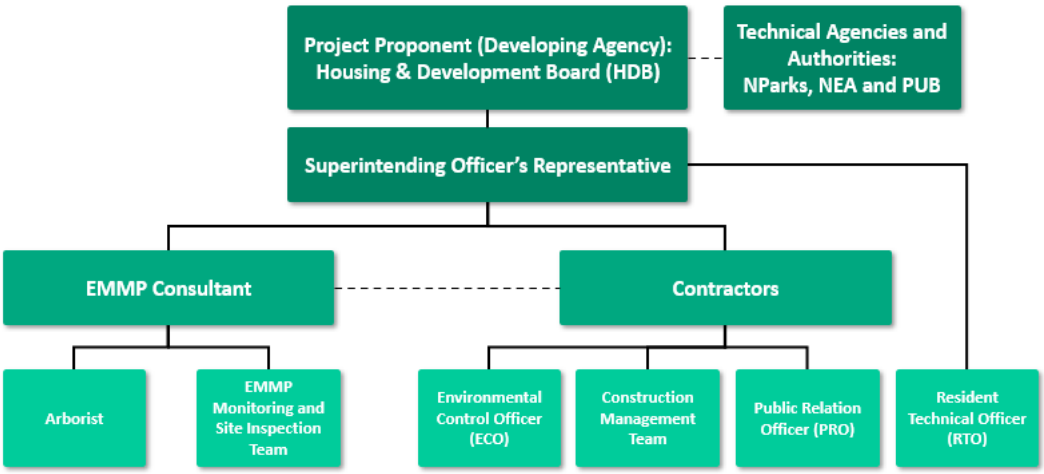


Figure 9.2.1 Project organisation and lines of communication during the construction phase

9.3 Project Organisation during the Operational Phase

The roles and responsibilities of the various parties responsible for implementing the EMMP during the operational phase are outlined below. The proposed Project organization and lines of communication with respect to environmental protection works are presented in Figure 9.3.1.

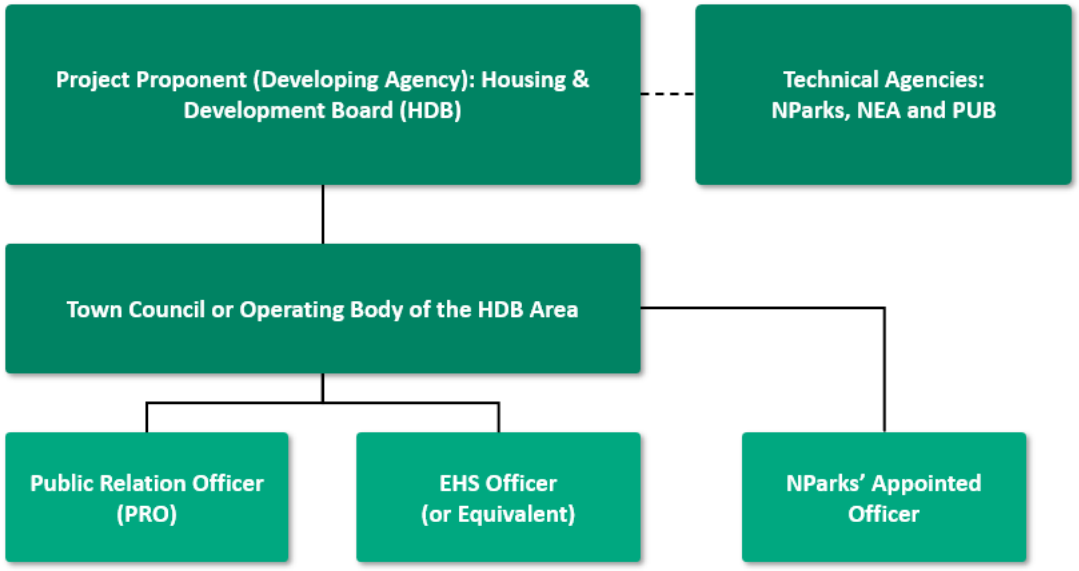


Figure 9.3.1 Project organisation and lines of communication during the operational phase

9.4 Roles and Responsibilities of the EMMP for the Construction Phase

9.4.1 Technical Agencies

Technical agencies constitute, but are not limited to NParks, PUB and NEA. These agencies will assess and approve the detailed EMMP for the construction and operational phases prior to commencement of works and where required during the course of the Project.

9.4.2 Developing Agency (HDB) and Resident Technical Officer (RTO)

The HDB, being the Project Owner, will oversee the construction phase of the Project in accordance with the design. In conjunction with the Resident Technical Officer (RTO), HDB are required to:

- Ensure resources are available to achieve the requirements of the EMMP;
- Provide guidance and advise on development and implementation of the EMMP;
- Ensure all environmental incidents and near misses are promptly investigated and reported;
- Resolve any non-compliance issues;
- Record, respond to, and action any complaints from members of the public, if any, with inputs from the Technical Agencies, if required; and
- Report to the Technical Agencies regarding implementation of the EMMP.

The Resident Technical Officer (RTO) is responsible for monitoring and overseeing construction activities to ensure compliance with environmental regulations and Project specifications. The RTO identifies and addresses any potential environmental risks or non-compliance issues, facilitating the adoption of sustainable practices and protecting the environment throughout the construction process. The RTO should:

- Monitor and oversee construction activities to ensure compliance with the EMMP, Project specifications, and environmental regulations;
- Conduct daily site inspections to verify the implementation of environmental mitigation measures;
- Address and resolve any environmental concerns or issues raised by the SO Rep., EMMP Consultant, technical agencies, or the public by seeking advice from EMMP Consultant/SO Rep.; and
- Provide guidance and support to the construction management team in implementing environmental best practices.

9.4.3 The Superintending Officer Representative (SO Rep)

The Superintending Officer Representative (SO Rep) is responsible for overseeing the construction works undertaken by various personnel, contractors and sub-contractors. The SO Rep should ensure that the construction works are performed by the contractors and personnel in accordance with the specification, contractual requirements, and EMMP. The SO Rep should also:

- Communicate the requirements of this plan to all staff, contractors and sub-contractors
- Monitor all staff, contractor’s and sub-contractor’s compliance with contract specifications and regulatory requirements, including the implementation of the environmental mitigation and monitoring measures and ensure their effectiveness, and other aspects of the environmental audit program
- Coordinate with the Project’s EHS Officer to monitor and participate in the implementation of the environmental audit program, with assistance from ECO, and ensure that the requirements in the environmental audit program are correctly followed
- Appoint third party environmental auditor to check and audit the environmental performance monitoring

- Implement measures to reduce impacts where emission/ discharge levels are exceeded. The SO Rep also acts as a point of contact between the Contractor and EMMP Consultant and should ensure all communications are passed between parties without delay
- Coordinate with the Project Owner and RTO for submission of environmental audit reports
- Carry out any complaint investigations and report to Developing Agency
- Resolve any non-compliance issues
- Promote environmental awareness and responsibility and lead by example

9.4.4 The Contractor

The term “Contractor” refers to all construction contractors and sub-contractors working onsite at any time. In addition to reporting to the SO Rep, the Contractor should:

- Responsible for executing approved EMMP and mitigation measures on site, whilst ensuring that the requirements related to standard mitigation measures and requirements are followed
- Work under the relevant contract scope, approved EMMP specifications
- Responsible to carry out works in a manner ensuring compliance to all applicable environmental legislation, environmental policy, mitigation/ enhancement measures recommended in the EIA, etc., set by relevant authorities and the Developing Agency
- Submit proposal for mitigation measures should there be an exceedance or environmental incident/ complaint
- Ensure that the roles of RTO, SO Rep, Environmental, Health and Safety Officer (EHS Officer), ECO, Certified Arborist, and Fauna Specialist(s) are adequately resourced;
- Participate in the required environmental site audits (via the SO Rep.) undertaken by third party independent Environmental Performance Auditor and undertake corrective actions instructed by the Environmental Performance Auditor;
- Undertake all monitoring and implement all mitigation measures recommended by the Arborist, Flora Specialist, and Ecologist, as far as practicable;
- Provide up-to-date information to the RTO, SO Rep, ECO, Certified Arborist, and Fauna Specialist(s) regarding any work activities which may contribute or continuously create adverse environmental conditions, or any changes to the work plan
- Prepare a detailed contract-specific EMMP, incorporating the relevant mitigation measures and monitoring works recommended in this EIA Report and seek technical agencies’ approval prior to the commencement of any works. This detailed EMMP will include, as a minimum, a Standard Operating Procedure (SOP) detailing:
    - Handling and storage of hazardous chemicals;
    - Biodiversity management plan
    - Individual environmental management plans as detailed in the NEA’s SHE Specifications (air, vector, waste, noise, water pollution management plans)
    - Monitoring plans (including but not limited to ecology, water pollution, air, noise, waste)
    - Existing legislation and environmental best practices to be implemented
    - Contingency planning during emergency situations

Besides, for site and/ or vegetation clearance before the commencement of actual construction, the Contractor will engage a certified Qualified Erosion Control Professional (QECP) to prepare an Erosion Control Plan (ECP) and obtain approval from the PUB.

For tree-felling, the Contractor will also map the trees on site and the trees planned for removal or retention and NParks’ approval, where the Contractor will consider the following requirements:

- An area rich in trees of conservation interest, the contractor should employ a certified arborist to map the trees carefully while applying for tree felling approval. This is to gauge the health, species, size and conservation significance of the tree
- If there are trees that must be transplanted, this should be done prior to commencing site clearance
- If the area is rich in wildlife, the contractor will consult wildlife specialist and prepare a wildlife shepherding plan, obtain NParks' approval and execute it prior to/ along the site clearance process

9.4.5 The Environmental Control Officer (ECO)

The registered Environmental Control Officer (ECO) should provide all the necessary information and assistance to the PRO in order to complete the complaint investigation. Following the investigation, the Contractor should promptly undertake the mitigation measures. The PRO and SO Rep. must ensure that the measures have been appropriately implemented. The Contractor, RTO, and SO Rep. will also be responsible for the leading and reporting of complaint investigation results and followed up actions to the Project Owner. The roles and responsibilities of an ECO include:

- To oversee/audit and manage the environmental impacts of the work sites and to ensure all works comply with the environmental requirements;
- To supervise the mitigation measures implemented by Contractors, identify gaps and to provide recommendation on monitoring and mitigation amendments (if any) to the plan where necessary to the EMMP Consultant;
- To train and educate all site personnel to work in a manner as to respect the surrounding environment e.g., toolbox talk;
- To identify, report and record potential and presenting environmental issues on site to the EMMP Consultant;
- To limit or advise to stop any Project activities if potential or presenting environmental issues are identified until rectified;
- To ensure site personnel working in the vicinity of forested area are regularly trained by specialists for biodiversity awareness;
- To notify EMMP Consultant of any such observation that is worthy of environmental concern;
- To discuss all environment incidences which may arise with the EMMP Consultant. ECO will work alongside EMMP Consultant to address incidences; and
- To inform EMMP Consultant and Contractors to notify NParks/PUB/NEA in the event of environmental emergency (e.g., roadkill, injured animal, and oil/chemical spill).

9.4.6 Construction Management Team

The Construction Management Team are responsible for overseeing and coordinating activities to ensure compliance with environmental regulations and the EMMP. By effectively managing construction operations, the team aims to minimise environmental impacts, mitigate risks, and promote sustainable practices, thereby contributing to the overall success of the Project. Their responsibilities include:

- Coordinate and supervise construction activities in accordance with the EMMP and environmental regulations;
- Ensure the integrity of Tree Protection Zone, prevent excessive or unauthorised vegetation clearance by ensuring construction works are prohibited within the TPZs;
- Implement measures to prevent or minimise environmental pollution, such as dust control, noise management, and sedimentation control;
- Ensure proper handling, storage, and disposal of construction waste and hazardous materials;
- Conduct regular inspections to identify any potential environmental risks or non-compliance issues;

- Collaborate with subcontractors and suppliers to ensure their adherence to environmental requirements; and
- Maintain records and documentation related to environmental compliance and reporting.

9.4.7 Public Relation Officer

The Public Relation Officer (PRO) is responsible for handling complaints and managing feedback and investigative work. The PRO shall be supported by the Contractors, SO Rep. and any other relevant parties.

During the construction phase, upon receipt of complaints, the PRO should undertake the following procedures:

- Log the complaint and record the date when the complaint is received onto the complaint database and inform the Contractor and SO Rep. immediately;
- Investigate the complaint with the SO Rep and Contractor(s) to determine its validity and assess whether the source of the problem is due to construction works;
- If a complaint is valid, liaise with the Contractor(s) and other relevant parties (e.g. ECO, EMMP Consultant) on the mitigation measures and seek agreement from the SO Rep.;
- Review the current situation and the implementation of the mitigation measures;
- Ensure that any valid reasons for complaints do not re-occur by revising the work methods, procedures, machines and/ or equipment;
- Submit a complaint report (as well as implementation of mitigation measures and the effectiveness of the mitigation measures, as advised by the relevant parties) to the SO Rep. and HDB;
- Log a record of the complaint, investigation, follow up actions and the results in the incident report.

9.4.8 EMMP Consultant

The responsibilities of the EMMP Consultant are as follow:

- To oversee the implementation of the EMMP by all responsible parties (refer to the Organisation Chart as shown in Figure 9.2.1);
- To provide advice on environmental issues, where appropriate, or possible;
- To ensure the EMMP Consultant's subcontractors and ECO understand their responsibilities as outlined within the EMMP;
- To advise all parties (e.g., Contractor's ECO, Site Engineers, Site Supervisors, Subcontractors and Site Workers, etc.) on matters related to environmental management and promote awareness within the site;
- To prepare and deliver monthly EMMP reporting to SO Rep., Developing Agency and Technical Agencies (e.g., NParks, if required) based on discussed timeline;
- To carry out bi-weekly environmental site inspection by relevant specialists (noise, ecologists, water quality etc.) depending on the ongoing activities on site;
- To discuss and resolve/mitigate any non-compliance or irregularities with Developing Agency/SO Rep./Technical Agencies; and
- To coordinate with Developing Agency/SO Rep./Technical Agencies on environment matters.

9.4.8.1 EMMP Site Inspection Team

When required, the EMMP Inspection Team formed by the EMMP Consultant and comprising environmental personnel with experience covering biodiversity, water resources, noise and vector control specialists can be called upon to assist.

The role of the EMMP Site Inspection Team will be to carry out the specific aforementioned tasks listed above for the EMMP Consultant e.g., carry out bi-weekly environmental site inspections to support ECO when required.

9.4.8.2 Arborist

An Arborist certified by the International Society of Arboriculture (ISA) plays an important role as part of the biodiversity monitoring programme during both construction and commissioning phases of this Project. He/ She will possess previous work experience in developments of similar size or complexity who is able to demonstrate capability in monitoring and managing all matters related to the adequate and successful conservation of trees and flora within and adjacent to the contract boundary. The Arborist will be employed by an EMMP Consultant. A detailed description of biodiversity monitoring programme is provided in Section 9.10, where the key responsibilities of the Arborist are listed as follows:

The key responsibilities of an ISA-certified Arborist during construction phase include but not limited to:

- Conduct tree mapping and assessment
- Implement tree protection plans
- Provide advice on tree transplanting
- Review Contractor's method statements for site clearance, tree felling and setting up of Tree Protection Zones (TPZ)
- Assess forest edge effects and its associated changes
- Implement tree maintenance and care
- Conduct monthly tree inspection and reporting

9.5 Roles and Responsibilities of the EMMP for the Operational Phase

9.5.1 Technical Agencies

Technical Agencies constitute, but are not limited to NParks, PUB and NEA. These agencies will assess and approve the detailed EMMP for the construction and operational phases, prior to commencement of works and, where required, during the course of the project.

9.5.2 Project Owner (HDB)

The HDB is a statutory board in Singapore under the Ministry of National Development responsible for public housing in Singapore, which is also the Project Owner for this Project. Therefore, it is responsible for overseeing and managing the environmental monitoring detailed in the EMMP for the operational phase. The HDB is required to:

- Ensure resources and appropriate personnel are available to achieve the requirements of the EMMP
- Provide leadership in the implementation of the EMMP
- Ensure all environmental incidents and near misses are promptly investigated and reported
- Resolve any non-compliance issues
- Record, respond to, and action any complaints from members of the public, if any, with inputs from the Technical Agencies, if required
- Reporting to the Technical Agencies and the HDB regarding implementation of the EMMP

9.5.3 EHS Officer (or Equivalent)

The EHS Officer will be appointed by HDB or town council and is responsible for the overall environmental, health and safety during the operational phase of the Project. With respect to the EMMP, the EHS Officer is required to:

- Carry out monitoring of environmental parameters and conduct any required laboratory analysis
- Liaise with HDB, NParks for any impact on the TPZ and subsequent actions to be taken thereof for safeguarding the area
- Conduct site inspections, report monitoring results, and coordinate environmental auditing as stipulated in the EMMP
- Coordinate with HDB regarding equipment, locations, and schedule of monitoring and auditing works
- Analyse environmental monitoring data and audit findings, review the adequacy of implementation of mitigation measures, identify adverse environmental impacts, and liaise with HDB
- Monitor compliance with conditions in the EMMP, relevant environmental protection and control regulations
- Report the results of the environmental monitoring program, and any required changes, to meet the requirements of the EMMP to HDB in a timely manner

9.5.4 Public Relation Officer

The Public Relation Officer (PRO) or relevant officer of the town council or operating body of the HDB area, is responsible for handling complaints and managing feedback and investigative work. The PRO shall be supported by the HDB, EHS Officer and any other relevant parties.

During the operational phase, upon receipt of complaints, the PRO should undertake the following procedures:

- Coordinate and support community engagement sessions for educating public on human wildlife conflict, and living in harmony with nature educational works organised by NParks or nature groups Log a record of the complaint, investigation, follow-up actions if members of public, nature groups, NParks lodge any wildlife impact in the area and the results in an inspection report. Plan and execute corrective actions to prevent from these incidents to recur.

The PRO should work with the HDB (e.g. HDB's representative of the town council) and EHS Officer (or equivalent) to gather all the necessary information and resources necessary to complete a complaint investigation. Following the investigation, the relevant officer of the town council or operating body of the HDB area and EHS Officer shall undertake appropriate mitigation measures. Follow-up is required by the PRO to ensure that the mitigation measures have been appropriately implemented. The complaint investigation report and corrective action plan should be prepared and approved by HDB and/ or other relevant Authorities within 24 hr upon receipt of complaints.

9.6 Construction Site Audit

Site surveillance provides a direct means to assess and ensure the Project's environmental protection and pollution control measures are in compliance with the contract specifications and the EMMP. The ECO should inspect the construction activities regularly and routinely to ensure that the appropriate environmental protection and pollution control mitigation measures are properly and timely implemented, based on the EMMP's recommendations. With well-defined pollution control and impact mitigation measures outlined, and a well-established efficient remedial action reporting system, the site inspection is an effective "tool" to ensure acceptable environmental performance at the construction site.

The ECO is responsible to formulate environmental site inspections, deficiencies, and the remedial action reporting system, and to carry out the site inspections. After consultation with Project's SO Rep, the ECO should prepare a procedure for the site inspections, deficiencies, remedial action, and reporting requirements. This documentation will be agreed to by the RTO and Contractor representative and approved by the Project Owner within 21 days of the commencement of the construction contract.

Site inspections should be carried out by SO Rep's EMMP Consultant at least once every two weeks (i.e. biweekly) for all the work areas during the construction phase. The inspections should cover the onsite environmental situation, pollution control and mitigation measures. Offsite environmental situations, which may be affected by onsite activities (directly or indirectly), should also be reviewed. Observed site conditions, with regards to defined environmental parameters will be noted, collated, and submitted to the Project Owner (HDB)

(inclusive of recommendations for improvements to the protection and pollution control and for taking corrective actions, if any). Monthly EMMP audit reports with collated and analysed obtained data will be submitted to the Project Owner (HDB) and SO Rep.

9.7 Operational Phase Audit

During the operation of the Project, annual monitoring (minimum frequency) for all environmental parameters should be conducted to ensure that all implemented measures are meeting their intended purpose, and that any potential changes in Project conditions such as increased traffic, track lighting, etc. are not having an adverse impact over and above the impacts identified in this assessment. A log tracking all maintenance procedures of equipment and carrying out of audits should be maintained by the Project Owner and the EHS Officer. Audits should be carried out by NParks and other relevant authorities (e.g. PUB, NEA) to assess the success of the implemented control measures.

A minimum of annual monitoring periods also enables the Project Owner and EHS Officer to address any potential issues, not originally identified during the current impact assessment, that may arise during the course of the Project. In this instance, the Project Owner should consider the impacts and, in consultation with the Technical Agencies and qualified professionals, develop measures to mitigate any identified impacts.

9.8 Complaint Handling

The Public Relation Officer (PRO) is responsible for handling complaints and managing feedback and investigative work. The PRO will be supported by the Project Owner, ECO, Contractor representatives, and any other relevant party.

During the construction phase, upon receipt of complaints, the PRO should undertake the following procedures:

- Log the complaint and record the date when the complaint is received onto the complaint database and inform the Project Owner, SO Rep, and EHS Officer immediately
- Investigate the complaint with the ECO to determine its validity and assess whether the source of the problem is due to construction works (the target time for response to the complainant is proposed to be 48 hours)
- If a complaint is valid and due to construction works, liaise with the ECO and EHS Officer on the mitigation measures and seek agreement from SO Rep
- Review the current situation and the ECO's and SO Rep's implementation of the mitigation measures
- Engage the ECO to undertake additional monitoring and auditing to verify the complaint if necessary. Ensure that any valid reasons for complaints do not re-occur by revising the work methods, procedures, machines and/ or equipment, etc.
- Submit complaint report (as well as the implementation of mitigation measures and the effectiveness of the mitigation measures as advised by the ECO) to the Project Owner, RTO and the SO Rep
- Log a record of the complaint, investigation, follow-up actions and the results in the environmental audit reports

The ECO and SO Rep should provide all the necessary information and assistance to the PRO in order to complete the complaint investigation. Following the investigation, the Contractor should promptly undertake the mitigation measures. The PRO and SO Rep should ensure that the measures have been appropriately implemented. The Contractor, RTO, and SO Rep should also be responsible for the reporting of complaint investigation results and followed up actions to the Project Owner.

During the operational phase, upon receipt of complaints, the PRO should undertake the following procedures:

- Log the complaint and record the date when the complaint is received onto the complaint database and inform the Project Owner and EHS Officer immediately
- Investigate the complaint with the ECO to determine its validity and assess whether the source of the problem is due to construction works (the target time for response to the complainant is proposed to be 48 hours)

- If a complaint is valid and due to construction works, liaise with the ECO and EHS Officer on the mitigation measures and seek agreement from SO Rep
- Review the current situation and the ECO's and SO Rep's implementation of the mitigation measures
- Engage the ECO to undertake additional monitoring and auditing to verify the complaint if necessary. Ensure that any valid reasons for complaints do not re-occur by noting the root cause of the complaint and revising (if necessary) the work methods, procedures, machines and/ or equipment, etc.
- Submit complaint report (as well as the implementation of mitigation measures and the effectiveness of the mitigation measures as advised by the ECO) to the Project Owner, RTO and the SO Rep
- Log a record of the complaint, investigation, follow-up actions and the results in the environmental audit reports

The PRO should work with the Project Owner and EHS Officer to gather all the necessary information and resources necessary to complete a complaint investigation. Following the investigation, the Project Manager and EHS Officer to undertake appropriate mitigation measures. Follow is required by the PRO to ensure that the mitigation measures have been appropriately implemented. Reporting of the complaint investigation results and followed up actions should be provided to the Project Owner and the Authorities.

9.9 Submission of Monthly Reports to Technical Agencies

During the construction phase, monthly reports on the implementation of construction EMMP should be submitted to the HDB and other Technical Agencies by the Contractor for record purposes. These reports will also be reviewed by EMMP Consultant/ Auditor, employed by SO Rep. The reports will include, but is not limited to the following:

- Results of environmental monitoring programme, or any required changes to meet the requirements of the EMMP
- Results of monthly tree, flora and fauna inspections
- Records of environmental site inspections, deficiencies/ non-compliance issues and its corresponding remedial action
- Records of all environmental incidents and near-misses, as well as their investigation and follow-up
- Records of complaints, as well as the investigation, follow-up actions/ implementation of mitigation measures and the effectiveness of these measures

9.10 Biodiversity Monitoring Programme Requirement

During the construction and operational phase of the Project, adequate EMMP for flora and fauna need to be developed in order to minimise and manage predicted construction and operational impacts. The biodiversity monitoring programme, as detailed in the sections below, will be carried out by the Contractor, under supervision of the SO Rep and Board's EMMP Consultant.

9.10.1 Construction Phase

9.10.1.1 Flora, Vegetation and Trees

The flora and arboriculture programme aims to assess and manage the impacts of construction to retained vegetation and habitat (i.e., adjacent forest), such as tree health, unauthorised vegetation removal, habitat degradation from soil erosion, and rubbish dumping.

This includes the reviewing of tree felling and site clearance plans (**Section 9.10.1.1.1**), verification and reviewing of site works (**Section 9.10.1.1.2**), transplantation of species of conservation significance (**Section 9.10.1.1.3**) and site inspections (**Section 9.10.1.1.4; Section 9.10.1.1.5**).

9.10.1.1.1 Review of Tree Felling and Site Clearance Plans

The Arborist's role is to determine the trees to be retained or felled before the commencement of construction activities. This includes the assessment of tree physiological health, vigour, and structural stability, photographs, as well as the geographic locations of each specimen. This should apply to trees within the development footprint, including working spaces, construction access roads, and hoarding boundaries.

Any horticultural waste resulting from vegetation clearance should be disposed of on the same day to reduce the likelihood of fauna seeking shelter among the horticultural waste.

9.10.1.1.2 Verification and Review of Footprints for Hoarding, Worksite Boundaries, and Access Roads

Following the pegging of the hoarding alignment or worksite boundaries, as well as setting out for areas required for access roads, site offices, storage yards etc., the alignment and footprints are to be verified by the Board's Flora Specialist via ground-truthing. This is to be carried out with the aid of a Global Positioning System (GPS) receiver and cross-checked with the development footprint drawings. The Flora Specialist should ensure there is no excessive vegetation and/or tree removal within the. The Flora Specialist should also review the proposed locations for access roads, site offices, storage yards, etc., to ensure vegetation removal is kept minimal.

9.10.1.1.3 Transplantation of Plant Species of Conservation Significance

For affected plant species of conservation significance located within the worksite, they should be transplanted prior to the start of hoarding installation and clearance works. The Flora Specialist should carry out consultant with NParks to determine the final list of specimens to be transplanted. Guidelines for sapling harvesting and transplantation is provided in Appendix O.

9.10.1.1.4 Monthly Arboriculture Inspection

The Arborist is to carry out the following during the monthly arboriculture inspections:

1. Assess the conditions of retained trees and trees within and around the worksite, i.e., physiological health, vigour, and structural stability, and recommended mitigation measures where necessary
    a. Ensure they have not deteriorated and that there are no mechanical damages
    b. Carry out rehabilitation and remediation measures of the trees exhibit signs of stress (e.g., implement a watering schedule to prevent plants from drying out)
    c. Implement long-term mitigation solutions or recommend additional tree removal where necessary
2. Review method statements from builders for construction at proximity to trees
3. Determine if more trees need to be removed after site clearance based on the construction activities

happening in proximity to the retained trees and liaise with NParks for permission where necessary

4. Ensure that works are carried in alignment with NParks' standards

9.10.1.1.5 Monthly Flora Inspection

The Flora Specialist is to carry out the following during the monthly flora inspections:

1. Identify any unauthorised removal of vegetation beyond the agreed worksite boundaries

9.10.2 Fauna

The fauna programme consists of managing of concerns related to fauna within and around all designated work areas. The objectives of fauna management plan are as follows:

- Minimise negative impacts to fauna, particularly to species of conservation interest
- Minimise fauna entrapment on site by inspecting features such as hoarding that may cause fauna entrapment as well as use of 100% biodegradable erosion control blankets
- Monitor presence of trapped/injured/dead fauna inside hoarded areas
- Prevent human-wildlife conflicts

It includes directional site clearance (Section 9.10.2.1), pre-felling tree inspections for fauna (Section 9.10.2.2), regular biodiversity awareness training for the site team and workers (Section 9.10.2.4), fauna response plan in event of animal encounters (Section 9.10.2.5), as well as site inspections (Section 9.10.2.3).

9.10.2.1 Directional Site Clearance

The worksite is bounded along the perimeter by roads and/or urban developments. Hence, there is no suitable refuge area that is directly contiguous to the worksite identified. However, it is still recommended for site clearance to be carried out in a directional manner. The objective of directional site clearance is to encourage fauna to leave the worksite before construction works begin to prevent fauna entrapment, injury and mortality, while minimising contact between human and wildlife. Directional site clearance also prevents incidents of fauna entrapment within the isolated green patches, which may otherwise occur if site clearance was to be carried in an unspecified manner.

During site clearance, clearance of vegetation is recommended to be carried out from the western to eastern part of the worksite (Figure 9.10.1) as the closest refuge area is located east of the worksite (i.e., N5 Forested Area). The disturbance generated by site clearance activities is expected to encourage target fauna to move out of the worksite on their own and potentially towards N5 Forested Area. Target fauna species include ground-dwelling mammals such as the Sunda pangolin (*Manis javanica*), as well as animals that may be implicated in human-wildlife conflicts (e.g., snakes).

The site clearance zone may be divided into smaller zones for ease of fauna management during site clearance.

The general proposed sequence and details for directional site clearance is provided below.

i. Hoarding installation

- Hoarding installation is recommended to be carried out from the western to eastern end, i.e., i.e., from Sembawang Drive to Canberra Road
- The site clearance zones should be hoarding up with zinc sheets (minimum 2.0 m height)
- Directional site clearance should be carried out from western end to eastern end, i.e., from Sembawang Drive to Canberra Road

ii. Pre-site clearance fauna inspection

- Prior to site clearance, camera trap monitoring may be conducted to determine the presence of target fauna within site clearance. Camera traps may be deployed 50 m apart within the forested area over a three-day period
- Additionally, removal of wild boars may be stipulated by NParks before site clearance. This shall be carried out according to the directions provided in Section 10 of Wildlife Act

- Before the commencement of site clearance works, the Ecologist shall conduct a fauna inspection in areas slated for clearance according to the workflow stated in Figure 9.10.2
- If fauna is found present, the Fauna Response Plan is to be activated

iii. Directional site clearance

- Directional site clearance to be carried out from western end to eastern end, i.e., from Sembawang Drive to Canberra Road

iv. Post-site clearance fauna inspection

- After site clearance has been completed, the Ecologists will visually inspect the site for presence of target fauna species (i.e., ground-dwelling birds and snakes). If there are no remaining fauna on site, the site clearance is then completed. If there are remaining fauna on-site, the Ecologists will develop methods to remove them in consultation with the Contractor and relevant authorities (e.g., NParks)



Legend

- Internal hoarding
- Direction of clearance
- Area to be cleared

Others

- Biodiversity Study Area
- Project site

Rev.	Date	By	Description	Chk'd	App'd
1	AUG 2024	IT	Final Report	SAG	JAG
-	JUL 2024	IT	Final Report	SAG	JAG
1	JUN 2024	IT	Draft Final Report	SAG	JAG
-	MAY 2024	IT	Draft Final Report	SAG	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG N4 (PART)

Figure Title :

Proposed direction of site clearance of Sembawang N4 Forested Area

Designed	Checked	Approved
IT	SAG	JAG
	Drawn: IT	Date: AUG 2024

Figure No. : 9.10.1 | Rev. : 1 | Sheet : 1 of 1

CAD File Name : NA | A3

Note: Source of basemap - Google Earth Map

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9.10.2.2 Pre-felling Fauna Inspection

Pre-felling fauna inspections shall be carried out by Ecologists. Clearance of undergrowth will first be conducted prior to felling of trees on site. After completion of undergrowth clearance, each zone shall be left to fallow for three days to encourage arboreal fauna to leave the site, before clearance of remaining trees within the zone can take place. No vegetation clearance can take place within this fallow period of three days. Pre-felling inspections for the undergrowth and remaining trees can be conducted together on the first day of each round of inspection.

1. Conduct pre-site clearance fauna inspections for trees and non-tree vegetation to be removed. The pre-site clearance fauna inspection includes the identification and reporting of the following:
    a. Active bird nests, including hollows, and other forms of nesting structures utilised by birds
    b. Active mammal nests/burrows/roosts
    c. Other less-mobile animals that are at risk of injury/mortality during tree felling or vegetation removal (e.g., Sunda pangolin)
    d. Animals that may be implicated in human-wildlife conflict (e.g., snakes)
2. Check tree trunks, branches and canopy with binoculars from multiple angles and distances. Any cavities in tree trunks that may be utilised as nesting/roosting structures are to be noted for closer inspection if deemed potentially active. If a nest is potentially identified and activity level is uncertain, the Ecologist will conduct or supervise the closer investigation of the nest site utilising elevating equipment where required
3. Produce a pre-felling fauna inspection report, indicating any relevant information collected during the inspection, including Tree Tag ID (and/or flora location coordinates if not tagged), animal observations, recommended actions, and photographic evidence
4. Pre-felling fauna inspection is valid for seven days, i.e., if the inspected trees or vegetation are not removed within seven days of the Ecologist's inspection, the inspection will be repeated
5. If animals or active nests are found, the Contractor shall:
    a. Not disturb the animal and allowed them to move away on their own before tree felling or vegetation removal, unless the Ecologist deems it necessary to relocate them
    b. Allow nesting birds to fledge and leave the nests on their own before tree felling or vegetation removal

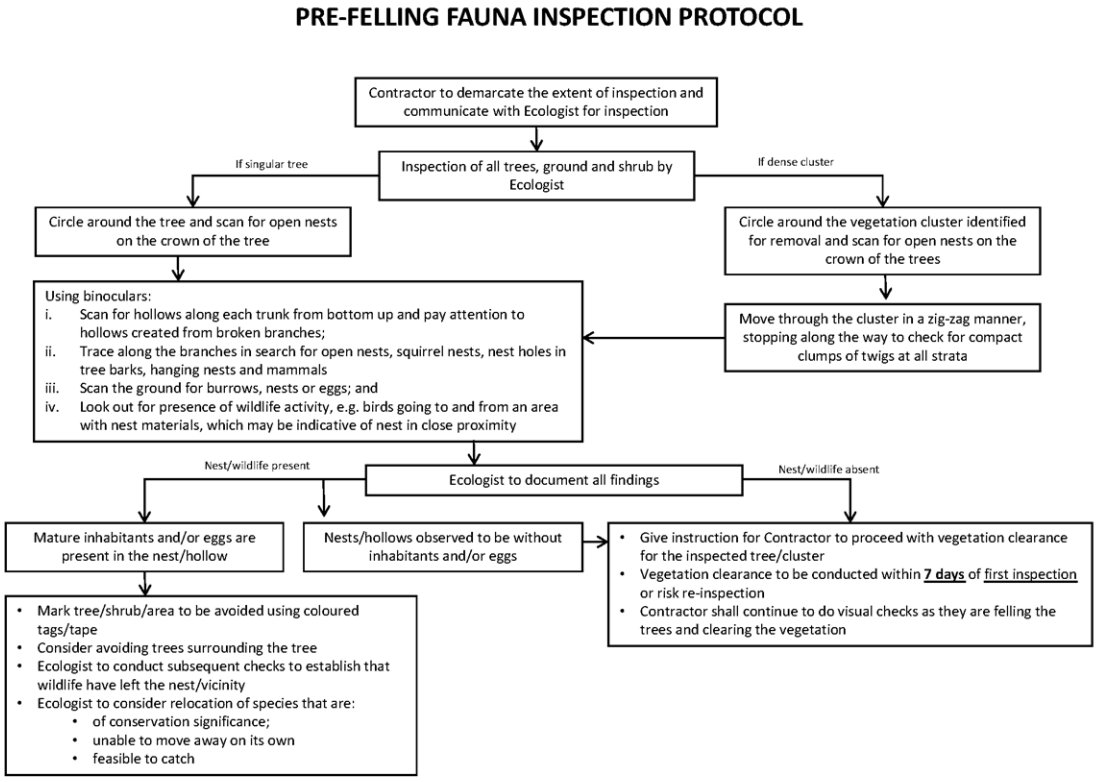


Figure 9.10.2 Pre-felling fauna inspection protocol

9.10.2.3 Fauna Inspection

Monthly fauna inspections will be conducted within the worksite boundaries. The following will be noted during the inspections:

1. Daily checks by ECO will be conducted on site for trapped fauna and roadkill
2. Presence of trapped/injured/dead fauna
3. Potential fauna entrapments (e.g., ECBs, pits, drains, ponds, trenches, tanks)
4. Gaps in hoarding around worksites involving heavy machinery that may allow entry of ground-dwelling fauna
5. Non-compliance of ECM measures
6. Improperly disposed/stored food and food packaging

The Contractor shall ensure that 100% bio-degradable erosion control blankets are used to prevent snake entrapment.

9.10.2.4 Biodiversity Awareness Training

The Ecologist shall conduct toolbox briefings on biodiversity awareness to inform site personnel of but not limited to the following:

- Ecological value of the site and its surrounding habitats
- Types of fauna present
- Biodiversity protection strategies
- Site personnel's responsibilities towards biodiversity
- How to respond to fauna encounters
- No feeding of wildlife
- Prevention of roadkills
- Inspection of trees before felling

All site personnel shall undergo biodiversity awareness training prior to commencing work at on-site, and regularly (every six months) throughout the duration of the construction. Documentation of such trainings and briefings shall be maintained.

Reminders on biodiversity awareness and actions to take when encountering wildlife will also be given to all site personnel during daily toolbox briefings.

9.10.2.5 Fauna Response Plan

The Fauna Response Plan will be activated whenever a trapped/injured/dead/dangerous animal is encountered around or within the worksite. The objective of the Fauna Response Plan is to minimise animal injury and mortality by responding appropriately to the different fauna encounter scenarios in Figure 3-1. This will be emphasised during the Biodiversity and Environmental Awareness Trainings (Section 9.10.2.4). All wildlife incidents shall be reported and documented in a Wildlife Incident Form (Appendix P).

Where fauna is trapped on-site, species-specific methods (e.g., one-way flap doors) shall be formulated to remove them, in consultation with the Board.

The Contractor shall engage a Wildlife Management Company to carry out trapping, rescue, and/or relocation of trapped or injured fauna in accordance with S10 directives. The Wildlife Management Company shall be listed under NParks' public register of certified Wildlife Management Contractors.

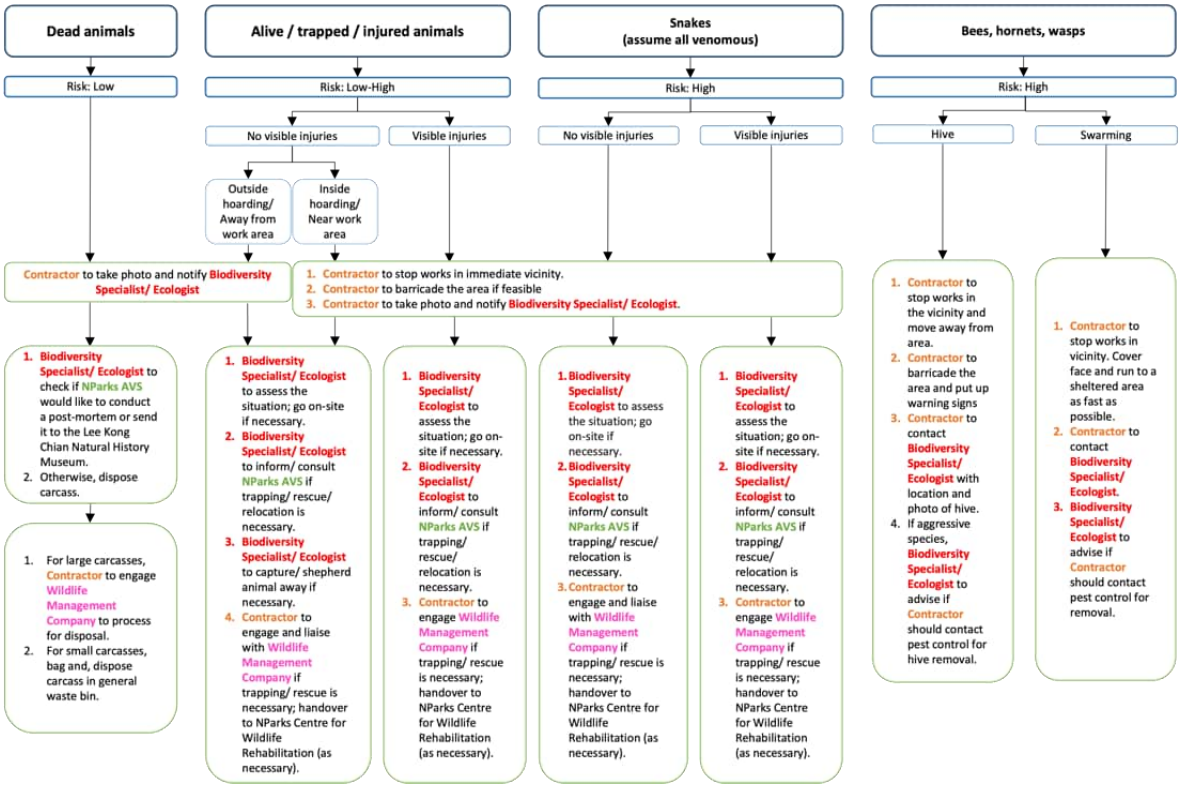


Figure 9.10.3 Fauna response plan

9.11 Water Resources Monitoring Programme Requirement

9.11.1 Construction Phase

In order to ensure that procedures are followed appropriately, the construction phase of the Project should be accompanied by an EMMP. The proposed water resources monitoring programme, as detailed below, should be carried out by the Contractor's ECO, under supervision of SO Rep. Monthly site inspection on the site should be conducted by EMMP consultant.

Water quality monitoring is essential as discharge of excess contaminants, especially pH, nutrients, and heavy metals, may lead to severe consequences (e.g. algae blooms).

Effluent will be discharged from sedimentation ponds during the construction phase, and therefore the monitoring of sedimentation pond effluent was recommended to be undertaken to ensure that the surface water quality will be in compliance with the relevant standards. It was also recommended to monitor their water quality throughout the construction period to ensure minor construction impacts on their water quality. For all discharge points from construction worksites, it is recommended to monitor water quality following Singapore's NEA Allowable Limits for Trade Effluent Discharge to Watercourse/ Controlled Watercourse.

Table 9.1 Recommended monitoring program during construction phase (surface water quality)

Test	Parameters	Monitoring Recommendation and Frequency
In-situ	Temperature	• Online real time monitoring for TSS at the discharge point location at all the construction sites throughout the construction period • Monthly monitoring for temperature, pH, conductivity, TDS and DO at all the discharge point locations at the construction sites throughout the construction period • Monthly monitoring for temperature, pH, conductivity, TDS and DO at two locations at Sungei Sembawang (i.e. upstream and downstream from Project site)
	pH	
	Conductivity (µS/cm)	
	Total Dissolved Solids (TDS)	
	Turbidity and Total Suspended Solids (TSS)	
	Dissolved Oxygen (DO)	
Ex-situ	Biochemical Oxygen Demand (BOD_5)	• Monthly monitoring for all the ex-situ parameters at the discharge points and throughout the construction period • Monthly monitoring for all the ex-situ parameters at two locations at Sungei Sembawang (i.e. upstream and downstream from Project site) and throughout the construction period
	Chemical Oxygen Demand (COD)	
	Total Suspended Solids (TSS)	
	Ammoniacal Nitrogen (NH_4-N)	
	Total Nitrogen (TN)	
	Nitrate (NO_3-N)	
	Total Phosphorus (TP)	
	Orthophosphate (PO_4)	
	Total Organic Carbon (TOC)	
	Oil & Grease (Total)	
	Oil & Grease (Hydrocarbon)	
	Lead (Pb)	
	Zinc (Zn)	
	Mercury (Hg)	
	Enterococcus	

Beside the water quality monitoring, hydrological conditions of drainage system within construction site and at immediate vicinity should also be closely monitored during construction phase. Before draining to public drains or watercourses, surface runoff from the construction site should be drained to the ECM treatment system to be filtered and to reduce peak runoff. The cut-off and perimeter drains should be inspected daily to ensure no surface runoff flowing out from the site untreated and no clogging which would affect the flow capacity of the drains/ streams. During heavy storm event, site inspection should be carried out to ensure no flooding.

9.11.2 Operational Phase

The operational phase of the Project should be accompanied by an EMMP to ensure the proposed development will have minor impact on the surrounding watercourses. Water quality monitoring is essential as discharge of excess contaminants, especially pH and suspended solids may lead to severe consequences (e.g. turbid waters) due to the operational activities. It was recommended to monitor their water quality during the first three (3) months of operational period to ensure minor operational impacts on their water quality. For main outlets/ drains of the proposed development, it is recommended to monitor water quality following Singapore NEA's Allowable Limits for Trade Effluent Discharge to Watercourse/ Controlled Watercourse.

Table 9.2 Recommended monitoring program during operational phase (surface water quality)

Test	Parameters	Monitoring Recommendation and Frequency
In-situ	Temperature	Monthly monitoring for all the in-situ parameters at two locations within Sungei Sembawang (upstream and downstream from the Project site), during the first three (3) months of operation period.
	pH	
	Conductivity	
	Total Dissolved Solids (TDS)	
	Turbidity	
	Dissolved Oxygen (DO)	
Ex-situ	Biochemical Oxygen Demand (BOD_5)	Monthly monitoring for all the ex-situ parameters at two locations within Sungei Sembawang (upstream and downstream from the Project site), during the first three (3) months of operation period.
	Chemical Oxygen Demand (COD)	
	Total Suspended Solids (TSS)	
	Total Nitrogen (TN)	
	Nitrate (NO_3-N)	
	Total Phosphorus (TP)	
	Orthophosphate (PO_4)	
	Enterococcus	

For the hydrological condition monitoring during operational phase, drainage system within the site and at immediate vicinity should be inspected especially during heavy storm event to ensure no flooding. A summary of recommended monitoring for groundwater is shown in the table below. Monthly audit of the entire site should be carried out by EMMP consultant during the first three (3) months of operation period.

9.12 Airborne Noise Monitoring Programme Requirement

9.12.1 Construction Phase

As noted in Section 9.12, the airborne noise monitoring programme can be implemented if required. Based on a review of the noise sensitive receptors around the Project site, a continuous monitoring programme as per Table 9.3 is proposed to be conducted during the construction phase.

Table 9.3 Recommended airborne noise monitoring programme during construction phase

No.	Location	Parameters	Frequency and Duration
1	N5 Forested Area	$L_{Aeq(12\ hrs)}$, $L_{Aeq(1\ hr)}$, and $L_{Aeq(5\ mins)}$	Before commencement of any construction works (including site clearance) • One-time airborne noise monitoring for 1 week at the proposed locations, for establishment of latest baseline During Construction Phase • Continuous monitoring at the proposed locations for the entire duration of construction.

9.12.2 Operational Phase

No noise monitoring programme was proposed for the operational phase due to the lack of information required regarding land traffic volumes. Usually conducted by an appointed Noise Consultant, AECOM recommends that the works for land traffic noise impact assessment be conducted as part of the detailed design process of the Project in accordance with the NEA guidelines as discussed in Section 8.5.3.3.

9.13 Proposed EMMP

The framework for the proposed EMMP is detailed below; however, it is important to note that this is not an exhaustive list of potential impacts, monitoring requirements and triggers. This EMMP is intended to be a living document and should be reviewed thoroughly by the Client/ Project Owner and the Contractor (CT) prior to implementation. Development of the following inputs, which have not been addressed in this Report, by the CT are also required, including but not limited to:

- Stakeholder Communications Plan;
- Site log for all monitoring activities and complaints;
- Construction Logistics Plan;
- Standard Operating Procedures for processes identified in Table 9.4 and Table 9.5 below;
- Emergency Response Plan;
- Inventory of wastewater streams;
- Training protocols for staff, where appropriate; and
- Maintenance and Audit Schedules.

9.13.1 Construction Phase

The EMMP for construction phase of the Project is described in table below.

Table 9.4 Proposed environmental management and monitoring plan for the construction phase

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Monthly Reporting	Site Responsibility	Triggers[5,6]
Biodiversity	Minimisation of construction impacts to flora/ vegetation	• Mark out site boundary (via hoarding); • Set up Tree Protection Zones (TPZs) around trees or other plant specimens to be retained within the worksites, if any; • Tag trees (with or without TPZs) meant to be protected or transplanted to avoid accidental removal, if required; and • Establishment of TPZs, if required	• Record locations, species and quantity of transplant candidates that are affected by construction (if any); and • Verification and review of footprints for hoarding, access roads and soil investigation works	Flora and Arboriculture	Within development boundary	Prior to site clearance	Not Applicable	CT (ECO, Floral Specialist)	Corrective actions will need to be taken if: • Hoarding alignment does not follow the hoarding plans of the Project Flora specialist will report to SO for downstream reporting
		• Establishment of TPZs, if required; and • Inspect the integrity of the TPZs; • Review method statements of construction works in proximity to retained trees; • Implement soil erosion control measures as soon as vegetation has been removed and soil is exposed; and • Identify excessive or unauthorised tree removal	• Identify trees that require management and maintenance such as tree care and pruning; • Assessment of the condition of retained trees, if any, to ensure that there has been no deterioration or mechanical damage and to determine if additional tree removal is required; • Check for mechanical damage on trees that may impair stability; • Determine if there are any unauthorised removal of flora within areas of conservation (if any) or beyond the demarcated worksite; • Identify areas with soil erosion and degradation that have resulted from construction activities; • Identify areas that are responding poorly due to the development impacts		Within development boundary and 15 m beyond hoarding line	Monthly for duration of construction	To be included in monthly report	CT (ECO, Floral Specialist, Arborist)	Corrective actions will need to be taken if: • Depending on the extent of the excessive clearance, flora specialist will report to SO Rep for downstream reporting to NParks; • The structure and health of the trees along the new forest edge has deteriorate and are deemed unsafe by an appointed Arborist; • Encroachment into or removal of TPZs resulting in impairment of structural stability and/or physiological health of

[5] Resident Technical Officer (RTO) and Site Officers (SO, WSHO and ECO) check the Study Area for construction progress and implementation of environmental mitigation measures.
[6] If there is trigger then all the mitigation and management measures should be audited in detail for compliance and corrective action must be taken in liaison with the Project Owner.

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Monthly Reporting	Site Responsibility	Triggers[5,6]
									trees
	• Minimisation of construction impacts to fauna • Minimisation of human-wildlife conflict	• Installation of site hoardings • Implementation of pre-site clearance fauna inspection • Implementation of directional clearing • Use of biodegradable erosion control blankets on exposed soils • Daily checks by ECO on site for trapped fauna and roadkill	• The hoarding must not have any gaps between the panels and are to extend at least 300 mm into the ground; • The access gates, when shut, must not have any gaps between the panels and must be flush as close to the ground as possible; and • Implementation of directional clearing after hoarding is implemented from the side of development nearest to the road i.e. to start hoarding from boundary nearest to Admiralty Road West first then move inwards towards Canberra Road • Check for presence of trapped/injured/dead fauna, potential fauna entrapments and gaps in site hoarding.	Fauna	Within development boundary	Prior to site clearance	To be included in monthly report	CT (ECO, Ecologist)	N/A
		• Ensure proper storage of machinery likely to leech harmful chemicals and fuel-powered equipment; • Store the aforementioned equipment away from waterbodies and/or sensitive habitats; and • Ensure that noise minimum control measures (as detailed in the Airborne Noise section 7.3.3 below) are adhered to.	• Check for non-compliance		Within development boundary	Monthly for duration of construction	To be included in monthly reports.	CT (ECO, Ecologist)	Corrective actions will need to be taken if: • Excessive disturbance generated by construction activities is detected
		• Execute wildlife response plan when a trapped/ injured/ dead/ dangerous animal is encountered around or within the worksite according to Section 10 of Wildlife Act	• Conduct regular toolbox briefing on biodiversity awareness to remind workers not to feed wildlife on site, and enforce proper trash management and disposal.		Within development boundary	Daily monitoring and record-keeping	To be included in monthly report	CT (ECO, Ecologist)	Wildlife response plan will be activated when fauna is encountered within development boundary
Water Resources (Hydrology and Surface Water Quality)	• Solid & Toxic Waste Generation • Liquid Effluent and stormwater run-off Generation • Improper Management of Chemical Substances • Storage and Disposal of Domestic Liquid and Construction Solid Wastes • Temporary or Permanent Land Use Change	• The drainage diversion for the watercourse affected by this development, Stream D2 within N4 Forested Area, will be installed before any construction phase begins. • Ensure continual free flow in the existing drain D2 until the permanent diversion drain is operational. • The Contractor must not fill or interfere with the existing drains without prior approval from PUB. • Obtain PUB's approval for any diversion of existing drains and canals before beginning the diversion work. • Design adequate drainage in accordance with PUB COP to effectively manage runoff from within, upstream of, and adjacent to the work site. The proposed system must not cause flooding nearby. • Conduct regular maintenance of stormwater and drainage systems to prevent channel blockages and consequent flooding. • Include geotechnical aspects of site slope stability, such as Earth Retaining Stabilizing Structure (ERSS), in the detailed engineering design for the construction phase. • The design engineers must propose ERSS when the site is clear and excavated. Simultaneously, the Environmental Control Officer (ECO) must ensure successful implementation of these measures during construction. • Implement a phased Excavation, Cut and Fill, and Earthmoving plan to minimize the area disturbed at any given time, reducing erosion and topsoil loss. • Develop water recycling systems on-site to minimize discharge from the construction site into the surface water drainage system. • Establish temporary routes for heavy vehicles/machinery to lessen soil compaction and soil permeability as much as possible. • Formulate a detailed emergency evacuation plan for potential	Not Applicable	All water quality parameters identified in Table 9.1 and any flooding issues should be recorded and inspected.	• Before discharge outlets of construction site • At 2 locations within Sungei Sembawang (upstream and downstream of site).	• Permanent TSS monitor installed at every discharge outlet; • Implementation of CCTV including a SIDS at every discharge outlet to monitor the surface run-off discharges from the sites; • Daily inspections of drains, to check for blockage or visual changes in water quality • Monthly water quality monitoring for all discharge point locations and other public drains during construction phase and Sungei Sembawang; • Intensity of the laboratory analysis will be increased (e.g. fortnightly, weekly) if in-situ measurements and/or monthly laboratory results indicate	To be included in monthly report	CT (ECO)	Investigation and corrective actions to be taken, when: • The following documentation are found inadequate/ missing: • ECM Plan; • Monitoring Log; • Training Log; • Audit Reports; • If the monitored parameters exceed applicable values of NEA Trade Effluent Discharge Limits at discharge point (refer to Table 5.12) • If the monitored parameters exceed applicable values of Water Quality Criteria for Aquatic Life at natural stream (refer to Table 5.12); • If any flooding

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Monthly Reporting	Site Responsibility	Triggers[5,6]
		flash floods on-site, including the development of an early warning system where applicable. • Install pumping stations to remove excess water accumulated within the site after heavy rainfall events. • Soil dewatering will be planned in phases to prevent the generation of large quantities of water discharged into receiving watercourses. This phased approach will also decrease groundwater drawdown and minimize the reduction of baseflow feeding the stream. • The Contractor must install piezometers to monitor changes in groundwater level, as required by Building Control Regulations 2003. This installation must be part of the instrumentation and monitoring plan, endorsed by a Qualified Professional (QP). • Appropriate Earth Retaining Stabilizing Structures (ERSS) will be carefully selected and designed to control groundwater settlement. • The planning, design, and submission of Earth Control Measures (ECM) plans to PUB will be handled by a Qualified Erosion Control Professional. This includes the installation, maintenance, monitoring, reporting, provision of erosion control blankets, CCTV at discharge points, Siltation and Erosion Control Measures (SIDS), sedimentation tanks, to comply with PUB's COP on Surface Water Drainage. • The Contractor must synchronize earthworks with ECM provision. Progress of earthworks will be carefully regulated to avoid exposing more areas than the proposed ECM can manage. • Biodegradable erosion blankets must be promptly provided to areas with bare soil surfaces on the same day of soil exposure. • Demolition and earthworks scheduling will be organized to minimize the quantity of stockpiles stored on-site. • ECM tanks/ponds will be designed with sufficient capacity to contain turbid stormwater before treatment at the ECM facility. • Contractors must always ensure proper operation and maintenance of their CCTV system in line with PUB's circular on Preventing Muddy Waters from Construction Sites. This measure aims to prevent deliberate tampering with the CCTV system to disguise silty discharge. • Effective implementation of ECM and monitoring will adhere to the Code of Practice on Surface Water Drainage to ensure that discharge into the stormwater drainage system does not exceed prescribed limits for Total Suspended Solids (TSS) under the Sewerage and Drainage (Surface Water Drainage) Regulations. • A Sediment Control Plan will be formulated, including measures such as sealing site hoarding and installing berms along the site hoarding, to prevent silty water from leaking out and accumulating at the site entrance. • Topsoil removed will be stockpiled in a designated area and adequately covered to prevent soil loss from secondary erosion. Conserved soil can be used for backfilling, while excess soil material must be stored properly for potential reuse. • Approved materials of the same or superior quality as the surrounding area will be used for backfilling works. All backfilled material will be free of debris and of good soil quality. • Where feasible, clean water flow will be segregated from silty water flow to maximize sedimentation tank holding capacity. • Manholes will always be adequately covered and temporarily sealed. • Finalise a complete inventory of all anticipated wastewater streams and volumes before the onset of construction phase works. • Maintain daily records of wastewater volume, as well as the			deterioration in the water quality. Intensified monitoring will be carried out until in-situ measurements and/or laboratory results indicate 'normality'/consistency with earlier monitored conditions; and • Daily inspection on perimeter drains to ensure no surface runoff flowing out from the site untreated done by the site officer with monthly audit done by EMMP consultant.			or clogging issues observed; • If complaints are received due to Project activities; and • If visual non-compliance to any of the minimum control or mitigation measures are observed on-site.

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Monthly Reporting	Site Responsibility	Triggers[5,6]
		volumes of sludge and other produced onsite. • Ensure containment ponds are made of impervious material and designed with sufficient capacity to hold the volumes of wastewater produced on site, accounting for stormwater runoff and firefighting needs as well. • Provide temporary storage volumes for overflow situations of untreated wastewater. This temporary storage should have sufficient capacity to capture any unexpected additional volumes, ensuring that untreated wastewater is not released to watercourses unless it complies with NEA guidelines on trade effluent discharge concentrations. • Equip containment ponds, as well as wastewater generating areas on site with spill clean-up kits. • Design adequate drainage systems, including cut-off drains, sump pit, road kerb, piping and toe walls to channel construction process wastewater streams (e.g. wash water) and stormwater runoff separately through detailed design to capture and treatment in the containment pond(s)/ kerb(s). Where applicable, include oil-water separators. • Seek approval from relevant authorities (i.e. PUB and NEA) in accordance with PUB Sewerage and Drainage (Trade Effluent) Regulations, if the wastewater is planned to be disposed to public sewer, or NEA's Trade Effluent Discharge Limits to watercourse if disposal to surface watercourses is intended. If such discharges are not approved, the trade effluent will be stored, treated or recycled on site and finally disposed off-site. • Obtain comments and approval from relevant authorities (e.g., Singapore Civil Defence Force [SCDF] and NEA) for the use of treated wastewater for firefighting purposes. • Provide appropriate concrete washout areas, ensuring these are not located near watercourses. • All vehicles are to undergo a wheel washing process before leaving the site to prevent earth, mud, and debris from being disposed of on surrounding roads. The wastewater generated from this activity should be stored and removed for treatment and disposal offsite by an approved Waste Management Contractor. • Establish regular and dedicated procedures for the inspection and maintenance of wastewater collection, storage, and treatment infrastructure (e.g., pipes, oil-water separators). • Implement regular and dedicated procedures for the management of stormwater collection, settling, testing, and eventual discharge to watercourses. • Develop a training program for all onsite workers, including subcontractors, to educate them on their obligations regarding proper water quality management. • Prohibit the discharge of pumped groundwater from soil dewatering and other wastewaters into aquatic habitats. • Prohibit the unmanaged discharge of any wastewater stream. • No trade effluent other than the nature or type approved by the NEA Director-General will be discharged into any watercourse or soil. • Apply the principles of reduce, reuse, and recycle to wastewater management onsite. • Store hazardous wastewater, such as oil water, thinners, solvents, or paints, on a hard stand under shelter with a curb around the storage area. Ensure this wastewater is removed for treatment and disposed of offsite by an approved Waste Management Contractor. Handle hazardous liquids as Hazardous Waste. • Provide an adequate number of enclosed bins. • Ensure waste disposal facilities are cleared up as often as necessary to prevent buildup. Conduct housekeeping checks at least once a day to ensure all litter is cleared from the site. • Develop a Standard Operating Procedure (SOP) for the safe							

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Monthly Reporting	Site Responsibility	Triggers[5,6]
		handling, transfer, storage, and disposal of solid waste. • Conduct appropriate tests to ascertain the presence or absence of contamination in excavated soil. • Ensure appropriate disposal of any waste listed in the Environmental Public Health (General Waste Collection) Regulations by a licensed waste operator. • Provide a sufficient number of proper sanitary facilities and ensure their maintenance. It is recommended to have one portable toilet per 10 individuals, serviced three times per week by NEA's Licensed Waste Collector (LWC) for regular sewage disposal. • Ensure toilet facilities are appropriately located away from any nearby watercourses. • If on-site dormitories are present, it is advised to install container toilets and obtain written approval from PUB to connect them to public sewers. • Establish a regular maintenance schedule to check and maintain the cleanliness and functionality of sanitary facilities on site, at least once a week, depending on the number of facilities. • Conduct inspections and audits to assess the hygienic conditions on site. • Implement the construction Environmental Management and Monitoring Plan (EMMP) and ensure complete preparation of associated plans and procedures. • Conduct leak detection tests periodically on toxic waste storage containers. • Store toxic waste and hazardous substances on a hard stand, under shelter with a kerb around the storage area. • Provide spill trays for all waste containers and regularly maintain them to prevent rain from washing out pollutive substances. • Ensure appropriate disposal of toxic waste in accordance with the Environmental Public Health (Toxic Industrial Waste) Regulations by a Licensed Waste Operator/Collector. • Establish a consignment notification/tracking system and a transport emergency response plan for the transportation of toxic waste. • Develop a Standard Operating Procedure (SOP) for the safe handling, transfer, and storage of toxic waste; conduct housekeeping checks at least once a day to ensure all toxic waste is cleared from the site. • Remove any hazardous substances or chemicals if safer alternatives are available. • Ensure chemical storage areas are adequate, located on paved ground, bunded, sheltered with adequate ventilation, and positioned away from waterways and drains. Safety Data Sheets (SDS) must be kept together with the stored chemicals. • The storage area must have a volume of 110% of the largest volume of chemical substances to be stored. • Utilize secondary containment with a capacity of more than 10% volume for single large containers and 25% of the total volume for multiple containers for all chemical stores and diesel generators to minimize spillages and soil and surface water contamination as per requirements in COPPC/SS593. Take caution around watercourses to prevent leaks of toxic chemicals such as petrol, diesel, oil, paint, and thinner from equipment. • Include oil-water separators in the proposed infrastructure for separate channelling of construction wastewater streams and stormwater runoff to capture inadvertent spills or leaked oils or greases, particularly in the vicinity of liquid storage or refuelling areas. • Immediately maintain or remove off-site any construction equipment causing pollution to the water system due to oil or							

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Monthly Reporting	Site Responsibility	Triggers[5,6]
		fuel leakage. • Conduct all activities involving repair, servicing, engine overhaul works, etc., in appropriately contained areas (e.g., concreted area with proper containment), and channel all wastes for proper treatment or disposal to meet regulations. • Prepare an emergency response plan, train the Emergency Response Team (ERT) to be competent in the response mechanism, and provide response kits for any spillages. • Implement good housekeeping practices to minimize careless spillage and maintain storage and workspace cleanliness. Assign a responsible person (e.g., ECO) to oversee the efficient operation of containment ponds/kerbs, adhering to good housekeeping practices. Regularly check containment ponds/kerbs at least daily to ensure proper functionality. Provide appropriate training, including safety codes and relevant manuals, to personnel handling chemicals on site. • Implementation of a construction Environmental Management and Monitoring Plan (EMMP) is essential, ensuring thorough preparation of associated plans and procedures.						
Airborne Noise	Noise from construction machines and equipment, especially rotational and vibratory equipment (e.g. dozers, cranes, excavators, trailers, generators, etc.)	• Label all machinery and equipment with a weather-proof sticker clearly indicating its noise emission level (at source) under normal operating conditions. • All machinery and equipment used onsite are sound-reduced as much as practicable. • House stationary noisy equipment in enclosures onsite where necessary. • Train and brief machine operators and workers on quieter work techniques. • Conduct ad-hoc noise monitoring during noisy operations as work progresses. • Erect noise barriers to minimise noise pollution affecting biodiversity within the biodiversity Study Area. • Limit construction works involving noisy machinery to daylight hours, from 8 am to 6 pm and minimise noisy construction activities during night works period. • Implement additional noise measures when noise monitoring indicates that levels are approaching or exceeding permissible limits. • Avoid shouting, whistling, sirens, or similar loud intermittent noises, especially in construction zones near ecologically sensitive receptors (e.g., N5 Forested Area), which can be impacted by such disturbances.	MITIGATION MEASURES FOR CONSTRUCTION NOISE: • Noise barriers of 6 m and 12 m height are proposed at the construction boundary fronting noise sensitive receptors (see Figure 7.5.13); • It is to be noted that Figure 7.5.13 does not present the internal noise barriers that have been considered in the mitigation. The Contractor shall refer to the tender specification or Client for details. • Extension of wildlife shepherding to fauna species potentially trapped within areas bounded by the proposed construction worksites and OCC. MITIGATION MEASURES FOR GENERAL CONSTRUCTION NOISE CONTROL: • Where controlling noise sources at the source is not feasible, acoustic enclosures or sheds are to be introduced to mitigate noise at the source. Typical acoustic enclosure covers the machine as fully as possible (with or without ventilation where applicable) to provide sound insulation. • Machines (such as trucks) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum; • Only well-maintained construction plants should be utilised on-site, and construction plants should be serviced regularly during the entire construction period; • The number of PMEs should be reduced as far as practicable when construction works are carried out at areas close to the noise sensitive receivers: • Silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction programme; • Behavioural practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items should be ensured; • Construction respite: Restrict high noise generating drilling activities only in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block, if possible; • Periodic noise monitoring by an independent third party, to establish compliance with requirements and to advise on equipment causing concern, and additional potential mitigation measures; • Minimise construction activities during night works period	$L_{Aeq(12\ hrs)}$, $L_{Aeq(1hr)}$, and $L_{Aeq(5\ mins)}$	• N5 Forested Area.	Before commencement of any construction works (including site clearance) • One-time airborne noise monitoring for 1 week at the proposed locations, for establishment of latest baseline. During Construction Phase • Continuous monitoring at the proposed locations (refer to Table 9.3) for the entire duration of construction. • Records on noise levels from construction sites should be properly kept and produced when requested.	To be included in monthly report	CT	Investigation and corrective actions to be taken, when any of the following documentation are found inadequate / missing: • Construction Noise Management Plan; • Monitoring Log. 1. If the monitored parameters exceed applicable values of EPM regulations. 2. If complaints are received due to Project activities. 3. If visual non-compliance to any of the minimum control or mitigation measures are observed on-site. 4. If there are any cracks / leaks present on the noise barrier installed.

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Monthly Reporting	Site Responsibility	Triggers[5,6]
			(i.e. after 6pm) to minimise noise disturbance to nocturnal animals; • Plan the layout of the site by considering using materials and other large structural equipment as noise barriers; • Construction plants known to emit noise strongly in one direction should, wherever possible, be orientated so that the noise is directed away from the nearby noise sensitive receptors; • Material stockpiles and other structures will be effectively utilised, wherever practicable, in screening noise from on-site construction activities; • All handheld percussive breakers and air compressors used on site will comply with local legislation and requirements; • Activities may be scheduled to minimise noise generated at certain areas during periods which may be particularly sensitive to noise; • Works using machines or vehicles that generate noise should be prohibited in the night and the dawn; • Appropriate hearing protectors should be used by personnel operation the plant or equipment, the hearing protector must attenuate the exposure of the user to sound pressure levels below 85dB (A). Signage to remind personnel to put on hearing protection will be put up at work areas that emit excessive noise. Choice of hearing protector such as ear plugs (for < 100 dB (A)), earmuffs (for 100 dB (A) to 120 dB (A), ear plugs and earmuffs (for > 120dB (A)) in various noise exposure level; • Noise awareness briefing should be conducted regularly and highlighted the noise mitigation measures such as position of machinery, making use of portable noise barriers and dos and don'ts for use of machinery at night; and • If noise remains an issue even after implementation of recommended mitigation measures such as noise barriers, contractor should consider implementation of proprietary noise barriers of high noise reduction capabilities to further reduce noise to acceptable levels.						

9.13.2 Operational Phase

The EMMP for operational phase of the Project is described in Table 9.5.

Table 9.5 Proposed environmental management and monitoring plan for the operational phase

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Site Responsibility	Triggers[7,8]
Biodiversity	Minimisation of operational impacts to flora/vegetation/fauna	Not Applicable						
Water Resources (Hydrology and Surface Water Quality)	• Stormwater run-off generation • Permanent land use change • Improper management of liquid and solid wastes • Accidental spill and	• Ensure the future drainage system is designed in accordance with PUB COP to ensure appropriate water conveyance within the proposed future development and to prevent flooding of adjacent areas. • Geotechnical aspect of site's slope stability (such as Earth Retaining Stabilising Structure [ERSS]) will be included in detailed design engineering for the operational phase. • Providing more softscape area should be considered in the design of the development which will help to reduce the	Not Applicable	All parameters identified in Table 9.2. And any flooding issues should be recorded and inspected.	Sungei Sembawang	Monthly inspection for the surface water quality and hydrology, especially during heavy storm event for hydrological conditions during first three (3) month of operational period. Monthly monitoring for all the in-situ and ex-situ	EHS Officer	Investigation and corrective actions to be taken, when: • If the monitored parameters of all discharge points exceed applicable values of NEA Trade Effluent Discharge Limits at discharge point (refer to

[7] Resident Technical Officer (RTO) and Site Officers (SO, WSHO and ECO) check the Study Area for construction progress and implementation of environmental mitigation measures.
[8] If there is trigger then all the mitigation and management measures should be audited in detail for compliance and corrective action must be taken in liaison with the Project Owner.

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Site Responsibility	Triggers[7,8]
	leaks	peak flow and reduce flood risk at downstream area. Active, Beautiful, Clean (ABC) Water design approach can be considered to reduce the peak flow. • Provide more pervious areas to increase the seepage of surface water into the soil. • Installation of recharge wells, if necessary. • Adequate drainage, piping and/ or channelling of stormwater runoff to be assured through detailed design [e.g. ABC Water design approach] for capturing and treatment before discharge into receiving watercourses. • Regular and dedicated procedures for the inspection and maintenance of stormwater collection, storage, and treatment infrastructure, such as pipes, oil water separation and silt screens etc. • Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of 'clean' water to surface waters, including associated measures required to prevent high sediment concentration stormwater drainage to surface waters. • Prepare sufficient disposal bins surrounding the Project to avoid improper disposal of waste. • Conduct regular inspection on wastes' storage system of the Project. • Monitor the proposed watercourses and its surroundings with CCTV surveillance regularly to ensure no contamination occurred. • Develop an Emergency Response Plan and conduct adequate training to maintenance workers to cope the accidental contamination of water. • Raise awareness of various stakeholders with community/ stakeholder engagement (e.g. signage boards, warning signs, etc.). • No vehicles allowed within the future managed vegetation (i.e. proposed park) at development area.			parameters at two locations within Sungei Sembawang (upstream and downstream of the Project site)		Table 5.12); • If any flooding issues observed; • If complaints are received due to Project activities; and • If visual non-compliance to any of the minimum control or mitigation measures are observed on-site.
Airborne Noise	Noise from Land Traffic Noise	MINIMUM CONTROLS FOR TRAFFIC NOISE: • Use of low-noise pavement mix for sections of new road networks near existing residential buildings shall be considered; and • Due to the lack of information at this juncture of reporting, assessment, minimum controls, and mitigation will be provided by the appointed Noise Consultant during the design stage and in accordance with the NEA TNIA Guideline, 2016 [R-26]. Note: As current means of noise impact assessment were only performed qualitatively, quantitative noise impact assessment must be conducted by the developer/ developing agent at a later stage to assess noise impacts arising from the operational phase related activities as mandated by law at later stages of the Project.	• MITIGATION MEASURES FOR TRAFFIC NOISE: Consider the provision of park areas/ ecological setback in between new road networks if in proximity to areas with NSRs.	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

10 Conclusion

As shown in the gazetted URA Master Plan 2019, Sembawang N4 is planned predominantly for Residential use, along with other supporting land uses such as Commercial and Residential, Education Institution, Place of Worship, etc. The Project site spans across approximately 53 ha and is bounded by Admiralty Road West and Admiralty Street to the north, Canberra Road and N5 Forested Area to the east, residential developments to the south and Sungei Sembawang to the west. The site is located in close proximity to urbanised area, with residential developments to the south, and industrial developments to the north. The larger green areas in the proximity of the site are Sembawang Park and Simpang, located approximately 1.3 km east of the site. In addition, Sembawang Airbase is approximately 1.5 km south of the site. Within the site, it is highly disturbed and urbanised with foreign worker dormitories and recreation centres located at the west and north, while other smaller areas are occupied by LTA's Laydown Area and NParks' Tree Bank. The vegetation within the site mostly comprises managed turf. A forested patch (i.e. N4 Forested Area) is located between the turf and Cochrane Lodges.

The focus of this EIA study was to establish environmental baseline conditions (i.e. biodiversity, hydrology, surface water quality, and airborne noise) and assess the potential impacts to the ecological receptors within the N4 and N5 Forested Areas arising from, and associated with, the construction and operational phases of the proposed developments. Although divided by road, these two forested areas represent habitat continuum with faunal movement of migratory species between the areas. In addition, the two patches of forest are also connected via underground culvert which discharges the water from the concrete drain within N5 Forested Area into the semi-naturalised drain within N4 Forested Area. These forested areas have proven to be an effective stepping-stone habitat, especially for N5 Forested Area which is crucial for faunal movement between Simpang and Central Catchment Nature Reserve via Sembawang Air Base, proven by the record of Sunda pangolin and otters in the area.

Based on the conceptual land use plan, majority of the site will be developed for housing, with supporting infrastructure and facilities. There will also be a proposed park to serve the new residential area.

Biodiversity surveys have found that the forest is generally dominated by exotic-dominated secondary forest with more than 240 flora species identified across both N4 and N5 Forested Areas. In total, five floral species of conservation significance were identified within N4 Forested Area (i.e. *Calophyllum inophyllum*, *Cyperus compressus*, *Macaranga griffithiana, Tectaria cf semipinnata, Trema tomentosum)*. Within N5 Forested Area a total of 17 CS species were identified Other specimens of value include a single record of Malayan banyan (*Ficus microcarpa*) at N4 Forested Area and 11 plant specimens within N5 Forested Area. Fauna field assessment recorded 212 species, with birds and butterflies making up more than half of species assemblage. A total of 13 species of conservation significance were identified, all of which belong to birds and mammals.

Because the majority of the N4 Forested Area will be cleared during the construction phase of the Project, the main impacts on this area were assessed to be due to inevitable loss of habitats and plant species. More specifically, the impact due to the loss of habitats was assessed as Major, while the plant mortality impacts were assessed as Moderate to Major. As such, compensatory measures such as habitat creation using native planting with ABC features running through the future park within the Project site will be explored.

As mentioned earlier, the N5 Forested Area is zoned "Residential" in the URA Masterplan, however, development details were not known at the time of writing this Report and were not included in this Study. However, given the proximity of the two forest patches, indirect impacts on biodiversity could still potentially occur, especially within construction impact zone (i.e. within 30 m from the construction footprint). However, it is to be noted that only a small portion of N5 Forested Area will be within impact zone, due to existing 'setback' provided by the Canberra Road. Therefore, the degradation of habitats within N5 Forested Area as well as decline in plant health were assessed Negligible. Fauna species may also be affected due to loss of or reduction in habitats and food sources, human-wildlife conflict, accidental injury or mortality, loss, or reduction in ecological connectivity for faunal movement, light disturbances, and human disturbances, with resulting impact significance ranging from Negligible to Major. As the N4 Forested Area will be cleared, loss of or reduction in habitats and food sources was assessed as an impact that will likely affect majority of fauna species. During the operational phase, the impacts on the fauna (light disturbances, accidental injury or mortality, human-wildlife conflict, human disturbances) were assessed to be Negligible to Moderate. However, it is assessed that those impacts could be reduced to Minor, with the successful implementation of proposed mitigation measures. Another notable source of impact to the N5

Forested Area, in particular fauna species, is due to the noise generated during the construction phase activities. Based on the results predicted by the noise models, the overall impact significance on identified ecological receptors was assessed to be **Major**. Potential ways to reduce the assessed airborne noise impacts could be by installing of noise barriers and implementing noise source control measures on the site. During the operational phase, pre-mitigated impact significance for habitat degradation and changes in microclimatic conditions were deemed to be Negligible for all the habitats within the 30 m impact zone within N5 Forested Area. Likely sources of noise impacts during the operational phase will be ACMV and increased traffic, whose impacts were assessed to be Negligible and Minor, respectively.

Hydrological surveys, catchment delineation and analysis of regional catchments show that the water from the semi-naturalised drain at N4 Forested Area eventually gets discharged into the Sungei Sembawang and from there it flows into the EJS. Therefore, these two waterbodies and their associated habitats were also taken into consideration for the purposes of this EIA. Hydrological changes expected to occur within the site were assessed to have Negligible impact to the existing hydrology of the beforementioned waterbodies. With regard to the surface water quality, under the assumption that appropriate minimum controls have been successfully implemented, the impact is expected to be Minor. Similarly, during the operational phase the hydrological and water quality impacts were assessed to be Negligible and Minor, respectively.

11 References

11.1 Legislation, Standard and Guideline

R-1. National Parks Board, 2020. Biodiversity Impact Assessment (BIA) Guidelines.

https://www.nparks.gov.sg/-/media/nparks-real-content/biodiversity/bia-guidelines.pdf?la=en&hash=67BBB6F740AE7CCE941D82B261BB3DAF9CF537B1

R-2. Legislation Division of Attorney General's Chambers of Singapore. Environmental Protection and Management Act. 2020

https://sso.agc.gov.sg/Act/EPMA1999

R-3. Legislation Division of Attorney General's Chambers of Singapore. Environmental Protection and Management (Trade Effluent) Regulations. 1999 (Revised Edition 2008).

https://sso.agc.gov.sg/SL/EPMA1999-RG5

R-4. World Health Organization (WHO), n.d., Water Quality Requirements.

https://iris.who.int/bitstream/handle/10665/44584/9789241548151_eng.pdf?sequence=1

R-5. United States Environmental Protection Agency, United States (USEPA), 2017, Water Quality Standards Handbook.

https://www.epa.gov/wqs-tech/water-quality-standards-handbook

R-6. Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ). Guidelines for Fresh and Marine Water Quality. 2000.

https://www.waterquality.gov.au/anz-guidelines/resources/previous-guidelines/anzecc-armcanz-2000

R-7. Canadian Council of Ministers of the Environment. Canadian Water Quality Guidelines for the Protection of Aquatic Life. 2007.

http://ceqg-rcqe.ccme.ca/en/index.html#void

R-8. Mitigating Impact from Aquaculture in the Philippines (PHILMINAQ), n.d. Water Quality Criteria and Standards for Freshwater and Marine Aquaculture

http://aquaculture.asia/files/PMNQ%20WQ%20standard%202.pdf

R-9. Department of Environment, Malaysia (DOE). National Water Quality Standards for Malaysia. n.d.

https://www.doe.gov.my/wp-content/uploads/2021/11/Standard-Kualiti-Air-Kebangsaan.pdf

R-10. Legislation Division of Attorney General's Chambers of Singapore. Environmental Protection and Management (Chapter 94A). 2018.

https://sso.agc.gov.sg/SL/EPMA1999-S154-2018

R-11. Singapore Standards SS593:2013. Code of Practice for Pollution Control (COPPC). 2013.

R-12. Association of Southeast Asian Nations (ASEAN). ASEAN Strategic Plan of Action on Water Resources Management. 2005.

https://oicwater.sesric.org/img/ASEAN-Strategic-Plan-of-Action-on-Water-Resources-Management.pdf

R-13. Legislation Division of Attorney General's Chambers of Singapore. Sewerage and Drainage Act (Chapter 294). 1999 (2020 Revised Edition)

https://sso.agc.gov.sg/Act/SDA1999

R-14. Legislation Division of Attorney General's Chambers of Singapore. Sewerage and Drainage Act (Chapter 294, Section 74). Sewerage and Drainage (Surface Water Drainage) Regulations. 1999 (Revised Edition 2007).

https://sso.agc.gov.sg/SL/SDA1999-RG4?DocDate=20070515

R-15. Legislation Division of Attorney General's Chambers of Singapore. Sewerage and Drainage (Trade Effluent) Regulations. 1999 (Revised Edition 2007).

https://sso.agc.gov.sg/SL/SDA1999-RG5?DocDate=20161003

R-16. Public Utilities Board (PUB). Code of Practice on Surface Water Drainage. 2018 (Addendum 2021).

https://www.pub.gov.sg/Documents/COP_Surface%20Water%20Drainage_7th%20Ed%20Add.%201.pdf

R-17. Public Utilities Board, Singapore (PUB), 2015, Preventing Muddy Waters from the Construction Sites.

https://www.pub.gov.sg/Documents/Circular2015Oct28.pdf

R-18. United Nations Economic Commission for Europe, United Nations (UNECE), 1994, Standard Statistical Classification of Surface Freshwater Quality for the Maintenance of Aquatic Life, New York and Geneva.

R-19. National Environmental Agency. Code of Practice for Licensed General Waste Collectors. 2019

https://www.nea.gov.sg/docs/default-source/resource/cop-gwc-version-date-30-nov-2016.pdf

R-20. National Environmental Agency. Code of Practice on Environmental Health. 2021

https://www.nea.gov.sg/docs/default-source/resource/practices-/copeh-2021.pdf

R-21. Legislation Division of Attorney General's Chambers of Singapore. Energy Conservation Act 2012 (2020 Revised Edition)

https://sso.agc.gov.sg/Act/ECA2012

R-22. Legislation Division of Attorney General's Chambers of Singapore. Environmental Public Health Act 1987 (2020 Revised Edition)

https://sso.agc.gov.sg/Act/EPHA1987

R-23. Legislation Division of Attorney General's Chambers of Singapore. Radiation Protection Act 2007 (2020 Revised Edition)

https://sso.agc.gov.sg/Act/RPA2007

R-24. Legislation Division of Attorney General's Chambers of Singapore. Environmental Protection and Management (Control of Noise at Construction Sites) Regulations. 2008.

https://sso.agc.gov.sg/SL/EPMA1999-RG2

R-25. National Environment Agency (NEA). Technical Guideline on Boundary Noise Limits for Air Conditioning and Mechanical Ventilation Systems in Non-Industrial Buildings. 2018.

https://www.nea.gov.sg/docs/default-source/default-document-library/technical-guideline-on-boundary-noise-limit-for-air-conditioning-and-mechanical-ventilation-systems-in-non-industrial-buildings---feb-2018.pdf

R-26. National Environment Agency (NEA). Technical Guideline for Land Traffic Noise Impact Assessment. 2016.

https://www.nea.gov.sg/docs/default-source/our-services/building-planning/technical-guideline-for-land-traffic-noise-impact-assessment.pdf

R-27. Ecological Impact Assessment (EcIA). EIANZ Guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd Edition. May 2018.

https://www.eianz.org/document/item/4447

R-28. Chartered Institute of Ecology and Environmental Management (CIEEM). Guidelines for ecological impact assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. September 2018.

https://cieem.net/wp-content/uploads/2019/02/Combined-EclA-guidelines-2018-compressed.pdf

R-29. National Parks Board (NParks). Conserving Our Biodiversity – Singapore's National Biodiversity Strategy and Action Plan (NBSAP). 2019.

https://www.nparks.gov.sg/-/media/nparks-real-content/biodiversity/national-plan/singapore_2009-nbsap_updated-may-2019_national-targets.pdf

R-30. Legislation Division of Attorney General's Chambers of Singapore. Wildlife Act. 2020.

https://sso.agc.gov.sg/Act/WA1965#pr10-

R-31. Legislation Division of Attorney General's Chambers of Singapore. Parks and Trees Act. 2020.

https://sso.agc.gov.sg/Act/PTA2005

R-32. Legislation Division of Attorney General's Chambers of Singapore. Parks and Trees (Heritage Road and Green Buffers) Order. 2006.

https://sso.agc.gov.sg/SL/PTA2005-OR2?DocDate=20061130&ValidDate=20061130

R-33. Legislation Division of Attorney General's Chambers of Singapore. Parks and Trees (Preservation of Trees) Order. 1998.

https://sso.agc.gov.sg/SL/PTA2005-OR1?DocDate=20171117

R-34. Singapore Standards SS602:2014 Code of Practice for Noise Control on Construction and Demolition Sites. 2014.

R-35. Department for Environment Food and Rural Affairs, 2011, Biodiversity 2020: A strategy for England's wildlife and ecosystem services

R-36. IUCN. (2012) Red List of Threatened Species: Version 2011.2.

R-37. National Environment Agency (NEA). Allowable Limits for Trade Effluent Discharge to Watercourse or Controlled Watercourse, 2008

https://www.nea.gov.sg/our-services/pollution-control/water-quality/allowable-limits-for-trade-effluent-discharge-to-watercourse-or-controlled-watercourse

R-38. Association of Southeast Asian Nations (ASEAN). ASEAN Marine Water Quality Management Guidelines and Monitoring Manual. 2008.

https://environment.asean.org/public/uploads/repositories/20220725-ASEAN-MarineWaterQualityManagementGuidelinesandMonitoringManual.pdf

R-39. Crosher I, Gold S, Heaver M, Heydon M, Moore L, Panks S, Scott S, Stone D & White N (2019) The Biodiversity Metric 2.0: auditing and accounting for biodiversity value. User guide (Beta version, July 2019). Natural England.

R-40. Hong Kong Environmental Protection Department. Environmental Impact Assessment Ordinance - Technical Memorandum. 2011.

https://www.epd.gov.hk/eia/english/legis/index3.html

R-41. National Environment Agency (NEA). Technical Guideline for Land Traffic Noise Impact Assessment. 2016.

https://www.nea.gov.sg/docs/default-source/our-services/technical-guidelines-for-noise-impact-assessment-.pdf

11.2 Websites

W-1. National Environment Agency (NEA). Singapore's Water Quality Guidelines for Recreational Beaches. 2021.

https://www.nea.gov.sg/our-services/pollution-control/water-quality/recreational-beaches

W-2. National Parks Board (2023) Species List (Red Data Book List).

https://www.nparks.gov.sg/biodiversity/wildlife-in-singapore/species-list/.

W-3. National University of Singapore Libraries (2020) Historical Maps of Singapore. Historical maps of 1943 through 2010.

https://libmaps.nus.edu.sg/.

W-4. Land Authority (2015) Height Datum & Height Determination using GNSS in Singapore.

https://fig.net/resources/proceedings/2015/2015_07_vrfp_comm5/5A_Khoo_Singapore_Height_Datum.pdf

W-5. Meteorological Service Singapore (MSS). Climate of Singapore

http://www.weather.gov.sg/climate-climate-of-singapore

W-6. Meteorological Service Singapore (MSS). 2022 Climate and Weather: The Year in Review

http://www.weather.gov.sg/wp-content/uploads/2023/01/The-Year-in-Review-2022.pdf

W-7. Meteorological Service Singapore (MSS). Past Climate Trends

http://www.weather.gov.sg/climate-past-climate-trends/

W-8. Meteorological Service Singapore (MSS). Annual Climate Assessment Report 2020

http://www.weather.gov.sg/wp-content/uploads/2021/03/Annual-Climate-Assessment-Report-2020-updated-3.pdf

W-9. Lee Kong Chian Natural History Museum (2021) Biodiversity of Singapore.

https://singapore.biodiversity.online

W-10. Butterflies of Singapore (2015) Life History of the Common Evening Brown.

https://butterflycircle.blogspot.com/2015/08/life-history-of-common-evening-brown.html?m=1

W-11. Butterflies of Singapore (2014) Life History of the Common Redeye.

https://butterflycircle.blogspot.com/2014/10/life-history-of-common-redeye.html?m=0

W-12. Ecology Asia (n.d.) Malayan Giant Frog

https://www.ecologyasia.com/verts/amphibians/malayan_giant_frog.htm

W-13. Eudey A, Kumar A, Singh M & Boonratana R (2020) *Macaca fascicularis*. The IUCN Red List of Threatened Species 2020.

https://www.iucnredlist.org/species/12551/17949449

W-14. iNaturalist (2021)

https://www.inaturalist.org/

W-15. OtterWatch (2017) Pang Sua Family – Trivia. Facebook.

https://www.facebook.com/OtterWatch/posts/pang-sua-family-triviaa-few-weeks-ago-a-family-of-6-otters-3-adults-3-sub-adults/1707691955970012/

W-16. Public Utilities Board (PUB). Water from Local Catchment.

https://www.pub.gov.sg/watersupply/fournationaltaps/localcatchmentwater

W-17. Bird Society of Singapore. (2023). Large-billed Crow.

https://singaporebirds.com/species/large-billed-crow/

W-18. Bird Society of Singapore (2023) Oriental Magpie-Robin.

https://singaporebirds.com/species/oriental-magpie-robin/

W-19. Bird Society of Singapore (2023) Swinhoe's White-eye.

https://singaporebirds.com/species/swinhoes-white-eye/

W-20. BirdLife International (2023) Species factsheet: *Pycnonotus zeylanicus*

http://datazone.birdlife.org/species/factsheet/straw-headed-bulbul-pycnonotus-zeylanicus

W-21. National Parks Board (2019) Flora and Fauna Web: *Nycticorax nycticorax*

https://www.nparks.gov.sg/florafaunaweb/fauna/2/7/275

W-22. Bird Society of Singapore (2023) Buffy Fish Owl.

https://singaporebirds.com/species/buffy-fish-owl/

W-23. Bird Society of Singapore (2023) Baya Weaver.

https://singaporebirds.com/species/baya-weaver/

W-24. Birdlife International (2023) Species factsheet: *Belocercus longicaudus.*

http://datazone.birdlife.org/species/factsheet/22685513

W-25. Guardian glass (2023) Guardian Bird 1st UV. Retrieved from: https://www.guardianglass.com/us/en/our-glass/guardian-bird1st-uv/guardian-bird1st-uv

11.3 Publications

P-1. Chong KY, Tan HT, & Corlett RT (2009) A checklist of the total vascular plant flora of Singapore: native, naturalised and cultivated species. Raffles Museum of Biodiversity Research, Singapore.

P-2. Lindsay S et al, (2022) Flora of Singapore: Checklist and bibliography. Gardens' Bulletin Singapore, 74 (Supplement 1): 3–860.

P-3. Royal Botanic Gardens Kew (2023b) Plants of the World Online.

https://powo.science.kew.org/

P-4. Global Biodiversity Information Facility (GBIF) (2023) World Checklist of Selected Plant Families. https://www.gbif.org/dataset/d43f62e9-d697-41c5-ba9d-0328d7b4571c

P-5. Ascher JS, Soh ZWW, Chui SX, Soh EJY, Ho BM, Lee JXQ, Gajanur AR and Ong AR (2022). The bees of Singapore (Hymenoptera: Apoidea: Anthophila): First comprehensive country checklist and conservation assessment for a Southeast Asian bee faunal. Raffles Bulletin of Zoology 70: 39–64.

P-6. Ngiam RWJ & Davison GWH (2011) A checklist of dragonflies in Singapore parks (Odonata: Anisoptera, Zygoptera). Nature in Singapore, 4: 349–353.

P-7. Jain A, Khew SK, Gan CW & Webb EL (2018) Butterfly extirpations, discoveries and rediscoveries in Singapore over 28 years. Raffles Bulletin of Zoology, 66: 217–257.

P-8. Khew SK (2015) A Field Guide to the Butterflies of Singapore (2nd edition). Ink Communications Pte Ltd, Singapore.

P-9. Ng PKL (1997) The conservation status of freshwater prawns and crabs in Singapore with emphasis on the nature reserves. Gardens' Bulletin Singapore, 49: 267–272.

P-10. Cai Y, Ng PKL & Choy S (2007) Freshwater shrimps of the family Atyidae (Crustacea: Decapoda: Caridea) from Peninsular Malaysia and Singapore. Raffles Bulletin of Zoology, 55: 277–309.

P-11. Kottelat M (2013) The fishes of the inland waters of southeast Asia: a catalogue and core bibliography of the fishes known to occur in freshwaters, mangroves and estuaries. Raffles Bulletin of Zoology.

P-12. Suzuki T, Shibukawa K, Senou H, Chen I-S (2015) [issued 2016] Redescription of Rhinogobius similis Gill 1859 (Gobiidae: Gobionellinae), the type species of the genus Rhinogobius Gill 1859, with designation of the neotype. Ichthyological Research, 63: 227–238.

P-13. Ho JK, Ramchunder SJ, Memory A, Theng M, Li T, Clews E, Cai Y, Tan HH, & Yeo DC (2016) A Guide to the Freshwater Fauna of Nee Soon Swamp Forest. Lee Kong Chian Natural History Museum & Tropical Marine Science Institute, National University of Singapore.

P-14. Tan SK, Chan SY & Clements GR (2012) A guide to snails and other non-marine molluscs of Singapore. Science Centre, Singapore. 176 pp.

P-15. Gill F & Donsker D (2022) IOC World Bird List (V12.1).

Http://www.worldbirdnames.org

P-16. Davison G H, Ng PKL, Chew HH (2008) The Singapore Red Book: Threatened plants and animals of Singapore. Nature Society (Singapore), Singapore. 285 pp.

P-17. Leslie A G et al, (2021) Singapore Geology (2021): Momoir of the bedrock, superficial and engineering geology. (Singapore: Building and Construction Authority.)

P-18. Wong, NY & Yu, C (2005). Study of green areas and urban heat island in a tropical city. Habitat International, 29, 547-558

P-19. Jusuf, S. K., Wong N.H., Hagen E., Anggoro, R., & Hong, Y. (2007). The influence of land use on the urban heat island in Singapore. Habitat International, 31, 232-242.

P-20. Kinnaird MF, TG O'Brien & S. Suryadi (1999) The importance of figs to Sulawesi's imperiled wildlife. Tropical Biodiversity, 6: 5–18.

P-21. Korine C, EWV Kalko & EA Herre (2000) Fruit characteristics and factors affecting fruit removal in Panamanian community of strangler figs. Oecologia, 123: 560–568

P-22. Guttensohn TT & Leong KP (2021) Pang Sua Woodland: Sanctuary Unveiled Along the Rail Corridor. Cicada Tree Eco-Place, Singapore.

P-23. Archer JS & Pickering J (2018) Discover Life bee species guide and world checklist (Hymenoptera: Apoidea: Anthophila). (Available at: https://www.discoverlife.org/mp/20q?guide=Apoidea_species)

P-24. Lim KS & Yong DL (2013) Recent trends of nationally threatened birds in Singapore. Proceedings of Nature Society, Singapore's Conference on 'Nature Conservation for a Sustainable Singapore', pp. 71-92

P-25. Tan T (2001) Population distribution of straw-headed bulbul Pycnonotus zeylanicus in Singapore and strategies for conservation. MSc dissertation. University College London, UK.

P-26. Yong DL, Lim KS, Lim KC, Tan T, Teo SY & Ho HC (2017) Significance of the globally threatened straw- headed bulbul Pycnonotus zeylanicus populations in Singapore: a last straw for the species? Bird Conservation International, 28(1): 126-132.

P-27. Peh KSH, de Jong J, Sodhi NS, Lim SLH & Yap CAM (2005) Lowland rainforest avifauna and human disturbance: persistence of primary forest birds in selectively logged forests and mixed-rural habitats of southern Peninsular Malaysia. Biological Conservation, 123: 489–505.

P-28. Yong DL, Lim KC & Lee TK (2018) A naturalist's guide to the birds of Singapore. John Beaufoy Publishing, UK.

P-29. Nash HC, Lee PB, Lim NT-L, Luz S, Li C, Chung YF, Olsson A, Boopal A, Ng Strange BC & Rao M (2020) Chapter 26 - The Sunda pangolin in Singapore: a multi-stakeholder approach to research and conservation. Biodiversity of World: Conservation from Genes to Landscapes, 2020: 411-425.

P-30. Pottie SA, Lane DJW, Kingston T & Lee BPYH (2005) The microchiropteran bat fauna of Singapore. Acta Chiropterologica, 7(2): 237–247

P-31. Ho, H.C., Owyong, A., & Jain A. (2019) The Green Rail Corridor – A Biodiversity and Ecological Overview. Nature Society (Singapore) (NSS), 52–55 pp.

P-32. Bradford M, & Murphy HT (2019). The importance of large-diameter trees in the wet tropical rainforests of Australia. Plos One, 1–16.

P-33. Lok AFSL, Ang WF, Ng BYQ, Leong TM, Yeo CK, & Tan HT (2013) Native fig species as a keystone resource for the Singapore urban environment. Singapore: Raffles Museum of Biodiversity Research, National University of Singapore.

P-34. Saura S, Bordin O and Fortin M-J (2013) Stepping stones are crucial for species' long-distance dispersal and range expansion through habitat networks. Journal of Applied Ecology, 51(1), 171–182.

P-35. Didham RK (1997) An overview of invertebrate responses to forest fragmentation. Forests and insects, 303-320.

P-36. Laurance WF and Bierregaard RO (1997) Tropical forest remnants: ecology, management, and conservation of fragmented communities. University of Chicago Press, Chicago.

P-37. Paton PW (1994) The effect of edge on avian nest success: how strong is the evidence?. Conservation biology, 8(1), 17-26.

P-38. Murcia C (1995) Edge effects in fragmented forests: implications for conservation. Trends in Ecology & Evolution, 10(2): 58–62.

P-39. Ngiam & Ng (2022) A Photographic Field Guide to the Dragonflies & Damselflies of Singapore. John Beaufoy Publishing, United Kingdom.

P-40. Tan HH, Lim KKP, Liew JH, Low BW, Lim R, Kwik J & Yeo CJD (2020) The non-native freshwater fishes of Singapore: an annotated compilation. Raffles Bulletin of Zoology, vol. 68, pp. 150–195.

P-41. Ng TH & Yeo CJD (2012) Non-indigenous frogs in Singapore. Nature in Singapore, vol. 5, pp. 95–102.

P-42. Pointier J, Toffart J & Lefévre M (1991) Life tables of freshwater snails of the genus Biomphalaria (B. glabrata, B. alexandrina, B. straminea) and of one of its competitors Melanoides tuberculata under laboratory conditions. Malacologia, vol. 33, pp. 43–54.

P-43. Pryor K (2022) Effects of human disturbance during residential developments on the productivity of White-bellied Sea-Eagle in the Hunter Region, New South Wales. The Whistler, New South Wales, Australia, vol.16, pp.66-73.

P-44. Gunawan, Nazar S & Noske R (2018) Nest cycle and nestling development of a pair of Changeable Hawk-Eagles Nisaetus cirrhatus in Gunung Halimun-Salak National Park. Kukila, West Java, vol. 20.

P-45. Lim NT & Ng PK (2007) Home range, activity cycle and natal den usage of a female Sunda pangolin *Manis javanica* (Mammalia: Pholidota) in Singapore. Endangered Species Research, vol. 4, no.1–2, pp. 233–240.

P-46. Khoo MDY & Sivasothi N (2018) Population structure, distribution, and habitat use of smooth-coated otters *Lutrogale Perspicillata* in Singapore. IUCN Otter Specialist Group Bulletin (Singapore), vol. 35, pp. 171–182.

P-47. Medway L & Marshall AG (1970) Roost-site selection among flat-headed bats (Tylonycteris spp.). Journal of Zoology (London), vol. 161, no. 2, pp. 237–245.

P-48. Zhang L, Liang B, Parsons S, Wei L & Zhang S (2006) Morphology, echolocation and foraging behaviour in two sympatric sibling species of bat (Tylonycteris pachypus and Tylonycteris robustula) (Chiroptera: Vespertilionidae). Journal of Zoology, vol. 271, no. 3, pp. 344–351.

P-49. Vuong T, Gábor C, Ruedi M, Furey N, Nguyen TS, Vu DT, Bonillo C & Hassanin A (2017) Comparative phylogeography of bamboo bats of the genus *Tylonycteris* (Chiroptera, Vespertilionidae) in Southeast Asia. *European Journal of Taxonomy,* no. 274, pp. 1-38.

P-50. Lim KKP & Leong TM (2014) New record of the Horsfield's large-footed myotis in Singapore. Singapore Biodiversity Records, pp. 106-107.

P-51. Lim KKP (2015) A juvenile large-footed Myotis bat at Punggol. Singapore Biodiversity Records, 2015:31.

P-52. Francis CM (2008) A Field Guide to the Mammals of Southeast Asia. New Holland Publishers (UK) Ltd, United Kingdom.

P-53. O'Dempsey, T, & Chew, PT (2011) The freshwater swamp forests of Sungei Seletar Catchment: a status report. In Proceedings of Nature Society, Singapore's Conference on "Nature Conservation for a Sustainable Singapore (pp. 121-166)

P-54. Tan HH, Yeo CJD, Ng TH, Tan SK & Low BW (2016) Fishes, shrimps and aquatic snails observed at Kranji Marsh. Singapore Biodiversity Records, Singapore, pp.186-190.

P-55. Finch, D., Schofield, H, and Mathews F. Traffic noise playback reduces the activity and feeding behaviour of free-living bats. Environmental Pollution Vol. 263, Part B, 2020, 114405, ISSN 0269-7491. https://doi.org/10.1016/j.envpol.2020.114405.

P-56. Parris, K.M., and A. Schneider 2008. Impacts of traffic noise and traffic volume on birds of roadside habitats. *Ecology and Society* 14(1): 29. http://www.ecologyandsociety.org/vol14/iss1/art29/.

P-57. Riley CM, Jayasri SL & Gumert MD (2015) Results of a nationwide census of the long-tailed macaque (*Macaca fascicularis*) population of Singapore. Raffles Bulletin of Zoology, 63.

P-58. Sha JCM, Gumert MD, Lee BPYH (2009) Status of the long-tailed macaque *Macaca fascicularis* in Singapore and implications for management. *Biodivers Conserv* 18, 2909–2926. https://doi.org/10.1007/s10531-009-9616-4

P-59. Chia et al. (2019) First confirmed breeding record of Plume-toed Swiftlet Collocalia affinis in Singapore, BirdingAsia 31: 85-87.

P-60. Lim KS & Yong DL (2013) Recent trends of nationally threatened birds in Singapore. Proceedings of Nature Society, Singapore's Conference on 'Nature Conservation for a Sustainable Singapore', pp. 71-92

P-61. Chng et al. (2021) Smuggled For its Song The Trade in Malaysia's Oriental Magpie-robins. TRAFFIC.

P-62. Guttensohn TT & Leong KP (2021) Pang Sua Woodland: Sanctuary Unveiled Along the Rail Corridor. Cicada Tree Eco-Place, Singapore.

P-63. Archer JS & Pickering J (2018) Discover Life bee species guide and world checklist (Hymenoptera: Apoidea: Anthophila). (Available at: https://www.discoverlife.org/mp/20q?guide=Apoidea_species)

P-64. Lim KS & Yong DL (2013) Recent trends of nationally threatened birds in Singapore. Proceedings of Nature Society, Singapore's Conference on 'Nature Conservation for a Sustainable Singapore', pp. 71-92

P-65. Tan T (2001) Population distribution of straw-headed bulbul Pycnonotus zeylanicus in Singapore and strategies for conservation. MSc dissertation. University College London, UK.

P-66. Tan (2011) The status and distribution of Changeable Hawk-eagle (Nisheatus cirrhatus) in Singapore. Singapore Bird Group.

P-67. Yeo CJD (2011) Introduced Decapod Crustaceans in Singapore's Reservoirs. COSMOS, 6.

P-68. Yong DL, Lim KS, Lim KC, Tan T, Teo SY & Ho HC (2017) Significance of the globally threatened straw- headed bulbul Pycnonotus zeylanicus populations in Singapore: a last straw for the species? Bird Conservation International, 28(1): 126-132.

P-69. Peh KSH, de Jong J, Sodhi NS, Lim SLH & Yap CAM (2005) Lowland rainforest avifauna and human disturbance: persistence of primary forest birds in selectively logged forests and mixed-rural habitats of southern Peninsular Malaysia. Biological Conservation, 123: 489–505.

P-70. Yong DL, Lim KC & Lee TK (2018) A naturalist's guide to the birds of Singapore. John Beaufoy Publishing, UK.

P-71. Nash HC, Lee PB, Lim NT-L, Luz S, Li C, Chung YF, Olsson A, Boopal A, Ng Strange BC & Rao M (2020) Chapter 26 - The Sunda pangolin in Singapore: a multi-stakeholder approach to research and conservation. Biodiversity of World: Conservation from Genes to Landscapes, 2020: 411-425.

P-72. Pottie SA, Lane DJW, Kingston T & Lee BPYH (2005) The microchiropteran bat fauna of Singapore. Acta Chiropterologica, 7(2): 237–247

P-73. Wu, Mengyue & Chong, Han & Tan, Yen Yi & Lim, Bryan & Wong, Anna & Oh, R.R.Y. & Lee, Jessica & Ng, Elize & Rheindt, Frank. (2023). Genomic data reveal shift in geographic source of an illegally traded songbird. Conservation Genetics. 1-9. 10.1007/s10592-023-01564-9.

P-74. Leong TM (2014) Naked bulldog bat from Sembawang. Singapore Biodiversity Records, Singapore, pp. 182-184

P-75. Figueroa A, Low MEY, Lim KKP (2023) Singapore's herpetofauna: updated and annotated checklist history, conservation, and distribution. Zootaxa. 2023 May 18;5287(1):1-378. Doi10.11646/zootaxa.5287.1.1.PMID:37518684

P-76. Bat Conservation Trust (2018). Bats and Artificial Lighting in the UK, 19(3), 451-454. Retrieved from: https://theilp.org.uk/publication/guidance-note-8-bats-and-artificial-lighting/

P-77. Department of Environment and Energy (2020). National light pollution guidelines for wildlife. Commonwealth of Australia. Retrieved from: https://www.agriculture.gov.au/sites/default/files/documents/national-light-pollution-guidelines-wildlife.pdf

11.4 Maps

M-1. URA Master Plan Map (2019).

https://www.ura.gov.sg/maps/?service=MP

M-2. National Archives of Singapore (2021) Maps and Building Plans.

https://www.nas.gov.sg/archivesonline/maps_building_plans/

M-3. OneMap (2021) Singapore Historical Map.

https://www.onemap.gov.sg/

M-4. National University of Singapore Libraries (2020) Historical Maps of Singapore.

https://libmaps.nus.edu.sg/

M-5. URA Master Plan Map (2019).

https://www.ura.gov.sg/maps/?service=MP

M-6. Building and Construction Authority. Geological Map of Singapore 2021.

M-7. Public Utilities Board (PUB) Water from Local Catchment

https://www.pub.gov.sg/watersupply/fournationaltaps/localcatchmentwater

11.5 Others

O-1. Google Inc. (2013) Google Earth 7.1.2.2041. Google Inc., California.

Appendix A
AECOM Health and Safety Plan

Delivering a better world

APPENDIX A:

HEALTH AND SAFETY PLAN

Specialist Consultancy Services for Environmental Impact Assessment at Sembawang Neighbourhood 4 (Part)

Prepared by:

AECOM Singapore Pte Ltd
300 Beach Road, #23-00 The Concourse,
Singapore 199555

Project Number: ***60702777***

HEALTH AND SAFETY PLAN
APPROVAL PAGE

This project Health and Safety Plan (HASP) was prepared for employees performing a specific, limited scope of work. It was prepared based on the best available information regarding the chemical, physical and biological hazards known or suspected to be present on the Project site. While it is not possible to discover, evaluate, and protect in advance against all possible hazards, which may be encountered during the completion of the projects, adherence to the requirements of the HASP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve this HASP. This HASP has been written for the exclusive use of AECOM, its employees, and subcontractors. The plan is written for specified site conditions, dates and personnel, and must be amended if these conditions change.

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LIST OF ATTACHMENTS

Attachment A – HASP Receipt and Acceptance Form
Attachment B – Emergency Response Information

1.0 Introduction

This Health and Safety Plan (HASP) was developed by AECOM's Environment Business Line (AECOM) for implementing the Specialist Consultancy Services For Environmental Impact Assessment (EIA) at Sembawang Neighbourhood 4 (Part). This establishes the health and safety procedures required to minimize potential risk to personnel for the duration of the activity. This is a project and site-specific HASP and should be used concurrently with the AECOM Field SH&E Manual and standard operating procedures (SOPs) and a completed site specific Emergency Response Information Form (Attachment B).

1.1 Policy

AECOM, as a leading global provider of environmental, health and safety services, is committed in protecting the safety and health of our employees and meeting our obligations with respect to the protection of others affected by the implementation of all our operations. We are also committed to protecting and preserving the natural environment in which we operate. The safety of persons and property is of vital importance to the success of this project and accident prevention measures shall be taken toward the avoidance of needless waste and loss. It shall be the policy of this project that all operations be conducted safely as stated in *AECOM SH&E Policy Statement*.

1.2 Scope and Application

The provisions of this HASP apply to all AECOM project staff who may potentially be exposed to safety and/or health hazards related to activities described in Section 3.0 of this document. Unanticipated site-specific conditions or situations may occur during the implementation of this project. Also, AECOM and/or the contractors may elect to perform certain tasks in a manner that is different from what was originally intended due to a change in field conditions. As such, this HASP must be considered a *working document* that is subject to change to meet the needs of this project.

1.3 Regulatory Compliance

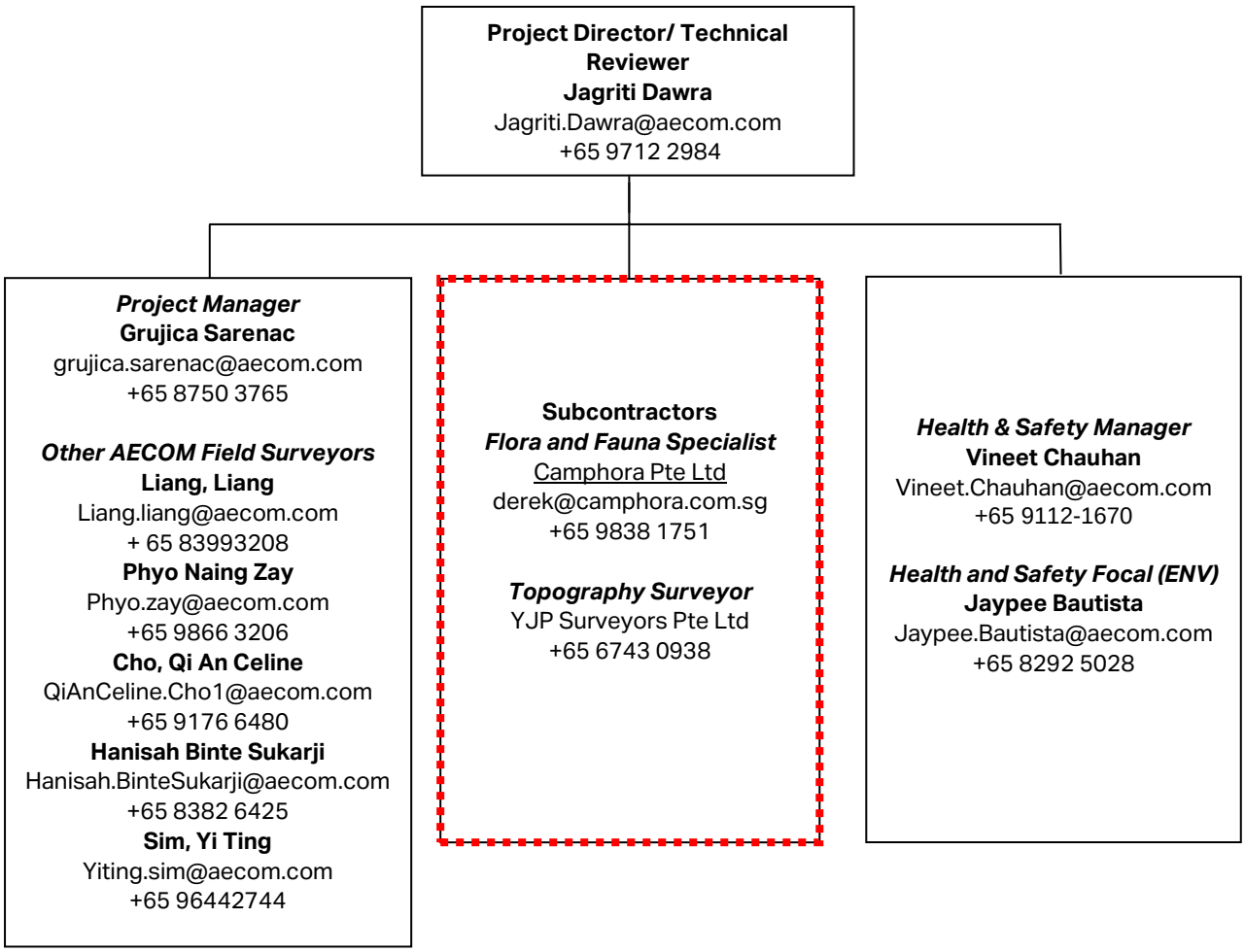
All activities covered by this HASP must be conducted in complete compliance with this HASP and with all applicable environmental, health and safety regulations of Singapore. Additionally, all work will be conducted in accordance with AECOM SH&E Policies and Procedures found in the *AECOM Field SH&E Manual* and Singapore Occupational Safety and Health Administration (OSHA) framework. Personnel covered by this HASP who cannot or will not comply with any of these requirements will be excluded from site activities.

1.4 Management of Change

The procedures in this HASP have been developed based on current knowledge regarding the specific biological and physical hazards, which are known or anticipated for the proposed onsite baseline survey. Site specific requirements and hazards for this project will be taken into consideration and will be included in any update of this HASP. Should additional information become available regarding unique site hazards or operational change, it may be necessary to modify this HASP. All proposed modifications to this HASP must be reviewed and approved by the AECOM Project Manager (PM) and HSSE Focal before such modifications are implemented. The Receipt and Acceptance Sign-off sheet must be submitted to the AECOM PM. The HASP Receipt and Acceptance Sign-off Sheet are included in this HASP as Attachment A.

1.5 Health and Safety Organization

The implementation of health and safety at the site location will be the shared responsibility of the Project Manager (PM), the Project Field Surveyors (FS), the HSSE Focal (HSSEF), and other site-based personnel and contractors implementing the proposed scope of work. The responsibilities of the PM, FS and HSSEF are shown in detail in the *AECOM SH&E Field Manual*. For the implementation of this project, the following Health and Safety Organizational Chart will apply:



1.5.1 Project Director and Project Supervisor

The Project Director is the lead of the entire AECOM working team. Project Supervisor is assisting Project Director in daily business administrative and project execution tasks, also serving as the advisor for the Project Manager in terms of site work arrangement, health and safety and budgetary resources. In this Project, both the Project Director and Project Supervisor are the technical leads in reviewing the EBS report(s) before external submission to the Client.

1.5.2 Project Manager

The Project Manager (PM) has overall management authority and responsibility for the project, including safety. The PM will provide the FS with work plans, safety personnel, and budgetary resources, which are appropriate to meet the safety needs of the project operations. Helping the PM with the management of the project is the Deputy Project Manager (DPM).

1.5.3 AECOM Field Surveyors

The AECOM Field Surveyor (FS) has the overall responsibility and authority to complete the work according to the provided scope of work. The FS must verify that all tasks are in compliance with the requirements of this HASP, and halt any activity that poses a potential hazard to personnel, property, or the environment.

1.5.4 Subcontractors

Subcontractors (in red box) involved in this project should review and understand the contents of this HASP prior to the start of on-site work. However, as part of the contract with the subcontractors, they are expected to follow their internal health and safety protocols. The subcontractor shall be fully responsible and shall indemnify AECOM for any losses, liabilities and claims as stipulated in Clause 9 and Clause 13 of the signed Subconsultant Engagement. Moreover, the subcontractors are expected to maintain proper and adequate insurances to cover health and safety related emergencies.

1.5.5 Other Field Personnel

All other field personnel covered by this HASP are responsible for following the health and safety procedures specified in this HASP and for performing their work in a safe and responsible manner.

1.6 Stop Work Authority

AECOM Stop Work Procedures (S3AS-106-PR) grants all AECOM employees, including employees of any of its subcontractors the right and responsibility to exercise a 'Stop Work Authority' any time that an employee



2.0 Project Background and Scope of Work

2.1 Project Background

AECOM Singapore Pte Ltd was appointed by the Housing Development Board (HDB) of Singapore, through the Authorisation Order dated 27 December 2022, to carry out Environmental Impact Assessment (EIA) at Sembawang Neighbourhood 4 (Part) (hereafter collectively referred to as 'Project site' and 'Biodiversity Study Area'). The Biodiversity Study Area which is divided into two sections by Canberra Road, as well as the Project site, is safeguarded for residential development and accompanying infrastructure (e.g. roads, sewers, drains etc.) based on URA's Master Plan 2019. In addition to this, an LTA proposed road network will be developed to increase connectivity within the area and other parts of Singapore.

The Biodiversity Study Area in Sembawang Neighbourhood 4 was formerly a rubber plantation in 1953 and dominantly grassland in 1993, is now mostly forested with the forest aging approximately 30 years old. The Biodiversity Study Area is approximated to be 28 hectares (ha) and the Project site is approximated to be 53 hectares (ha). The indicative proposed boundary of the Project site and Biodiversity Study Area is shown below in Figure 1.

As the existing terrain of the Biodiversity Study Area is mostly forested and undulating, the project would require site clearance (removal of existing trees) and earthworks cutting/filling to achieve the platform levels required for the development as well as the construction of roads, drains, sewers, etc., to serve the development. For earthworks filling, good earth material will be used.

Location map of site areas is shown in **Figure 1**.

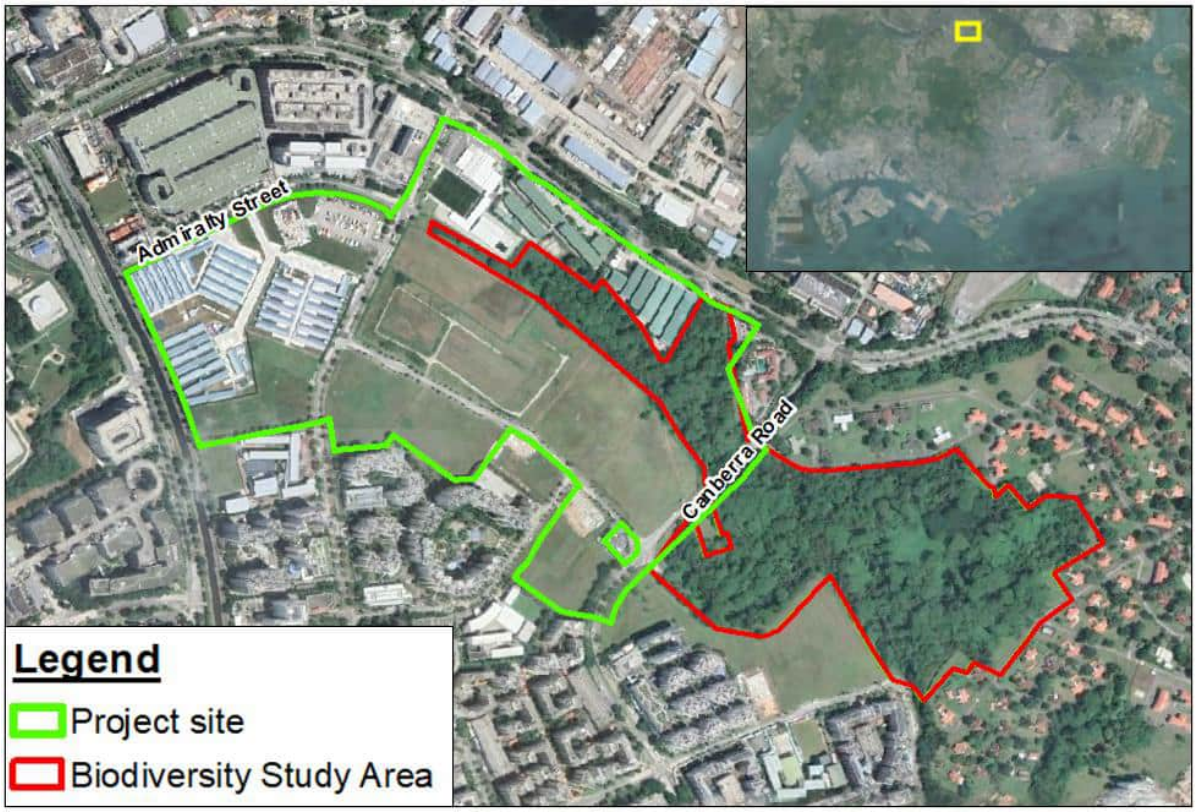


Figure 1 Project Location

2.2 Scope of Work

To assess the nature and existing baseline of Project site and Biodiversity Study Area, HDB would like to conduct an Environmental Impact Assessment (EIA) at the Project site and Biodiversity Study Area. The scope of the field work for the project is composed of the following items:

2.2.1 Biodiversity Study

This study will include biodiversity baseline studies which will consist of habitat mapping, list of important flora and fauna species present, with a focus on those that are threatened and/or are of high conservation value, have significant ecological functions, such as keystone species, and/or are of public interest. The EIS will assess the impacts on flora and fauna communities and/or ecological processes due to risk of pollution to aquatic habitats and noise pollution from the construction and operational phase of the project. Area of high conservation value and buffer zones will be identified. Baseline results will inform assessment of impacts, as well as to propose appropriate mitigation measures (if warranted) and recommendations for monitoring programme.

2.2.2 Hydrology and Water Quality

This study will identify and map out the existing watercourses and investigate the flow conditions (indicative water depth, flow velocity and width during wet and dry weathers) of those watercourses. The dimensions, pattern and profile of each watercourse channel will be identified and documented based on multiple samplings under wet and dry weather conditions. Hydrological analysis will be conducted to identify surface water sources and sub-catchment areas that contribute to the major watercourses in the site. Impacts that are related to the stream watercourses alignment, potential runoff and water pollution will be identified for the construction and operational phase. In addition, baseline surface water quality will be carried out to establish the baseline conditions in the identified watercourses. Potential impacts that are related to possible construction activities will be identified, and contaminant concentrations will be compared to relevant water quality criteria.

2.2.3 Groundwater Level

A groundwater investigation will be carried out to assess the groundwater levels in the vicinity of the natural watercourses. The groundwater level will be compared to water levels in the nearby waterbody to assess the degree of dependency of watercourse flow from the groundwater. The baseline data will be used for further groundwater impact assessment, together with the use of relevant information generated from hydrological analysis.

2.2.4 Airborne Noise

The baseline noise monitoring will be carried out to establish the baseline noise levels. This study will assess the potential impact from noise generated qualitatively or quantitatively during construction phase, and qualitatively during the operational phase, to the neighbouring sensitive receptors.

2.2.5 Topography Survey

Topographic survey will be conducted to gather data about the elevation of points within the study area and present them as contour lines on a plot. The purpose of a topographic survey is to collect survey data about the natural and man-made features of the land, as well as its elevations. A survey map of terrain and levels within the Project site and Biodiversity Study Area will be provided.

3.0 Hazard Assessment

3.1 Remote Site Work

Lone work is not permitted in remote areas, minimum two person teams are required. Prior to conducting activities in remote areas, the Project Manager, in consultation with the field staff, must develop a functional communication system consisting of devices and protocols.

For the communication devices, consideration may be given to the type of equipment required and the suitability of the equipment for the proposed works location. Where necessary, external expert advice on communication devices must be sourced. Communication equipment that may be considered for remote work includes wide-ranging network coverage mobile phones, satellite/GPS communication devices, or personal locator beacons.

The Project Manager must ensure a Communication Plan is developed for the remote works. The plan should outline the time and frequency of check-in, contact numbers for field staff and nominated check-in persons, contact numbers for alternative contacts, and escalation procedures for failed or missed check-ins.

The Project Manager must ensure appropriate resourcing, accommodation; equipment and transport are sourced prior to commencement of the works.

Field Staff are required to have an adequately stocked first aid kit with them for the duration of the works.

3.2 Physical Hazards

AECOM recognizes that performing certain tasks related to executing the scope of work for the site would expose workers to a variety of physical hazards. As such, AECOM employees have been trained and mentored to carry out assessment activities following AECOM standard operating procedures (SOPs) making SH&E a priority in their operations.

3.2.1 Falling Objects

Suspended loads or falling objects may be present at the site in the form of tree branches, old logs, collapsing remnants of old structures and other aboveground objects (e.g., suspended loads in a construction site within the site). The field staff must initially assess the site for presence of falling object(s), and the work must be conducted away from locations that may be directly impacted by such. Pathways should be planned and selected such that they are away from potential falling loads and/or suspended objects. For works within construction sites, the field staff must comply to the construction developer's health and safety procedures and as a minimum should wear a hardhat and safety shoes.

3.2.2 Slip, Trip and Fall Hazards

On any work area, it is expected that the ground may be uneven. The ground surface may be unreliable due to settling. The site should be initially assessed for potential slip, trip and fall hazards. Identify excavations, open pits, holes, and trenches then place appropriate markers at locations with these hazards. Establish and follow an unobstructed walking path identified when working due to the irregular terrain.

3.2.3 Pinch Points

The use of hand tools, mechanical equipment can create pinch points within the working area. Pinch points can be recognized when moving objects are present in the work space in close proximity to employees, and it is reasonable to assume that a part of the employee's body can be caught between the moving objects. Pinch points will be considered when performing a JSRA for the task being performed and recommendations will be made to reduce the potential for body parts to become caught in moving parts, including but not limited to:

- When tools are used as an extension of the body consideration will be given to how the tool may become a hazard if it is caught within moving parts; and
- The use of PPE, e.g. gloves, boots, etc., to protect exposed body parts.

3.2.4 Manual Lifting

Most materials associated with construction-related activities are moved by hand. The human body is subject to severe damage in the forms of back injury, muscle strains, and hernia if caution is not observed in the handling process. Whenever possible, use at least two people to lift, or roll/lift with your arms as close to the body as possible. Under no circumstances should any one person lift more than 12 kgs unassisted. Using the proper techniques to lift and move heavy pieces of equipment is important to reduce the potential for back injury. Use mechanical devices to move objects that are too heavy to be moved manually. If mechanical devices are not available, ask another person to assist you. Bend at the knees and not the waist when lifting loads. Let your legs do the lifting and do not twist your body while lifting. Be sure the path you are taking while carrying a heavy object is free of obstructions and slip, trip and fall hazards.

3.2.5 Cuts and Lacerations

Field personnel should always look for sharp surfaces such as glass when handling sampling bottles, soil samples or debris. Always wear cut/puncture resistant gloves when hand-clearing cannot be avoided. Never attempt to remove objects caught in an auger stem with the hand and make sure the equipment is turned off.

3.3 Weather Hazards

3.3.1 Heat Stress

Heat stress related problems include **heat rash, fainting, heat cramps, heat exhaustion and heat stroke.** Increased body temperature and physical discomfort also promote irritability and a decreased attention to the performance of hazardous tasks. The surveyors should establish work-rest cycles (short and frequent are more beneficial than long and seldom) and rest in a shaded, cool area.

Most workers exposed to hot environments drink less fluid than needed because of an insufficient thirst. DO NOT DEPEND ON THIRST TO SIGNAL WHEN AND HOW MUCH TO DRINK. **During field work, drink at least 4 - 6 litres (120 - 200 ounces) of fluids for an 8-hour workday.** Sufficient potable water and approved beverages should be made available each day for the field team. The field surveyors should also identify the most effective technique for heat stress monitoring.

3.3.2 Sun Exposure

Field personnel are encouraged to liberally apply sunscreen, with a minimum sun protection factor (SPF) of 30, when working outdoors to avoid sunburn and potential skin cancer, which is associated with excessive sun exposure to unprotected skin. Additionally, employees should consider wearing safety glasses that offer protection from UVA/UVB rays.

3.3.3 Darkness

AECOM discourages field activities to be done at low light conditions, particularly at night. When working in dark areas, ensure that additional artificial lighting must be present to illuminate the work area to ensure that paths and potential site hazards are clearly visible. The field personnel should also recognize the effect of fatigue on workers not accustomed to working at night or extended periods. If night works is required, approval from the PM/DPM, and URA must be obtained prior to start of any night works. Moreover, a minimum of two personnel should be completing the work. Lone worker at night time is NOT allowed.

3.3.4 Haze

Haze can occur for some period of time in Singapore every year and the atmosphere could filled with dust, some or other dry particulates such fine suspended particles that obscure the clarity of sky. N95 mask should be wore if the haze will affect the work performance during field survey. If N95 masks are used, note that it will increase effort of breathing. It may cause discomfort in breathing, tiredness or headache. Instituting regular breaks should be considered and drink more water to ensure enough hydration during field survey.

3.3.5 Inclement Weather and Other Natural Disasters

Severe weather can occur with little warning. Employees will be vigilant for the potential of storms, lightning, high winds, and flash flood events. The field personnel will be attentive to daily weather forecasts for the project area each morning. Predicted weather conditions of potential field impact should be considered when performing the work. No field surveys will be conducted during inclement weather, thunder or lightning in the vicinity of the study area.

Be alert to the signs of changing weather, such as darkening skies, a sudden wind shift or drop in temperature. If you are expected to be onsite, plan your evacuation and safety measures in advance. During thunderstorms, when you first see lightning or hear thunder, activate your emergency plan and go inside to the closest building or vehicle. In the event that the national weather service predicts that one of the areas where AECOM is working is in the direct path of a typhoon or cyclone, the PM will immediately contact the field personnel to determine what, if any, precautions are necessary, including the need for evacuation.

This same protocol will be followed in the event that other natural disasters (e.g., floods, landslides, earthquakes, etc.) could impact field personnel. DO NOT IGNORE INSTRUCTIONS TO GET TO SAFETY.

3.4 Biological Hazards

As the site is located in a secondary forest, biological hazards are expected to be present. The AECOM project team shall ensure that the potential for exposure to specific biological hazards are assessed prior to the commencement of work and that the procedures specified by this HASP are integrated into the project planning process and conveyed to AECOM employees conducting the field work. This information shall be communicated in the site kick-off meetings. Possible biological hazards that may be encountered at the site include mosquitoes, wild boars, spiders, bees, and snakes. Where detected, assessment of trees will only be carried out at a distance.

The hazard assessments must also consider the additional hazards posed by vegetative clearing such as the increased risk of coming in contact with plants that may cause irritation, cuts and punctures. Hazards associated with the use of tools and equipment to remove vegetation.

3.4.1 Spiders

Spiders can be found in derelict buildings, sheltered areas, basements, storage areas, well heads, and even on open ground. Spiders can be found year round in sheltered areas and are often present in well heads and valve boxes. Most spider bites produce wounds with localized inflammation and swelling. All spiders are poisonous, but fear of all spiders is unwarranted because most are either too small or possess poison that is too weak to harm humans. Only a few have bites that are dangerous to humans. However, the bite of these few species can cause serious medical problems and possible death under certain circumstances.

3.4.2 Mosquitoes

When a mosquito bites, it injects an enzyme that breaks down blood capillaries and acts as an anticoagulant. The enzymes induce an immune response in the host that results in itching and local inflammation. The tendency to scratch the bite sites can lead to secondary infections. CDC data indicates that mosquito-borne illnesses, including the strains of dengue, Zika, malaria and encephalitis, are a health risk to employees working

in outdoor environments. Mosquitoes breed in stagnant water and typically only travel a quarter mile from their breeding site. Whenever possible, stagnant water should be drained to eliminate breeding areas. Project managers and client should be contacted to determine whether water can be drained and the most appropriate method for draining containers, containment areas, and other objects of standing water. Application of mosquito-repellent lotion is advised especially when working outdoors. Employees also need to consider whether they are sensitive to the use of insect repellents. Priority should be given to elimination of breeding areas.

3.4.3 Bees and Hornets

Bees, hornets and wasps may be found in derelict buildings, sheltered areas, and even on open ground. Avoid reaching into areas where visibility is limited. If stung by a wasp or bee or hornet, notify a co-worker or someone who can help should you have an allergic reaction. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or sting or any swelling or numbness beyond the site of the bite or sting.

Employees with known allergies to insect stings should consult their personal physician for advice on any immediate medications that they should carry with them. AECOM recommends that employees with known allergies inform their co-workers of the allergy and the location of the medications they might carry for the allergy.

3.4.4 Snakes

Most snake bites happen when the snake is trodden on, either in the dark or in undergrowth. If you find a snake while at work, contact local authorities which will arrange for a suitably qualified snake handler to catch and relocate the snake. DO NOT attempt to catch the snake yourself as this may result in serious injury. Simply track the snake's movements and await the arrival of the snake handler. Attention to the following recommendations might reduce the number of accidents.

- Know your local snakes, the sort of places where they like to live and hide, at what times of year, day/night or in what kinds of weather they are most likely to be active.
- Be especially vigilant about snake bites after rains, during flooding, at harvest time and at night.
- Wear proper shoes or boots and long trousers, especially when walking in the dark or in undergrowth.
- Avoid working in areas where snakes are suspected present or there is a history of their presence. Wear snake chaps if it is necessary to work in or near these areas.
- Avoid snakes as far as possible. Never handle, threaten or attack a snake and never intentionally trap or corner a snake in an enclosed space.
- Avoid or take great care handling dead snakes, or snakes that appear to be dead.
- Avoid having rubble, rubbish, termite mounds or domestic animals close to human dwellings, as all of these attract snakes.
- If you suspect that snake is present in close proximity to your work location, back off and request for help.
- Avoid work alone in remote sites – the buddy can serve as additional eyes for hazard identification and aide in times of emergency
- Prepare an emergency vehicle on standby for working in remote sites especially difficult in transportation (e.g. rent a car)

The hazard assessments must also consider the additional hazards posed by vegetative clearing such as the increased risk of coming in contact with plants that may cause irritation, cuts and punctures. Hazards associated with the use of tools and equipment to remove vegetation.

3.4.5 Wild Boars

There is potential dangerous of wild boar attack in forested areas, especially at the border of Bukit Timah Nature Reserve which is approximately 500m away from the former Turf Club at Bukit Timah. There are a few recommendations when encountered wild boar:

- Be calm and move slowly away from the wild boar.

- Do not approach or attempt to attack the wild boar.
- Keep a safe distance and do not corner or provoke the wild boar.
- If see adults with young piglets, leave them alone to avoid increase the alertness of the adult and they may attempt to defend their youngs.
- Wear proper shoes or boots and long trousers, especially when walking in the dark or in undergrowth.
- Avoid working in areas where wild boars are suspected present or there is a history of their presence.
- Avoid or take great care handling dead wild boar, or wild boar that appear to be dead.
- If you suspect that wild boar is present in close proximity to your work location, back off and request for help.

3.4.6 Stray Dogs and Other Wild Animals

Stray dogs and other wild animals may be present in the study area. Dogs have the tendency to attack once it demonstrates aggressive behaviour such as growling, crouching and barking. If an aggressive dog approaches. Stand still with arms relaxed at the sides. Do not wave the arms or hands around as this can be seen as aggressive by the dog. Do not stare in the dog's eyes or meet it at eye level.
If employees get bitten or injured such as scratches or scrapes from the dog, proceed to the nearest medical centre (see Emergency Response section). The wounds should be treated and the necessary vaccines must be availed.
Whilst unlikely, crocodiles may venture into the streams and water bodies within the site. Once crocodile is sighted, never enter or approach the water. Check if there are warning signs that indicate potential presence of crocodiles. Do not carry out work late in the afternoon when it is already dark.

4.0 Personal Protective Equipment

4.1 Basic PPE

PPE will be worn during field work activities to meet the facility's basic PPE requirements and to prevent on-site personnel from being injured by the safety hazards posed by the site and/or the activities being performed. The following tables describe the basic PPE requirements for general site activities and for certain specific tasks/areas.

Basic PPE Item	Requirements for Donning Item
Long sleeved work jacket or shirt; 100% cotton	Required at all times. No torn or sleeveless shirts allowed
Long pants; denim or cotton	Required at all times. No short pants allowed.
Closed shoes/knee-high rubber boots/gaiters	Required at all times.
Hard Hat (ANSI Z89.1, Type 1, Class E)	Required when working in areas or activities with overhead hazards (i.e. operation of rig)
Traffic vests (ANSI 107, Class II)	Required when working in areas with moving vehicles.
Work Gloves	Type required dependent on work performed. Brightly colored gloves are recommended.

4.2 Other Safety Equipment

The following additional safety items should be available at the site:

- Portable, hand-held eyewash bottles
- Fully-stocked First Aid Kit
- Hard barricades or traffic cones to designate work area;

- Multipurpose Dry Chemical (Type A-B-C) Fire (when hot works are implemented). The fire extinguisher should be accessible and placed close to the area were the Hot Work activities are occurring.
- Trekking pole/stick
- Face shield/mask

5.0 Personal & Travel Related Safety & Security

5.1 General Information

This project involves travel to an area of Singapore that may or may not pose security threats to the AECOM field team members that will perform the project work. All field personnel will use the buddy system when working within any controlled work area. Under no circumstances will any employee be present alone in a controlled area. To ensure the personal safety of AECOM staff, the following general precautions need to be considered and implemented:

- Obtain travel, health and security advisories applicable prior to mobilization. This includes notice to proceed from NParks, URA, SLA, ISD, MINDEF and SPF.
- Schedule onsite works during daylight hours or until nearby establishments are still open.
- Keep a mobile phone with you onsite. Maintain regular contact with someone in the office.
- To avoid being a target, dress conservatively. Do not wear expensive looking jewellery.
- Always try to travel light. You can move more quickly and with ease and will be more likely to have a free hand.
- If you wear glasses, pack an extra pair and pack medicines you need in your carry-on luggage.
- Notify a representative of the site/facility and your supervisor immediately if you become concerned at any time about your personal safety and security while conducting this work.

5.2 Communications

Throughout field surveys, a minimum of two personnel will work together at all times and carry hand phones to keep in contact with non-field personnel. Local telephone facilities or services may be limited at the site. Field teams must have a portable mobile phone to contact other AECOM Project Managers, and if necessary, local emergency responders.

6.0 Site Control

6.1 Housekeeping

During site activities, work areas will be continuously policed for identification of excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials.

6.2 Smoking, Eating, or Drinking

Smoking, eating and drinking will not be permitted inside any controlled work area at any time. Field workers will first wash hands and face immediately after leaving controlled work areas (and always prior to eating or drinking). Consumption of alcoholic beverages is prohibited at any AECOM site.

6.3 Personal Hygiene

The following personal hygiene requirements will be observed:

- Water Supply: A water supply meeting the following requirements will be utilized:
  - ❖ Potable Water - An adequate supply of potable water will be available for field personnel consumption. Potable water can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Where drinking fountains are not available, individual-use cups will be provided as well as

adequate disposal containers. Potable water containers will be properly identified in order to distinguish them from non-potable water sources.

- ❖ Non-Potable Water - Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers of non-potable water will be marked with a label stating:

Non-Potable Water
Not Intended for Drinking Water Consumption

- Toilet Facilities: The FS shall identify the nearest toilet facilities.

7.0 Health and Safety Requirements

7.1 Training Requirements

7.1.1 Site Safety Officer Accreditation

All AECOM personnel performing activities covered by this HASP must have completed the appropriate prescribed internal training requirements.

7.2 SH&E Briefings and Meetings

7.2.1 Field Kick-off Meetings

Prior to the commencement of on-site activities, a field kick-off meeting will be conducted by the FS to review the specific requirements of this HASP. Attendance of the pre-entry meeting is mandatory for all personnel covered by this HASP and must be documented on the HASP Acceptance Form provided in Attachment A. All documentation should be maintained in the project file. The pre-entry briefing must be completed for each new employee before they begin work at the site.

7.3 Medical Surveillance Program

AECOM has a medical surveillance program in place specifically designed to provide pre-placement baseline medical examinations to determine the medical suitability of, and to establish a "medical baseline" for, newly hired employees. The program provides annual examinations to detect medical conditions or changes, which may affect medical suitability for unrestricted work; and also provides interim and post exposure examinations, as necessary, based on types of projects and materials handled.

7.4 Substance Abuse

AECOM understands that the unlawful or improper presence or use of controlled substances or alcohol in the workplace presents a danger to everyone. Employees who refuse to meet the requirements of the AECOM Substance Abuse Policy shall be removed from the project and may be subjected to disciplinary action, up to and including termination.

8.0 Emergency Response

AECOM response actions will be limited to evacuation and medical/first aid as described within this section. As such, this section of the HASP has been written to comply with 29CFR 1910.38 (a). AECOM employees and their subcontractors should be prepared to evacuate the work site in the event of an emergency. When work involves working at a remote location where medical facilities may not exist, it is imperative that the field team understand how to contact transportation companies to assist with transport to the closest medical facility. This information must be determined in advance of mobilizing to a remote location with no medical facilities, reviewed with the field team and verified with the identified transport companies on the day of field mobilization to ensure services are available. AECOM will bring a portable phone to the site to ensure that communications with local emergency responders is maintained, when necessary.

8.1 Emergency Information and References

Prior to working, the field personnel will review with the PM the scope of work and any site-specific information that may be available, including emergency information specific to the site location, emergency contact information and the designated emergency evacuation area. Emergency references of MEDICAL (ambulance), FIRE and POLICE services that can be summoned to the facility during an emergency should be determined as part of the Site Specific Data Form and should be discussed during the daily safety meetings. The field personnel and/or PM must ensure completion of the **Emergency Response Information** form (Attachment B) prior to mobilization.

8.2 Accident Reporting and Investigation

8.2.1 AECOM Reporting Requirements

All work-related H&S incidents, including injuries and illnesses, first aid cases, accidents, property damage incidents, and near-miss incidents must be reported to the PM as soon as possible. The PM should then notify the HSSE Focal to discuss the incident and to determine whether the incident must be reported to LTA (see below) and whether an accident investigation should be conducted and documented. If any person is injured, his/her supervisor, the PM and HSSE Focal must be notified immediately.

If an investigation will be required, it should be conducted as soon as emergency conditions are under control. The purpose of the investigation is not to attribute blame but to determine the pertinent facts so that repeat or similar occurrences can be avoided. An AECOM Accident Investigation Form in the *AECOM Field SH&E Manual* must be completed as soon as possible and submitted to the PM.

8.3 Emergency Contacts

All emergency contacts have been documented in the original Health and Safety Plan. The emergency contacts have been redacted in this version for confidentiality.

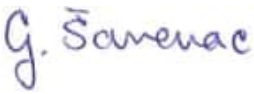
Attachment A

HASP Receipt and Acceptance Form

Health and Safety Plan Receipt and Acceptance Form

for Specialist Consultancy Services For Environmental Impact Assessment (EIA) at Sembawang N4 (Part) Project.

I have received a copy of the Health and Safety Plan (HASP) prepared for the above referenced project. I have read and understood its contents and I agree that I will abide by its requirements.

Name	Signature	Company	Date
Jaypee Perez Bautista		AECOM Singapore Pte Ltd	23 Feb 2023
Jagriti Dawra		AECOM Singapore Pte Ltd	23 Feb 2023
Grujica Sarenac		AECOM Singapore Pte Ltd	22 Feb 2023
Cho, Qi An Celine		AECOM Singapore Pte Ltd	23 Feb 2023
Dr. Liang Liang		AECOM Singapore Pte Ltd	23 Feb 2023
Phyo Naing Zay		AECOM Singapore Pte Ltd	23 Feb 2023
Hanisah Binte Sukarji		AECOM Singapore Pte Ltd	23 Feb 2023
Sim, Yi Ting		AECOM Singapore Pte Ltd	23 Feb 2023
Seow, Boon Yee		AECOM Singapore Pte Ltd	23 Feb 2023
Lew, En Qi		AECOM Singapore Pte Ltd	23 Feb 2023

Attachment B

Emergency Response Information

Local Police: Woodlands East Neighbourhood Police Centre, 3 Woodlands Drive 63, Singapore 737890

Tel: +65 6767 9999

Local Fire: Woodlands Fire Station, 1 Woodlands industrial Park D St 2 , Singapore 738782

Tel: +65 6884 1350

Closest Hospital/Clinic to Site:

Hospitals and Clinics Near Project site

Name of Hospital and Clinic	Distance from Project site (km)	Address	Contact Number/Hotline	Opening Hours	Coordinates
The Cliniq	~765m	590A,Montreal Link Singapore 751591	+65 9117 2541	Mon – Thurs: 9am - 12pm; 4pm - 6pm, 8pm-11pm Sun: 9am - 12pm	1°27'1.70"N, 103°49'36.06"E
Wen and Weng Family Clinic	~700m	505 Canberra Link, #01-03, Singapore 750505	+65 6257 1198	Mon – Fri: 8.30am - 9pm Sat-Sun: 8.30am – 9.30pm	1°26'59.59"N, 103°49'22.21"E
VitaCare Family Clinic	~1530m	Blk 361 Sembawang Cres, #01-06, Singapore 750361	+65 6366 6088	Mon-Fri: 8am – 2pm, 6pm – 9pm Sat-Sun: 9am - 2pm	1°26'43.72"N, 103°48'51.48"E
Greenlife Clinic and Surgery	~920m	11 Canberra Road, #02-01, Sembawang MRT Station, Singapore 759775	+65 6756 2676	Mon-Fri: 8am-12pm, 2pm-4pm, 6pm-9pm Sat:8am-12pm, 2pm-4pm Sun:6pm-8pm	1°26'55.29"N, 103°49'11.05"E
Canberra Care Medical Clinic	~1550m	120 Canberra Cres, #01-04, Singapore 750120	+65 6483 1128	Mon:8.30am-1pm, 2pm-4pm, 6.30pm-9pm Tues and Thurs: 8.30am-1pm, 2pm-4pm	1°26'41.53"N, 103°49'51.71"E

				Wed and Fri: 8.30am-1pm, 2pm-4pm Sat: 8.30am-1pm	
Raffles Medical Group	~880m	Sembawang Way, #01-06 Block 355A, Singapore 750355	+65 6853 7703	Mon-Fri: 8.30am – 1pm, 2pm-5.30pm Sat:8.30am-1pm	1°26'58.13"N, 103°49'8.17"E

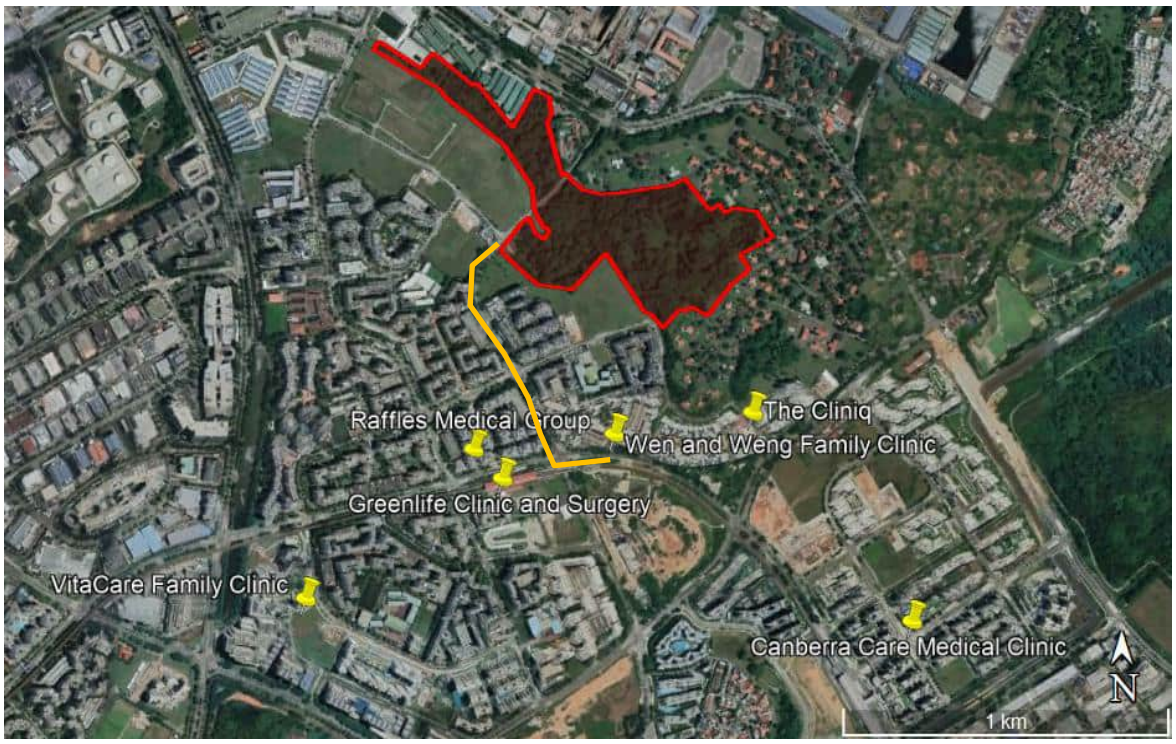
Emergency Alarms, Evacuation Route/s and Procedures:

In the case of an emergency, AECOM will contact appropriate local emergency response agencies.

In the event of an emergency, all personnel should proceed to the designated emergency muster point (unless directed to an alternate muster point by the AECOM emergency coordinator).

Depending upon the type of emergency, AECOM will determine whether the muster point is a safe distance from the emergency location. Employees will be moved further from the site of the emergency if it is determined that the muster point is not at a safe distance.

Location of Nearest Hospital/Clinic:



Appendix B
AECOM Job Safety Risk Assessment

Delivering a better world

APPENDIX B:

JOB SAFETY RISK ASSESSMENT

SPECIALIST CONSULTANCY SERVICES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AT SEMBAWANG NEIGHBOURHOOD 4 (PART)

Prepared by:

AECOM Singapore Pte Ltd

300 Beach Road, #23-00 The Concourse,

Singapore 199555

Project Number: ***60702777***

JOB SAFETY RISK ASSESSMENT

Project:	Specialist Consultancy Services for Environmental Impact Assessment (EIA) at Sembawang Neighbourhood 4 (Part)		**Location:**	Sembawang Neighborhood 4	
Work Activity:	Site walkabout/ reconnaissance, water quality sampling, biodiversity surveys, topographic survey, noise monitoring				
Personnel Protective Equipment (PPE):	Long-sleeved shirt, long trousers, raincoat/poncho (as applicable), mosquito head net, trekking pole, face shield/mask, knee-high rubber boots and insect repellent.				
Development Team:	**Name/Designation**	**Date**	**Reviewed by:**	**Name/Designation**	**Date**
	Grujica Sarenac / Consultant	22 February 2023		Jaypee Bautista / RA Champion	22 February 2023
JSRA Type:	☒ New ☐ Revised		**Next Review Date:**	21 February 2024	

No	Job Steps	Potential Hazard(s)	Existing Risk Control	Initial Risk Evaluation			Additional Risk Control	Residual Risk Evaluation			Responsible Person	Completed by:
				L	S	R		L	S	R		
1.1	Site walkabout / locating of point counts/transects • Inspecting the area / vicinity walk within the site • Conduct flora and fauna surveys	Slips, trips and fall due to uneven surface, slippery ground, soft soil, obstructions (fence/railing) or wayward objects (FB, FC)	- Use alternative routes, if available, for areas blocked by fences/railings - Assess for slippery, uneven surface or obstructions; remove wayward objects; identify safe routes and pathways; follow designated paths as shown in maps (access maps)	3	2	6	- If climbing over a low fence or railing cannot be avoided, always maintain three-point contact - Use trekking poles or stick to assess the ground and to aid balance when walking around uneven/grassy ground - Remove obstructions - Maintain a slow and steady walking pace while working onsite - Ensure anti-slip threads on safety boots are clean and not worn out	1	2	2	AECOM Personnel	22 February 2023
1.2		Falling object causing injuries to the field staff	- Inspect the site for the presence of potential falling objects such as tree branches, old logs, collapsing remnants of old structures, etc. - Identify alternative routes to avoid the potential area of impact from falling objects - Inform the team of the presence of the falling objects, if any	2	3	6	- Rope off the area, if possible, where fall hazards may exist - Use hard hats in the vicinity of the area where fall hazard may exist - Use alternative routes, if available	1	3	2	AECOM Personnel	22 February 2023

No	Job Steps	Potential Hazard(s)	Existing Risk Control	Initial Risk Evaluation			Additional Risk Control	Residual Risk Evaluation			Responsible Person	Completed by:
				L	S	R		L	S	R		
1.3		Exposure to extreme heat	- Take periodic breaks and keep hydrated – drink water or ionic drinks - Stay under the shade whenever possible	3	2	6	- Apply sunscreen as necessary - Use umbrella as necessary	1	2	3	AECOM Personnel	22 February 2023
1.4		Haze-related hazards - Difficulty in breathing (acute) and respiratory illness (chronic)	- Wear N95 mask when necessary	3	1	3	- Not required	-	-	-	AECOM Personnel	22 February 2023
1.5		Biological hazard - Mosquito bites (and other insect bites – bees, hornets, ants)	- Read AECOM Safety for Life Safety Alert regarding mosquitoes and malaria - Be on an active lookout for beehives and hornet nests	3	2	6	- Use insect repellent (spray or patch) - Wear light coloured clothing with long sleeves and long pants - Be aware of peak mosquito hours – avoid works during dusk and dawn - Wear mosquito head nets - Use a poncho/raincoat, if necessary, to cover body parts	1	2	2	AECOM Personnel	22 February 2023
1.6		Biological hazard - Snake bites (CB) / animal bites (wild animals like wild boars)	- Read AECOM Safety for Life Safety Alert regarding safety measures during snake season - Do not approach or provoke wild animals - Leave the area cautiously and slowly	2	3	6	- Avoid walking through dense vegetation / tall grass. Use known tracks or cleared routes (i.e., with no or little vegetation). - If there is a person who is familiar with the site, seek advice on safer or alternative routes. - Always carry a stick or trekking pole which you can use as protection - Use knee-high rubber boots or gaiters, especially when walking on grassy and waterlogged areas - Avoid walking alone in remote sites	1	3	3	AECOM Personnel	22 February 2023

No	Job Steps	Potential Hazard(s)	Existing Risk Control	Initial Risk Evaluation			Additional Risk Control	Residual Risk Evaluation			Responsible Person	Completed by:
				L	S	R		L	S	R		
1.7		Intermittent weather	- Stop work during heavy rain or thunderstorm	2	4	8	- Seek shelter; do not hide under trees in case of thunderstorms - Resume work only 30 minutes after a thunderstorm	1	3	3	AECOM Personnel	
2.1	Water Quality Sampling • Grab sampling of water sample using sample container • Use of water quality kit to measure water parameters	Contact with preservatives in sampling bottles (CW)	Wear appropriate PPE, such as nitrile gloves, long sleeve shirts and safety glasses	2	1	2	- Not required	-	-	-	AECOM Personnel	22 February 2023
2.2		Ergonomic hazards – repetitive movements, overreaching, bending, twisting, slouching (O)	- Observe good ergonomic practices such as minimizing twisting, bending and slouching, avoiding overreaching and awkward positions - Sit on a stool, if possible	3	2	6	- Sit on a stool, if possible - Use a trolley to carry buckets to designated waste disposal/storage location or - Avoid overfilling the buckets (at most, half-filled) if a trolley is not available or usable	1	2	2	AECOM Personnel	22 February 2023
2.3		Falling object causing injuries to the field staff	- Inspect the site for the presence of potential falling objects such as tree branches, old logs, collapsing remnants of old structures, etc. - Identify alternative routes to avoid the potential area of impact from falling objects - Inform the team of the presence of the falling objects, if any	2	3	6	- Rope off the area, if possible, where fall hazards may exist - Use hard hats in the vicinity of the area where fall hazard may exist - Use alternative routes, if available	1	3	2	AECOM Personnel	22 February 2023
2.4		Slip, trip, fall due soft grounds or slippery surface/uneven grounds while climbing the fence; Getting stuck/trapped in subsiding/very soft ground (FS, FB) Slip, trip and fall into waterbody (FB)	- Observe good housekeeping practices – clean up spills - Maintain slow and steady walking pace while walking on site - Conduct surface water sampling with a buddy as a watchman	2	3	6	- Remove obstructions if observed - Use a trekking pole for additional support - Wear rubber boots / high boots with high traction - Ensure three-point contact while climbing the fence	1	3	3	AECOM Personnel	22 February 2023

No	Job Steps	Potential Hazard(s)	Existing Risk Control	Initial Risk Evaluation			Additional Risk Control	Residual Risk Evaluation			Responsible Person	Completed by:
				L	S	R		L	S	R		
3.1	Installation / placement of noise monitoring equipment • Attach microphone to the pole and drive the pole to the ground	Ergonomic – repetitive movement and awkward posture (slouching, twisting, overreaching, kneeling, lifting) when shifting / setting up the equipment	- Keep tools and equipment within arm's reach - Use proper lifting techniques - Use pallet jack/trolley or a two-man lift when lifting heavy equipment - Use proper equipment to extend hand reach instead of overreaching	3	2	6	- Do not sustain awkward positions (e.g. shoulders too high/low, prolonged extension of elbow) - Take frequent breaks to rest muscles and hydrate - Use a stool or knee pad, if possible, to avoid awkward legs	1	2	2	AECOM Personnel	22 February 2023
3.2	• Store battery-powered measurement equipment in the protective box • Secure cable and equipment box • Noise monitoring will run for 1 week before removal • Demobilization – retrieval of equipment from the site	Hand injury (cuts, lacerations, puncture, an abrasions) due to pinch points and sharp edges	- Identify and be aware of possible pinch points and sharp edges during installation of equipment	2	2	4	- Use cut and puncture resistant working gloves	1	1	1	AECOM Personnel	22 February 2023
5.1	Elevation/Topo Survey (subcon YJP Surveyor) • Locate monitoring wells/survey points • Open the well cover and well cap and set up survey equipment • Read elevation data and coordinates/northing-easting • Moving from	Struck by moving vehicles (SB)	- Wear high visibility clothing when moving around areas near the road	2	3	6	- Assign traffic watch/spotter - Utilize cones, signs, flags and/or other traffic control, if necessary	1	3	3	AECOM Personnel & YJP Surveyor	22 February 2023
5.2		Slip, trips and falls due to slippery and uneven surface and/or due to obstructions (FS, SA)	- Identify safe routes and pathways; - Assess for slippery, uneven surface or obstructions				- Remove obstructions - Maintain a slow and steady walking pace while working onsite. Ensure anti-slip threads on safety boots are clean and not worn out	1	2	2	AECOM Personnel & YJP Surveyor	22 February 2023
5.3		Falling object causing injuries to the field staff	- Inspect the site for the presence of potential falling objects such as tree branches, old logs, collapsing remnants of old structures, etc. - Identify alternative routes to avoid the potential area of	2	3	6	- Rope off the area, if possible, where fall hazards may exist - Use hard hats in the vicinity of the area where fall hazard may exist - Use alternative routes, if	1	3	2	AECOM Personnel & YJP Surveyor	22 February 2023

No	Job Steps	Potential Hazard(s)	Existing Risk Control	Initial Risk Evaluation			Additional Risk Control	Residual Risk Evaluation			Responsible Person	Completed by:
				L	S	R		L	S	R		
	each location		impact from falling objects - Inform the team of the presence of the falling objects, if any				available					
5.4		Hand injury, pinch points (CBT)	- Be aware of possible pinch points or sharp edges when opening well covers/caps - Use mechanical means (e.g. hooks) when opening well covers/caps - Wear appropriate working gloves	2	1	2	- Not required	-	-	-	AECOM Personnel & YJP Surveyor	22 February 2023
5.5		Biological hazard - Snake bites (CB) / animal bites (wild animals, stray dogs)	- Do not approach or provoke wild animals - Leave the area cautiously	2	3	6	- Always carry a stick or trekking pole which you can use as protection - Wear knee-length rubber boots or gaiters	1	3	3	AECOM Personnel & YJP Surveyor	22 February 2023
6.1	Biodiversity survey	Refer to the General Safety Plan provided in Appendix C and developed by Camphora Pte Ltd for this project									Camphora Personnel	22 February 2023

My signature below indicates that all requirements and conditions listed above have been verified, met, and reviewed will all affected personnel prior to start of work.	
Supervisor's Signature: G. Sarenac Grujica Sarenac	Date/Time: 22 February 2023

I have read this JSRA, and I understand the hazards and safe work practices associated with the task.					
Signature:	Cho, Qi An Celine	Date/Time: 22 February 2023	Signature:	Seow, Boon Yee	Date/Time: 22 February 2023
Signature:	Dr Liang Liang	Date/Time: 22 February 2023	Signature:	Lew, En Qi	Date/Time: 22 February 2023
Signature	Phyo Naing Zay	Date/Time: 22 February 2023	Signature:	Tiffany Tan	Date/Time: 22 February 2023
Signature:	Sim, Yi Ting	Date/Time: 22 February 2023	Signature:	Hanzel Lalitan	Date/Time: 22 February 2023

RISK ASSESSMENT GUIDE

Assessment of Severity:

LEVEL	SEVERITY	DESCRIPTION
1	**Negligible**	Not likely to cause injury or ill-health.
2	**Minor**	Injury or ill-health requiring first-aid only (includes minor cuts and bruises, irritation, ill-health with temporary discomfort).
3	**Moderate**	Injury requiring medical treatment or ill-health leading to disability (includes lacerations, burns, sprains, minor fractures, dermatitis, deafness and work-related upper limb disorders).
4	**Major**	Serious injuries or life-threatening occupational disease (includes amputations, major fractures, multiple injuries, occupational cancer, acute poisoning).
5	**Catastrophic**	Fatality, fatal diseases or multiple major injuries.

Assessment of Likelihood:

LEVEL	LIKELIHOOD	DESCRIPTION
1	**Rare**	Not expected to occur but still possible
2	**Remote**	Not likely to occur under normal circumstances
3	**Occasional**	Possible or known to occur
4	**Frequent**	Common occurrence
5	**Almost Certain**	Continual or repeating experience

Risk Evaluation:

Likelihood(L) / **Severity (S)**	*Rare (1)*	*Remote (2)*	*Occasional (3)*	*Frequent (4)*	*Almost Certain (5)*
Catastrophic (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	15
Minor (2)	2	4	6	8	10
Negligible (1)	1	2	3	4	5

Acceptability of Risk and Recommended Actions:

RISK LEVEL	ACCEPTABILITY OF RISK	RECOMMENDED ACTIONS
Low Risk (1-3)	**Acceptable**	• No additional risk control measures may be needed. • However, frequent review and monitoring of hazards are required to ensure that the risk level assigned is accurate and does not increase over time.
Medium Risk (4-12)	**Moderately acceptable**	• A careful evaluation of the hazards should be carried out to ensure that the risk level is reduced to as low as reasonably practicable (ALARP) within a defined time period. • Interim risk control measures, such as administrative controls or PPE, may be implemented while longer term measures are being established. • Management attention is required.
High Risk (15-25)	**Not acceptable**	• High Risk level must be reduced to at least Medium Risk before work commences. • There should not be any interim risk control measures and risk control measures should not be overly dependent on personal protective equipment or appliances. • If practicable, the hazard should be eliminated before work commences. • Immediate management review/ intervention is required before work commences.

Code for Potential Hazards:

Caught Between (CBT)	Contacted By (CB)	Fall to Below (FB)	Overexertion (O)	Struck Against (SA)
Caught In (CI)	Contact With (CW)	Fall – Same Level (FS)	Release To (R)	Struck By (SB)

Appendix C
Camphora Safety Plan

Delivering a better world

[camphora]
natura in minima maxima

RISK ASSESSMENT FORM

Company :	Camphora Pte Ltd	**Conducted by:**	Derek Yap		Reference
Process :	Conducting surveys of flora and fauna	**Names, designations**	Lead Arborist		Cam-EIA
Location :	Forested sites	**Date :**	17th March 2023		
First Assessment Date:	17th March 2023	**Project Name :**	Sembawang N4		
Last Review Date:	17th March 2023				

1. Hazard Identification				2. Risk Evaluation				3. Risk Control	
1a.	1b.	1c.	1d.	2a.	2b.	2c.	2d.	3a.	3b.
No.	Work Activity	Hazard	Possible Accident / Ill Health & Persons-at-Risk	Existing Risk Control (if any)	S	L	Risk Level	Additional Risk Control	Action Officer, Designation (Follow-up date)
1	Mobilisation of project team	Unaware of site conditions and site-specific safety rules and regulations	Entering into prohibited areas, injury to persons	Ensure approval has been granted by clients/authority; carry approval letter if available; seek advice from clients regarding site access/conditions.	2	1	2 (L)	Study topography plans prior to entry.	Designated team leader for the project
2	Working within natural/forested areas during the day	Falling branches, dangerous fauna, thorns, plants with sap that cause irritations, unobvious obstacles, uneven ground	Stings/bites/scratches, trips/slips/falls, head injury, feet injury, getting lost	Work in a group of at least 2 people; visually assess the surroundings for hornets/bees/snakes/dead branches/roots/protruding vegetation while walking; stamp feet and make loud noises when walking through thick vegetation; wear long sleeves and pants; wear appropriate close-toed footwear; use clear paths where possible; ensure experienced field personnel are present at all times;	3	1	3 (L)	Exit forested site during inclement weather; use GPS to track location; bring spare batteries for GPS; remain contactable by mobile phone.	Designated team leader for the project
3	Night works	Dangerous fauna, getting lost	Stings/bites/scratches, trips/slips/falls, head injury, feet injury, getting lost	Work in a group of at least 3 people; visually assess the surroundings for hornets/bees/snakes/dead branches/roots/protruding vegetation while walking; stamp feet and make loud noises when walking through thick vegetation; wear long sleeves and pants; wear appropriate close-toed footwear; use clear paths where possible; ensure experienced field personnel are present at all times; bring first aid kit; avoid areas where crocodiles have been	2	1	2 (L)	Use GPS to track location; bring spare batteries for GPS; remain contactable by mobile phone; bring spare batteries for torches/headlamps	Designated team leader for the project
4	Working at water edges	Falling into water	To trips/slips/falls, drowning	Work in a group of at least 2 people; wear appropriate close-toed footwear; avoid working near the edge of deep water; wear life vest if working near the edge of deep water is necessary.	4	1	4 (L)	Conduct works during low tide.	Designated team leader for the project
5	Working within mudflats, intertidal areas or water bodies	Soft substrate, large boulders, loose fishing lines, dangerous animals	Stuck in mud, stings/bites/scratches, trips/slips/falls	Work in a group of at least 2 people; be at most 2 m from the other personnel when in the water; wear appropriate footwear such as booties; wear long sleeves and pants; ensure experienced field personnel are present at all times; train personnel to move through muddy areas and identify points to avoid and traverse; bring first aid	3	1	3 (L)	Ensure that a third individual is present on-site (and who is not in the water) and remains contactable by mobile phone; conduct works during low tide; be aware of tide times; ensure access to hot water to treat stings/bites by	Designated team leader for the project
6	Working near steep slopes	Falling from slope	Injury from trips/slips/falls	Avoid steep slopes.	2	1	2 (L)	Avoid works during inclement weather.	Designated team leader for the project
7	Working outdoors	Lightning	Lightning strike	Stop all work activity and seek shelther when there is lightning.	5	1	5 (M)	Continue work at least 30 minutes after the last lightning strike; monitor NEA app for lightning activity.	Designated team leader for the project
8	Working outdoors	Heat	Heat sickness, heat stroke	Bring plenty of water; take regular breaks	2	1	2 (L)	Wear light-coloured clothings.	Designated team leader for the project
9	Collection of plant specimens	Use of secateurs	Cuts and injuries by improper use of secateurs	Be aware of cutting points; do not deviate attention when making cuts.	2	1	2 (L)	Wear gloves.	Designated team leader for the project
10	Bat trapping and handling of live bats	Sustaining accidental bat bites	Potential spread of unknown diseases	Put on full PPE (bite-resistant leather gloves, face masks, face shield) and receive pre-exposure rabies vaccination. Work in teams with at least three trained bat handlers. Minimise bat handling time. Avoid handling bats if there are open wounds on handler.	2	3	6 (M)	Bring field first aid kit (with iodine solution for immediate disinfection in the case of an accidental bite). Prepare emergency exit route to TTSH (hospital with post-exposure rabies vaccination). Prepare oral hydration salts and small syringes to feed and calm fruit bats down if they get overly stressed during handling and disentanglement.	Designated team leader for the project

Severity	(1)	(2)	(3)	(4)	(5)
Catastrophic (5)	5 (M)	10 (M)	15 (H)	20 (H)	25 (H)
Major (4)	4 (M)	8 (M)	12 (M)	16 (H)	20 (H)
Moderate (3)	3 (L)	6 (M)	9 (M)	12 (M	15 (H)
Minor (2)	2 (L)	4 (M)	6 (M)	8 (M)	10 (M)
Negligible (1)	1 (L)	2 (L)	3 (L)	4 (M)	5 (M)

H= High Risk, M = Medium risk, L = Low Risk

Likelihood		Description
Almost Certain	5	Continual or repeating experience.
Frequent	4	4 Common occurrences.
Occasional	3	Possible or known to occur.
Remote	2	Not likely to occur under normal circumstances.
Rare	1	Not expected to occur but still possible.

Severity		Description
Catastrophic	5	Fatality, fatal diseases or multiple major injuries.
Major	4	Serious injuries or life-threatening occupational disease (includes amputations, major fractures, multiple injuries, occupational cancer, acute poisoning).
Moderate	3	Injury requiring medical treatment or ill-health leading to disability (includes lacerations, burns, sprains, minor fractures, dermatitis, deafness, work-related upper limb disorders).
Minor	2	Injury or ill-health requiring first-aid only (includes minor cuts and bruises, irritation, ill-health with temporary discomfort).
Negligible	1	Not likely to cause injury or ill-health

Risk level	Risk Acceptability	Recommended actions
High Risk	Not acceptable	• High Risk level must be reduced to at least Medium Risk before work commences. • There should not be any interim risk control measures. Risk control measures should not be overly dependent on PPE or appliances. • If practicable, the hazard should be eliminated before work commences. • Management review is required before work commences.
Medium Risk	Tolerable	• A careful evaluation of the hazards should be carried out to ensure that the risk level is reduced to as low as reasonably practicable (ALARP) within a defined time period. • Interim risk control measures, such as administrative controls or PPE, may be implemented while longer term measures are being established. • Management attention is required.
Low Risk	Acceptable	• No additional risk control measures may be needed. • Frequent review and monitoring of hazards are required to ensure that the risk level assigned is accurate and does not increase overtime.

Contact Information

Contact List

Emergency Contacts

Ambulance	995
Fire	995
Police	999

Team Contacts

SN	Role	Name	HP
	Personnel title	**Name**	**IC no.**	**Contact no.**
1	Project manager (OIC)	Isabelle Tan	Sxxx5849A	97940904
2	Project coordinator (2IC)	Badrul	Sxxx2794H	83397514
4	Lead arborist	Derek Yap	Sxxx1806C	9838 1751
5	Senior flora specialist	Boo Chih Min	Sxxx5320A	9783 4814

Appendix D
Floral Species List

Delivering a better world

Species	Family	Origin	Status	Habit	Common Name	N 4	N 5
Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	Acacia-Tree, Earleaf Acacia, Black Wattle, Wattle, Bunga Siam, Akasia Kuning, Yellow Wattle, Ear-Pod Wattle, Northern Black Wattle, Papua Wattle	Y	Y
Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	Silver Wattle, Brown Salwood, Sabah Salwood, Mangge Hutan, Tongke Hutan, Lancewood, Mangium, Mangium Wattle, Forest Mangrove, Mange, Hickory Wattle, Black Wattle, Sally Wattle, Broadleaf Salwood	Y	Y
Acmella oleracea	Asteraceae	Exotic	-	Herb	Toothache Plant	Y	N
Acrostichum aureum	Pteridaceae	Native	Common	Herb	Leather Fern, Paku Laut, Mangrove Fern, Coarse Swamp Fern, Golden Leather Fern, Piai Raya, Larat, Piai	N	Y
Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	Saga, Coral Bean Tree, Daun Tumpul, Suga, Redwood, Red Sandalwood Tree, Peacock Flower Fence, Barbados Pride, Coral Pea, Red Bead Tree, Circassian Bean, Coralwood	Y	Y
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	-	N	Y
Adiantum latifolium	Adiantaceae	Exotic	Naturalised	Herb	-	Y	Y
Agelaea borneensis	Connaraceae	Native	Common	Climber	-	N	Y
Agelaea macrophylla	Connaraceae	Native	Common	Climber	Akar Pinang Ketul, Akar Pinang Kutai	N	Y
Aglaonema commutatum	Araceae	Exotic	Casual	Herb	Painted Drop-Tongue, Chinese Evergreen, Silver Evergreen, Pewter	N	Y
Allamanda cathartica	Apocynaceae	Exotic	Naturalised	Climber	Allamanda, Golden-Trumpet, Common Allamanda, Yellow Allamanda, Akar Cempaka Hutan, Bunga Akar Kuning, Akar Chempaka Kuning, Allamada Trumpet Vine, Golden Trumpet Vine	N	Y
Alocasia macrorrhizos	Araceae	Exotic	Naturalised	Herb	Giant Taro, Greater Alocasia, Birah Negeri, Elephant's Ear	N	Y
Alocasia odora	Araceae	Exotic	-	Herb	-	N	Y
Alsophila latebrosa	Cyatheaceae	Native	Common	Tree	Tree Fern, Paku	Y	Y
Alstonia angustiloba	Apocynaceae	Native	Common	Tree	Common Pulai, Pulai	N	Y
Alstonia macrophylla	Apocynaceae	Exotic	Naturalised	Tree	-	N	Y
Alstonia scholaris	Apocynaceae	Exotic	Naturalised	Tree	Indian Pulai, White Cheesewood, Devil Tree, Blackboard Tree, Milkwood Pine, Dita Bark, Bitter Bark	N	Y
Amblovenatum opulentum	Thelypteridaceae	Native	Common	Climber	-	N	Y
Andira inermis	Fabaceae	Exotic	Casual	Tree	Brown Heart, Cabbage Tree, Bastard Mahogany, Bay Seed, Cabbage Bark, Crown Heart, Partridge Wood, Pig'S Turd, Angelin, River Almond	Y	Y
Anodendron candolleanum	Apocynaceae	Native	Data Deficient	Climber	-	Y	Y
Antigonon leptopus	Polygonaceae	Exotic	Casual	Climber	Coral Vine, Mountain-Rose Coralvine, Rosa De Montana, Bellísima, Corallita, Bunga Bonet, Bunga Berteh, Honolulu Creeper, Confederate Vine, Mexican Creeper, Coral Creeper, Chain Of Love, Hearts On A Chain, Love Vine, Queen'S Wreath	N	Y
Aphanamixis polystachya	Meliaceae	Native	Common	Tree	Pasak Lingga, Amoora, Cikih, Kasai Paya, Kulim Burung, Pithraj Tree	N	Y
Ardisia elliptica	Primulaceae	Native	Common	Tree	Seashore Ardisia	N	Y
Arthrophyllum jackianum	Araliaceae	Native	Common	Tree	Ivy Palm, Tumbuh Kelapa, Common Ivy Palm, Tumbuh Nyior	N	Y
Artocarpus heterophyllus	Moraceae	Exotic	Casual	Tree	Jackfruit, Nangka, Jack, Jak, Jake Tree	Y	Y
Artocarpus integer	Moraceae	Cryptogenic	-	Tree	Cempedak, Champedah, Chempedak, Chempedak Utan, Bangkong, Baroh	Y	N
Asplenium nidus	Aspleniaceae	Native	Common	Epiphyte	Bird's Nest Fern, Rumah Langsuyar, Paku Pandan	N	Y
Asystasia gangetica ssp. gangetica	Acanthaceae	Exotic	Naturalised	Herb	-	Y	Y

Asystasia gangetica ssp. micrantha	Acanthaceae	Exotic	Naturalised	Herb	Common Asystasia, Chinese Violet, Creeping Foxglove, Ganges Primrose	Y	Y
Axonopus compressus	Poaceae	Exotic	Naturalised	Herb	Tropical Carpet Grass, Wide-Leaved Carpet Grass, Cow Grass, Rumput Parit	Y	N
Azadirachta indica	Meliaceae	Exotic	Casual	Tree	Neem Tree, Nim Tree, Indian Lilac, Margosa Tree	Y	Y
Baccaurea motleyana	Phyllanthaceae	Native	Critically endangered	Tree	Rambai, Common Rambai, Jelintik, Buah Jentik, Asam Lambun, Tampoi	N	Y
Bambusa heterostachya	Poaceae	Exotic	Casual	Shrub	-	N	Y
Bambusa vulgaris	Poaceae	Exotic	Casual	Shrub	Common Bamboo, Golden Bamboo	N	Y
Bridelia stipularis	Phyllanthaceae	Native	Common	Shrub	Kenidai, Kernam	N	Y
Caladium bicolor	Araceae	Exotic	Cultivated	Herb	Heart Of Jesus, Angel Wings, Fancy Leaf Caladium, Elephant's Ears	N	Y
Callicarpa longifolia	Lamiaceae	Native	Vulnerable	Shrub	Long Leaved Beauty Berry, Nasi-Nasi, White-Berried Malayan Lilac, Capal, Capal Kecil, Karat Besi, Tampah Besi, Tampal Besi, Tampung Besi, Tampung Besi Putih	N	Y
Calophyllum inophyllum	Calophyllaceae	Native	Endangered	Tree	Penaga Laut, Bintangor Laut, Borneo Mahogany, Alexandrine Laurel, Alexandrian Laurel, Alexandra Laurel, Indian Laurel, Laurel Wood, Beauty Leaf, Nyamplung, Penaga, Bodek Laut, Paku Achu, Bintangur Bunga	Y	Y
Calophyllum soulattri	Calophyllacaeae	Exotic	Not assessed	Tree	Bintangor Bunut, Malang-Malang, Mintak	N	Y
Carica papaya	Caricaceae	Exotic	Casual	Tree	Papaya, Betik, Pawpaw, Betek, Melon Tree, Ketalah	N	Y
Caryota mitis	Arecaceae	Native	Common	Tree	Fishtail Palm, Common Fishtail Palm, Burmese Fishtail Palm, Clustered Fishtail Palm, Rabok, Rebuk, Meridin, Dudok, Tukas	Y	Y
Cassia fistula	Fabaceae	Exotic	Casual	Tree	Golden Shower Tree, Golden Shower, Shower Of Gold, Indian Laburnum, Purging Cassia, Rajah Kayu, Pudding Pipe Tree, Golden Rain Tree, Monkey-Pod Tree, Bereksa, Kasia Sena	N	Y
Casuarina equisetifolia	Casuarinaceae	Native	Common	Tree	Casuarina, Common Rhu, Common Ru, Horsetail Tree, Beach She-Oak, Whistling Pine, Aru, Southsea Ironwood, Mile Tree, Australian Pine, Cemara Laut, Horsetail Casuarina, She-Oak, Ru	N	Y
Causonis trifolia	Vitaceae	Native	Data Deficient	Climber	Three-Leaved Wild Vine	Y	Y
Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	Ambay Pumpwood	Y	Y
Ceiba pentandra	Malvaceae	Exotic	Casual	Tree	Kapok Tree, Silk Cotton Tree, White Silk Cotton Tree, Kabu-Kabu, Kapok, Kapuk, Kekabu, P.W.D. Tree	Y	N
Cenchrus purpureus	Poaceae	Exotic	Naturalised	Herb	Napier Grass, Elephant Grass, Uganda Grass	N	Y
Centrosema molle	Fabaceae	Exotic	Naturalised	Climber	Soft Butterfly Pea	Y	Y
Christella dentata	Thelypteridaceae	Native	Common	Herb	Binung	Y	Y
Chromolaena odorata	Asteraceae	Exotic	Naturalised	Herb	Christmas Bush, Bitter Bush, Siam Weed	N	Y
Cinnamomum iners	Lauraceae	Native	Common	Tree	Wild Cinnamon, Clove Cinnamon, Kayu Manis, Kayu Manis Hutan, Medang Teja, Teja Lawang	Y	Y
Cissus hastata	Vitaceae	Native	Common	Climber	-	Y	Y
Cissus repens	Vitaceae	Native	Vulnerable	Climber	Malayan Wild Vine, Carik Merah, Lakum, Pokok Riang Hutan	N	Y
Claoxylon indicum	Euphorbiaceae	Native	Common	Tree	Laping Budak, Jarak Kayu, Lampin Budak	Y	Y
Clausena excavata	Rutaceae	Native	Common	Shrub	Pink Lime-Berry, Cama, Cemama, Cemamar, Cerek, Cerek Hitam, Kemantu Hitam, Secerek, Semeru, Suntang Hitam	Y	Y
Clerodendrum chinense	Lamiaceae	Exotic	Naturalised	Shrub	Glory Bower, Cashmere Bouquet, Chinese Glory Flower	N	Y
Clerodendrum disparifolium	Lamiaceae	Native	Common	Tree	Swaddling Flower, Celeguri, Guriam, Kecolam, Keculun, Lampin Badak, Lampin Budak, Lelampang Badak, Pencolam, Puding, Seleguri, Seleguri Betina, Selulang Bukit, Sempayan Pitu, Tudung Roman, Uluh Ulai, Unting-Unting	N	Y

Clerodendrum villosum	Lamiaceae	Native	Common	Shrub	-	Y	Y
Cnestis palala	Connaraceae	Native	Vulnerable	Climber	-	N	Y
Coccinia grandis	Cucurbitaceae	Exotic	Naturalised	Herb	Ivy Gourd, Scarlet-Fruited Gourd	N	Y
Cocos nucifera	Arecaceae	Exotic	Naturalised	Tree	Coconut, Coconut Palm, Kelapa, Niyor	Y	Y
Colocasia esculenta	Araceae	Exotic	Casual	Herb	Cocoyam, Taro, Dasheen, Ubi Keladi, Eddoe, Elephant'S Ear, Keladi, Yam	N	Y
Commelina diffusa	Commelinaceae	Cryptogenic	-	Herb	Spreading Dayflower, Climbing Dayflower, Scurvy Weed	Y	Y
Cordyline fruticosa	Asparagaceae	Exotic	Casual	Herb	Red Dracaena, Cabbage Tree	N	Y
Costus lucanusianus	Costaceae	Exotic	Naturalised	Herb	African Spiral Flag	N	Y
Cuphea calophylla	Lythraceae	Exotic	-	Herb	-	Y	N
Cyclosorus interruptus	Thelypteridaceae	Native	Common	Herb	Swamp Shield-Fern	Y	Y
Cyperus aromaticus	Cyperaceae	Exotic	Naturalised	Herb	Navua Sedge	Y	N
Cyperus compressus	Cyperaceae	Native	Vulnerable	Herb	Annual Sedge, Hedgehog Sedge	Y	N
Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	Tembusu, Tembusu Hutan, Tembusu Tembaga, Common Tembusu, Temusu, Temensu, Temesu, Semesu, Anan, Tembusu-Padang, Ironwood	Y	Y
Davallia denticulata	Davalliaceae	Native	Common	Epiphyte	Rabbit's Foot Fern, Paku Tertutup	Y	Y
Decalobanthus peltatus	Convolvulaceae	Exotic	Naturalised	Climber	-	Y	N
Dicranopteris linearis	Gleicheniaceae	Native	Common	Climber	Resam, Bengkawang	Y	Y
Dieffenbachia seguine var. seguine	Araceae	Exotic	Casual	Herb	Dumb Cane	Y	Y
Dillenia suffruticosa	Dilleniaceae	Native	Common	Shrub	Simpuh Air, Simpoh Air, Shrubby Simpoh, Simpoh Ayer, White Simpoh, Yellow Simpoh	Y	Y
Dioscorea alata	Dioscoreaceae	Exotic	-	Climber	Water Yam, White Yam, Winged Yam, Greater Yam	N	Y
Dioscorea sansibarensis	Dioscoreaceae	Exotic	Naturalised	Climber	Zanzibar Yam	N	Y
Dipterocarpus alatus	Dipterocarpaceae	Exotic	Cultivated	Tree	Hairy-Leafed Apitong, Keruing, Yang, Gurjin	N	Y
Dracaena angustifolia	Asparagaceae	Exotic	Naturalised	Herb	-	N	Y
Dracaena fragrans	Asparagaceae	Exotic	Casual	Herb	Corn Palm, Palmillo, Fortune Plant, Corn Plant, Senjuang Wangi, Dragon Plant, Iron Plant	Y	N
Dracaena reflexa	Asparagaceae	Exotic	-	Herb	-	N	Y
Dracaena surculosa	Asparagaceae	Exotic	Naturalised	Herb	Gold Dust Dracaena, Spotted Dracaena, Japanese Bamboo	N	Y
Drynaria quercifolia	Polypodiaceae	Native	Common	Epiphyte	Oak Leaf Fern, Daun Kepala Tupai, Sakat Laipang	N	Y
Durio zibethinus	Malvaceae	Exotic	Casual	Tree	Durian, Durian Kampong	N	Y
Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	African Oil Palm	Y	Y
Emblica urinaria	Phyllanthaceae	Exotic	Naturalised	Herb	Shatterstone, Leafflower, Chamber Bitter	Y	N

Emilia sonchifolia	Asteraceae	Native	Common	Herb	Katumbi Jantan, Cupid's Shaving Brush, Emilia, Lilac Tasselflower, Red Tassel Flower, Purple Sow Thistle, Flora'S Paintbrush	Y	N
Epipremnum aureum	Araceae	Exotic	Casual	Climber	Golden Pothos, Money Plant, Devil's Ivy, Ivy Arum	Y	Y
Epipremnum pinnatum	Araceae	Exotic	Naturalised	Epiphyte	Dragon-Tail Plant, Taro Vine, Silver Vine	Y	N
Eragrostis unioloides	Poaceae	Native	Common	Herb	-	N	Y
Eurya acuminata	Pentaphylacaceae	Native	Common	Shrub	-	Y	N
Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	Albizia, Kayu Machis, Batai, Peacocksplume	Y	Y
Ficus benjamina	Moraceae	Cryptogenic	-	Strangler	Weeping Fig, Benjamin's Fig, Malayan Banyan, Java Fig, Tropical Laurel, Weeping Laurel, Waringin, Ara Waringin, Jejawi, Java Willow, Java Tree, Beringin, Benjamin Tree, Small-Leaved Fig, Small-Leaved Rubber Plant	Y	Y
Ficus fistulosa	Moraceae	Native	Common	Tree	Common Yellow Stem-Fig, Ara Serapat, Kelampung Bukit	Y	Y
Ficus grossularioides var. *grossularioides*	Moraceae	Native	Common	Tree	Ara Putih, White-Leafed Fig	Y	N
Ficus heteropleura	Moraceae	Native	Common	Climber	Sandy-Leafed Fig	Y	Y
Ficus hispida	Moraceae	Exotic	Casual	Tree	-	N	Y
Ficus microcarpa	Moraceae	Native	Common	Strangler	Malayan Banyan, Jejawi, Curtain Fig, Chinese Banyan, Glossy-Leaf Fig, Jawi Jawi, Small-Fruited Fig, Indian Laurel Fig, Laurel Fig	Y	Y
Ficus religiosa	Moraceae	Exotic	Naturalised	Tree	Sacred Fig Tree, Bodhi Tree, Pipul Tree, Budi, Pipal Tree, Pepul Tree, Bo Tree, Bodi, Ara Budi, Peepul Tree	Y	N
Ficus variegata	Moraceae	Native	Common	Tree	Common Red-Stem Fig, Variegated Fig, Variegated Rubber Plant, Ara Kelumpang, Ficus polysyce	Y	Y
Fimbristylis dichotoma	Cyperaceae	Native	Common	Herb	Forked Frimbry	N	Y
Flagellaria indica	Flagellariaceae	Native	Common	Climber	Common Flagellaria, Rotan Dini, False Rattan	Y	Y
Gloriosa superba	Colchicaceae	Exotic	Casual	Climber	Climbing Lily, Tiger'S Claws, Tiger Claw, Flame Lily, Glory Lily, Gloriosa Lily, Androcymbium Lily	N	Y
Goniophlebium percussum	Polypodiaceae	Native	Vulnerable	Epiphyte	-	N	Y
Grypothrix triphylla	Thelypteridaceae	Native	Common	Herb	-	Y	Y
Heliconia 'Golden Torch Sunshine'	Heliconiaceae	Exotic	-	Herb	-	Y	N
Heliconia psittacorum	Heliconiaceae	Exotic	Casual	Herb	Parakeet Flower	N	Y
Heliconia rostrata	Heliconiaceae	Exotic	Casual	Herb	Fishtail Heliconia, Hanging Lobster'S Claw	N	Y
Heptapleurum actinophyllum	Araliaceae	Exotic	Casual	Epiphyte	Umbrella Tree, Octopus Tree, Australian Ivy - Palm, Queensland, Ivy Palm, Brassaia	N	Y
Hibiscus tiliaceus	Malvaceae	Native	Common	Tree	Sea Hibiscus, Beach Hibiscus, Linden Hibiscus, Cotton Tree, Baru Baru, Bebaru, Mahoe	N	Y
Hippobroma longiflora	Campanulaceae	Exotic	Naturalised	Herb	Star Of Bethlehem, Madam Fate	Y	N
Hopea odorata	Dipterocarpaceae	Exotic	Cultivated	Tree	Chengal Pasir, Merawan Siput Jantan, Chengal Kampong, Cengal Pasir, Cengal Pulau, Telshur, Takhian-Yai, Ironwood	Y	N
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	-	N	Y
Horsfieldia polyspherula var. polyspherula	Myristicaceae	Native	Vulnerable	Tree	-	N	Y

Ilex cymosa	Aquifoliaceae	Native	Common	Tree	Marsh Holly, Mensirah, Mesirah, Timah-Timah	N	Y
Imperata cylindrica	Poaceae	Native	Common	Herb	Lalang, Cogon Grass, Alang-Alang, Blady Grass, Speargrass	Y	N
Ipomoea batatas	Convolvulaceae	Exotic	Casual	Climber	Sweet Potato, Keledek	N	Y
Ipomoea cairica	Convolvulaceae	Exotic	Naturalised	Climber	Messina Creeper, Mile A Minute Vine, Railway Creeper	Y	N
Ischaemum ciliare	Poaceae	Native	Common	Herb	Smutgrass	Y	N
Ischaemum muticum	Poaceae	Native	Common	Herb	Seashore Centipede Grass, Rumput Tembaga Jantan, Rumput Kemarau	N	Y
Khaya senegalensis	Meliaceae	Exotic	Cultivated	Tree	Senegal Mahogany, African Mahogany, Senegal Khaya, Bisselon	N	Y
Kyllinga polyphylla	Cyperaceae	Exotic	Naturalised	Herb	Navua Sedge	Y	N
Lantana camara	Verbenaceae	Exotic	Naturalised	Shrub	Big-Sage, Wild-Sage, Red-Sage, White-Sage, Tickberry, West Indian Lantana	Y	Y
Lepisanthes rubiginosa	Sapindaceae	Native	Common	Tree	-	N	Y
Lepistemon cf. binectarifer	Convolvulaceae	Native	Data Deficient	Climber	-	Y	N
Leucaena leucocephala	Fabaceae	Exotic	Naturalised	Tree	Lead Tree, Reuse Wattel, White Popinac, Horse Tamarind, Wild Tamarind, Leucaena, Jumbie Bean, Jumbay, Ipil-Ipil, Petai Jawa	Y	Y
Leuenbergeria bleo	Cactaceae	Exotic	Cultivated	Shrub	Wax Rose, Rose Cactus, Jarum Tujuh Bilah, Leaf Cactus, Perescia	N	Y
Licuala grandis	Arecaceae	Exotic	Cultivated	Shrub	Grosse Licuala Palm, Vanuatu Fan Palm, Ruffled Fan Palm, Palas Kipas, Palas, Palas Payung	Y	Y
Licuala orbicularis	Arecaceae	Exotic	Cultivated	Shrub	Daun Nisang, Gereneh, Parasol Palm	Y	N
Licuala spinosa	Arecaceae	Native	Common	Shrub	Palas, Mangrove Fan Palm, Spiny Licuala Palm	N	Y
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	-	N	Y
Litsea elliptica	Lauraceae	Native	Common	Tree	-	Y	Y
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	Blue Laurel, Medang	N	Y
Lygodium flexuosum	Schizaeaceae	Native	Common	Climber	Maidenhair Creeper	Y	Y
Lygodium microphyllum	Schizaeaceae	Native	Common	Climber	Ribu-Ribu, Selada, Climbing Maidenhair Fern, Snake Fern, Old World Climbing Fern, Small Leaf Climbing Fern, Lygodium scandens	Y	Y
Macaranga bancana	Euphorbiaceae	Native	Common	Tree	-	N	Y
Macaranga conifera	Euphorbiaceae	Native	Common	Tree	-	Y	Y
Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	-	Y	Y
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	Mahang Bulan, Mahang Tutup	Y	Y
Macaranga heynei	Euphorbiaceae	Native	Common	Tree	-	Y	Y
Macaranga hypoleuca	Euphorbiaceae	Native	Common	Tree	-	N	Y
Mallotus paniculatus	Euphorbiaceae	Native	Common	Shrub	-	Y	Y
Mangifera indica	Anacardiaceae	Exotic	Casual	Tree	Mango, Mangas, Mangga, Mempalam, Puah, Mempelam	Y	Y

Mangifera odorata	Anacardiaceae	Native	Critically endangered	Tree	Saipan Mango, Fragrant Mango, Kuini, Kweni, Kuweni, Kuwini, Wani	Y	N
Manihot carthagenensis ssp. glaziovii	Euphorbiaceae	Exotic	Naturalised	Tree	Tree Cassava, Ceara Rubber Tree	Y	Y
Manihot esculenta	Euphorbiaceae	Exotic	Naturalised	Herb	Manihot, Tapioca, Bitter Cassava, Manioc, Mandioca, Ubi Kayu, Gari	Y	Y
Melastoma malabathricum	Melastomataceae	Native	Common	Shrub	Common Sendudok, Singapore Rhododendron, Indian Rhododendron, Sesenduk, Malabar Gooseberry, Straits Rhododendron, Sendudok, Senduduk	Y	Y
Melicope lunu-ankenda	Rutaceae	Native	Endangered	Tree	-	N	Y
Melothria pendula	Cucurbitaceae	Exotic	Naturalised	Climber	Guadeloupe Cucumber	N	Y
Miconia crenata	Melastomataceae	Exotic	Naturalised	Herb	Koster's Curse, Hairy Clidemia	Y	Y
Miconia dependens	Melastomataceae	Exotic	Naturalised	Shrub	-	N	Y
Microlepia speluncae	Dennstaedtiaceae	Native	Vulnerable	Herb	-	N	Y
Microsorum punctatum	Polypodiaceae	Native	Common	Epiphyte	-	N	Y
Mikania micrantha	Asteraceae	Exotic	Naturalised	Climber	American Rope, Mile-A-Minute Weed, Bittervine, Chinese Creeper, Climbing Hempvine	Y	Y
Mimosa pudica	Fabaceae	Exotic	Naturalised	Shrub	Sensitive Plant, Sleepy Plant, Action Plant, Dormilones, Touch-Me-Not, Shameplant, Shy Plant	Y	Y
Momordica charantia	Cucurbitaceae	Exotic	Casual	Climber	Balsam Pear, Bitter Gourd, Bitter Cucumber, La-Kwa, Leprosy Gourd, Peria Laut, Bitter Melon	N	Y
Monochoria hastata	Pontederiaceae	Cryptogenic	-	Herb	-	Y	N
Morinda citrifolia	Rubiaceae	Native	Common	Tree	Mengkudu Besar, Inda, Menkudu, Indian Mulberry, Noni, Great Morinda, Cheese Fruit, Mengkudu, Awl Tree, Brimstone Tree	Y	Y
Morus alba	Moraceae	Exotic	Cultivated	Tree	White Mulberry	N	Y
Mucuna pruriens var. pruriens	Fabaceae	Exotic	Naturalised	Climber	-	N	Y
Muntingia calabura	Muntingiaceae	Exotic	Naturalised	Tree	Buah Cheri, Malayan Cherry, Singapore Cherry, Calabura, Cherry Tree, Japanese Cherry, Jamaican Cherry, West Indian Cherry Tree, Kerukup-Siam, Buah Ceri, Capulin, Panama Berry	Y	N
Musa cultivar	Musaceae	Exotic	Cultivated	Herb	Banana	N	Y
Nelsonia canescens	Acanthaceae	Exotic	Casual	Herb	Blue Pussyleaf	Y	N
Neolitsea cassia	Lauraceae	Native	Vulnerable	Shrub	Shore Laurel, Tejur, Tejur Pasir, Medang Pasir	Y	N
Neoscortechinia sumatrensis	Euphorbiaceae	Native	Critically endangered	Tree	-	N	Y
Nepenthes gracilis	Nepenthaceae	Native	Common	Climber	Slender Pitcher Plant, Periok Kera, Monkey Cup	N	Y
Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	Rambutan, Hairy Lychee	N	Y
Nephrolepis biserrata	Oleandraceae	Native	Common	Herb	Broad Sword Fern, Paku Larat, Giant Sword Fern, Sword Fern	Y	Y
Neustanthus phaseoloides	Fabaceae	Exotic	Naturalised	Climber	Pueraria phaseoloides	N	Y
Nothaphoebe umbelliflora	Lauraceae	Native	Common	Tree	-	N	Y
Oncosperma tigillarium	Arecaceae	Native	Vulnerable	Tree	Nibung, Nibong, Nibung Palm	N	Y

Ottochloa nodosa	Poaceae	Native	Common	Herb	-	Y	Y
Oxalis barrelieri	Oxalidaceae	Exotic	Naturalised	Herb	Lavender Sorrel	Y	Y
Oxyceros longiflorus	Rubiaceae	Native	Common	Climber	Akar Berdara Laut	Y	Y
Paederia foetida	Rubiaceae	Native	Common	Climber	Lesser Malayan Stinkwort, Akar Sekentut, Daun Kentut-Kentut	N	Y
Pandanus amaryllifolius	Pandanaceae	Exotic	Casual	Shrub	Pandan, Fragrant Pandan, Scented Pandan, Screwpine, Fragrant Screwpine, Indonesian Screwpine, Pandan Rampeh, Pandan Wangi, Daun Pandan	N	Y
Passiflora edulis	Passifloraceae	Exotic	Cultivated	Herb	Purple Passion Fruit, Purple Granadilla	N	Y
Passiflora foetida	Passifloraceae	Exotic	Naturalised	Climber	Running Pop, Love-In-A-Mist, Wild Water Lemon, Stinking Passionflower	Y	N
Passiflora laurifolia	Passifloraceae	Exotic	Naturalised	Climber	Water Lemon, Yellow Granadilla, Bell Apple, Passion Fruit, Buah Susu, Jamaica Honeysuckle, Belle Apple, Vinegar Pear, Pomme-De-Liane	N	Y
Passiflora suberosa	Passifloraceae	Exotic	Naturalised	Climber	Corky Passionflower, Corkystem Passionflower, Devil's Pumpkin, Indigo Berry	N	Y
Peltophorum pterocarpum	Fabaceae	Native	Critically endangered	Tree	Yellow Flame, Jemerlang Laut, Yellow Flamboyant, Jamerelang, Balai, Batai, Batai Laut, Yellow Poinciana, Copper Pod, Rusty Shield Bearer, Rusty-Shield Tree	N	Y
Pentaspadon motleyi	Anacardiaceae	Exotic	Cultivated	Tree	Pelong, White Pelong-Tree, Pelajau	Y	N
Peperomia pellucida	Piperaceae	Exotic	Naturalised	Herb	Shiny Bush, Pepper Elder	Y	N
Persicaria chinensis var. chinensis	Polygonaceae	Exotic	Naturalised	Herb	Chinese Knotweed, Sembuluh	N	Y
Pilea microphylla	Urticaceae	Exotic	Naturalised	Herb	Artillery Plant, Gunpowder Plant, Pistol Plant	Y	N
Piper aduncum	Piperaceae	Exotic	Naturalised	Tree	Spiked Pepper, Matico, Higuillo De Hoja Menuda	Y	Y
Piper betle	Piperaceae	Exotic	Casual	Climber	Betel, Betel Vine, Betel Pepper, Betle Pepper, Pan, Sireh	N	Y
Piper sarmentosum	Piperaceae	Native	Common	Climber	Wild Pepper, Wild Betel, Kadok, Kaduk, Daun Kaduk, Chabei, Sri Tanah, Chaa Phluu, La Lot, Akar Bugu, Sirih Duduk	Y	Y
Pipturus argenteus	Urticaceae	Cryptogenic	-	Shrub	False Stinger, Native Mulberry, White Mulberry, White Nettle	N	Y
Pittosporum ridleyi	Pittosporaceae	Native	Vulnerable	Tree	Belalang Puak, Splay-Berry Tree, Giramong	N	Y
Pityrogramma calomelanos	Adiantaceae	Exotic	Naturalised	Herb	Silver Fern, Silverback Fern, Dixie Silverback Fern	Y	N
Planchonella obovata	Sapotaceae	Native	Common	Tree	Sea Gutta, Menasi, Northern Yellow Boxwood, Yellow Teak, Black Ash, Pulau Dammar, Misi, Nyatoh Laut	Y	Y
Pleocnemia irregularis	Dryopteridaceae	Native	Common	Herb	-	N	Y
Pterocarpus indicus	Fabaceae	Exotic	Casual	Tree	Angsana, Sena, Burmese Rosewood, Philippine Mahogany, Andaman Redwood, Red Sandalwood, Padouk, Padauk, Narra, Pokok Sena	N	Y
Ptychosperma macarthurii	Arecaceae	Exotic	Naturalised	Tree	Macarthur Palm, Hurricane Palm, Macarthur Feather Palm, Cluster Palm	Y	Y
Pyrrosia longifolia	Polypodiaceae	Native	Common	Epiphyte	Suloi	N	Y
Rhopaloblaste ceramica	Arecaceae	Exotic	Cultivated	Tree	Singapore Walking-Stick Palm, Kerinting, Rintin	N	Y
Rhynchospora corymbosa	Cyperaceae	Native	Common	Herb	Scirpus Corymbosus	Y	N
Roystonea oleracea	Arecaceae	Exotic	Cultivated	Tree	Cabbage Palm, Palmiste, Feathery Cabbage Palm, Caribbean Royal Palm, Caribee Royal Palm, West Indian Royal Palm	N	Y
Ruellia blechum	Acanthaceae	Exotic	Casual	Herb	Browne's Blechum, Green Shrimp Plant	Y	N

Ruellia repens	Acanthaceae	Cryptogenic	-	Herb	Creeping Ruellia	Y	N
Russelia equisetiformis	Scrophulariaceae	Exotic	Cultivated	Herb	Firecracker Plant	Y	N
Saccharum officinarum	Poaceae	Exotic	Casual	Herb	Sugarcane, Tebu	N	Y
Samanea saman	Fabaceae	Exotic	Casual	Tree	Rain Tree, Pukul Lima, Cow Tamarind, Hujan-Hujan, East Indian Walnut, Monkey-Pod, Saman	Y	Y
Santiria laevigata	Burseraceae	Native	Vulnerable	Tree	-	N	Y
Saribus rotundifolius	Arecaceae	Exotic	Casual	Herb	Footstool Palm, Java Palm, Sadeng, Serdang, Fan Palm, Anahaw Palm	Y	N
Schefflera actinophylla	Araliaceae	Exotic	Casual	Epiphyte	Umbrella Tree, Octopus Tree, Australian Ivy - Palm, Queensland, Ivy Palm, Brassaia	N	Y
Scleria oblata	Cyperaceae	Native	Common	Herb	-	N	Y
Selaginella ciliaris	Selaginellaceae	Native	Common	Climber	-	N	Y
Senna siamea	Fabaceae	Exotic	Cultivated	Tree	Kassod Tree, Siamese Cassia, Thailand Shower, Johar, Jahor, Busuk-Busuk, Petai Belalang	N	Y
Senna spectabilis	Fabaceae	Exotic	Casual	Tree	American Cassia, Popcorn Tree, Weeping Cassia, Drooping Cassia, Popcorn Bush, Golden Wonder Tree, Spectacular Cassia, Yellow Cassia	N	Y
Sieruela rutidosperma	Cleomaceae	Exotic	Naturalised	Herb	Fringed Spiderflower, Ciliate Spider-Flower, Consumption Weed, Wild Cat's Whiskers	Y	N
Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	African Tulip Tree, Flame Of The Forest, Fountain Tree, Fire Tree, Fire Bell, Nandi Flame, Gabon Tulip Tree, Syringe Tree, Pancut-Pancut, Panchot	Y	Y
Spermacoce alata	Rubiaceae	Exotic	Naturalised	Herb	Oval-leaved False Buttonweed	N	Y
Spermacoce ocymifolia	Rubiaceae	Exotic	Naturalised	Herb	-	Y	N
Spermacoce remota	Rubiaceae	Exotic	Naturalised	Herb	Woodland False Buttonweed	N	Y
Sphaerostephanos polycarpos	Thelypteridaceae	Native	Common	Herb	-	Y	N
Sphagneticola trilobata	Asteraceae	Exotic	Naturalised	Herb	Yellow Creeping Daisy, Singapore Daisy, Creeping Ox-Eye, Trailing Daisy, Rabbit's Paw	Y	N
Stenochlaena palustris	Blechnaceae	Native	Common	Climber	Climbing Fern, Akar Paku, Paku Ranu, Paku Miding	Y	Y
Sterculia parviflora	Malvaceae	Native	Critically endangered	Tree	Common Sterculia, Kelumpang Burong, Kelumpang Gajah, Samrong	N	Y
Strobilanthes reptans	Acanthaceae	Exotic	Naturalised	Herb	Dragon's Tongue	Y	N
Synedrella nodiflora	Asteraceae	Exotic	Naturalised	Herb	Cinderella Weed, Pig's Grass	Y	N
Syngonium angustatum	Araceae	Exotic	Naturalised	Climber	Arrowhead Vine	Y	Y
Syzygium aqueum	Myrtaceae	Exotic	Cultivated	Tree	Water Apple, Jambu Air Mawar, Water Rose Apple, Watery Rose Apple, Water Cherry, Java Apple, Bell Fruit, Jambu Ayer, Jambu Chili, Jambu Air	N	Y
Syzygium borneense	Myrtaceae	Native	Common	Tree	Bullate Eugenia	N	Y
Syzygium cerasiforme	Myrtaceae	Native	Common	Tree	Common Kelat, Gelam Tikus, Ubah, Benitan Putih, Kecam, Kelat Lapis, Kelat Merah, Kelat Nasi-Nasi, Kelat Paya, Kelat Putih, Sekujah	N	Y
Syzygium grande	Myrtaceae	Native	Common	Tree	Sea Apple, Jambu Laut, Kilat Jambu, Jambu Air Laut, Jambu Ayer Laut, Jambu Jembah, Jembah, Kerian Acheh, Kerian Ayer, Keriang Batu, Ubah	Y	Y
Syzygium jambos	Myrtaceae	Exotic	Casual	Tree	Rose Apple, Malabar Plum, Jambu Air Mawar, Jambu Mawar, Jambu Kraton, Jambu Kelampok, Jambu Mawer	N	Y
Syzygium myrtifolium	Myrtaceae	Native	Critically endangered	Tree	Kelat Oil, Kelat Paya, Red Lip	Y	Y

Syzygium polyanthum	Myrtaceae	Native	Common	Tree	Indonesian Bayleaf, Salam, Samak, Indian Bayleaf, Buah Salam, Kelat Samak, Serah	Y	Y
Syzygium pycnanthum	Myrtaceae	Native	Critically endangered	Tree	Wild Rose-Apple	Y	N
Syzygium zeylanicum	Myrtaceae	Native	Common	Tree	Spicate Eugenia, Kelat Nasi Nasi, Kelat Nenasi, Gelam Tikus, Gelam Paya, Gelam Tikus Laut, Kelat Merah	N	Y
Tabebuia rosea	Bignoniaceae	Exotic	Casual	Tree	Trumpet Tree, Pink Poui, New World Trumpet, Rosy Trumpet Tree, Pink Tecoma	Y	Y
Taenitis blechnoides	Pteridaceae	Native	Common	Climber	Ribbon Fern	Y	Y
Tectaria semipinnata	Dryopteridaceae	Native	Endangered	Herb	-	Y	N
Terminalia catappa	Combretaceae	Native	Common	Tree	Sea Almond, Ketapang, Tropical Almond Tree, Pacific Almond, Singapore Almond, Indian Almond, Lingtak, Bastard Almond, Telisai, Jelawai Ketapang	Y	Y
Tetracera indica	Dilleniaceae	Native	Common	Climber	Fireweed, Tetracera, Hedge Row Tetracera, Puson Dumarun, Akar Pulas Duyio, Akar Mempelas, Empelas	N	Y
Timonius wallichianus	Rubiaceae	Native	Common	Tree	Silver Timon, Triang, Berombong, Merombong, Tabah	N	Y
Tinospora crispa	Menispermaceae	Exotic	Casual	Climber	Petawali, Makabuhai, Liane-Quinine	N	Y
Trema tomentosum	Cannabaceae	Native	Vulnerable	Shrub	Poison Peach	Y	N
Typhonium roxburghii	Araceae	Cryptogenic	-	Herb	-	N	Y
Uncaria cordata	Rubiaceae	Native	Endangered	Climber	Gambir-Gambir Hutan	N	Y
Urochloa maxima	Poaceae	Exotic	Naturalised	Herb	Guinea Grass, Green Panic Grass	N	Y
Urochloa mutica	Poaceae	Exotic	Naturalised	Herb	-	N	Y
Vandellia diffusa	Linderniaceae	Exotic	-	Herb		Y	N
Vitex pinnata	Lamiaceae	Native	Common	Tree	Leban, Malayan Teak, Vitex, Halban, Leban Buas, Leban Papa, Leban Tandok	Y	Y
Xanthosoma sagittifolium	Araceae	Exotic	Cultivated	Herb	-	N	Y
Xanthostemon chrysanthus	Myrtaceae	Exotic	Cultivated	Tree	Golden Penda, Golden Myrtle, Black Penda	Y	N
Youngia japonica	Asteraceae	Exotic	Naturalised	Herb	Oriental False Hawksbeard	Y	N

Appendix E
List and Location of Plant Species of Conservation Significance

Delivering a better world

Species	Family	Origin	Status	Habit	Common Name	CS	Remarks	N4	N5
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	-	Yes	-	N	Y
Baccaurea motleyana	Phyllanthaceae	Native	Critically endangered	Tree	Rambai, Common Rambai, Jelintik, Buah Jentik, Asam Lambun, Tampoi	No	Cultivated	N	Y
Callicarpa longifolia	Lamiaceae	Native	Vulnerable	Shrub	Long Leaved Beauty Berry, Nasi-Nasi, White-Berried Malayan Lilac, Capal, Capal Kecil, Karat Besi, Tampah Besi, Tampal Besi, Tampung Besi, Tampung Besi Putih	Yes	-	N	Y
Calophyllum inophyllum	Calophyllaceae	Native	Endangered	Tree	Penaga Laut, Bintangor Laut, Borneo Mahogany, Alexandrine Laurel, Alexandrian Laurel, Alexandra Laurel, Indian Laurel, Laurel Wood, Beauty Leaf, Nyamplung, Penaga, Bodek Laut, Paku Achu, Bintangur Bunga	Yes	-	Y	Y
Cissus repens	Vitaceae	Native	Vulnerable	Climber	Malayan Wild Vine, Carik Merah, Lakum, Pokok Riang Hutan	Yes	-	N	Y
Cnestis palala	Connaraceae	Native	Vulnerable	Climber	-	Yes	-	N	Y
Cyperus compressus	Cyperaceae	Native	Vulnerable	Herb	Annual Sedge, Hedgehog Sedge	Yes	-	Y	N
Goniophlebium percussum	Polypodiaceae	Native	Vulnerable	Epiphyte	-	Yes	-	N	Y
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	-	Yes	-	N	Y
Horsfieldia polyspherula var. polyspherula	Myristicaceae	Native	Vulnerable	Tree	-	Yes	-	N	Y
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	-	Yes	-	N	Y
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	Blue Laurel, Medang	Yes	-	N	Y
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	Mahang Bulan, Mahang Tutup	Yes	-	Y	Y
Mangifera odorata	Anacardiaceae	Native	Critically endangered	Tree	Saipan Mango, Fragrant Mango, Kuini, Kweni, Kuweni, Kuwini, Wani	No	Cultivated	Y	N
Melicope lunu-ankenda	Rutaceae	Native	Endangered	Tree	-	Yes	-	N	Y
Microlepia speluncae	Dennstaedtiaceae	Native	Vulnerable	Herb	-	Yes	-	N	Y
Neolitsea cassia	Lauraceae	Native	Vulnerable	Shrub	Shore Laurel, Tejur, Tejur Pasir, Medang Pasir	No	Cultivated	Y	N
Neoscortechinia sumatrensis	Euphorbiaceae	Native	Critically endangered	Tree	-	Yes	-	N	Y
Oncosperma tigillarium	Arecaceae	Native	Vulnerable	Tree	Nibung, Nibong, Nibung Palm	No	Cultivated	N	Y
Peltophorum pterocarpum	Fabaceae	Native	Critically endangered	Tree	Yellow Flame, Jemerlang Laut, Yellow Flamboyant, Jamerelang, Balai, Batai, Batai Laut, Yellow Poinciana, Copper Pod, Rusty Shield Bearer, Rusty-Shield Tree	No	Cultivated	N	Y
Pittosporum ridleyi	Pittosporaceae	Native	Vulnerable	Tree	Belalang Puak, Splay-Berry Tree, Giramong	Yes	-	N	Y
Santiria laevigata	Burseraceae	Native	Vulnerable	Tree	-	Yes	-	N	Y
Sterculia parviflora	Malvaceae	Native	Critically endangered	Tree	Common Sterculia, Kelumpang Burong, Kelumpang Gajah, Samrong	No	Cultivated	N	Y
Syzygium myrtifolium	Myrtaceae	Native	Critically endangered	Tree	Kelat Oil, Kelat Paya, Red Lip	No	Cultivated	Y	Y
Syzygium pycnanthum	Myrtaceae	Native	Critically endangered	Tree	Wild Rose-Apple	No	Cultivated	Y	N

Tectaria semipinnata	Dryopteridaceae	Native	Endangered	Herb	-	Yes	-	Y	N
Trema tomentosum	Cannabaceae	Native	Vulnerable	Shrub	Poison Peach	Yes	-	Y	N
Uncaria cordata	Rubiaceae	Native	Endangered	Climber	Gambir-Gambir Hutan	Yes	-	N	Y

Species	Family	Origin	Status	Habit	Latitude	Longitude	Girth/spread (m)	Height (m)
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	1.455981005	103.824887	-	-
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	1.45617798	103.825008	-	-
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	1.456217039	103.824977	-	-
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	1.45627697	103.82244	-	-
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	1.45612	103.82487	-	-
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	1.456154007	103.825197	-	-
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	1.456170017	103.825065	-	-
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	1.456015036	103.824792	-	-
Adenia cordifolia	Passifloraceae	Native	Endangered	Climber	1.456127018	103.824666	-	-
Callicarpa longifolia	Lamiaceae	Native	Vulnerable	Shrub	1.453739014	103.824658	< 0.05	1.5
Calophyllum inophyllum	Calophyllaceae	Native	Endangered	Tree	1.45511901	103.821083	0.05	2
Calophyllum inophyllum	Calophyllaceae	Native	Endangered	Tree	1.459842822	103.818414	2.3	20
Cissus repens	Vitaceae	Native	Vulnerable	Climber	1.455837004	103.823575	-	-
Cnestis palala	Connaraceae	Native	Vulnerable	Climber	1.454497	103.823841	NA	NA
Cyperus compressus	Cyperaceae	Native	Vulnerable	Herb	1.460833037	103.816702	-	-
Goniophlebium percussum	Polypodiaceae	Native	Vulnerable	Epiphyte	1.457227	103.822482	-	-
Goniophlebium percussum	Polypodiaceae	Native	Vulnerable	Epiphyte	1.456867	103.82271	-	-
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.456716014	103.82406	0.3	8
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.456694975	103.824148	0.2	8
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.456484003	103.824462	0.05	1.8
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.456354	103.824217	< 0.05	0.05
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.456349976	103.824181	0.05	1.8
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.456821961	103.824102	< 0.05	1
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.453897012	103.825352	0.2	2

Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.453897012	103.825352	0.1	4
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.453990974	103.825324	0.1	5
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.453990974	103.825324	0.2	5
Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	1.453947728	103.82533	0.3	6
Horsfieldia polyspherula var. *polyspherula*	Myristicaceae	Native	Vulnerable	Tree	1.456808969	103.824228	0.1	4
Horsfieldia polyspherula var. *polyspherula*	Myristicaceae	Native	Vulnerable	Tree	1.456589028	103.824276	0.1	5
Horsfieldia polyspherula var. *polyspherula*	Myristicaceae	Native	Vulnerable	Tree	1.453940012	103.825291	0.05	1.5
Horsfieldia polyspherula var. *polyspherula*	Myristicaceae	Native	Vulnerable	Tree	1.456807964	103.824129	0.1	4.5
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.456359029	103.824846	< 0.05	1
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.456342014	103.824045	< 0.05	0.6
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.456400016	103.824076	0.05	0.5
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.454043025	103.825207	< 0.05	0.3
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.453773966	103.824924	0.05	1.5
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.45427403	103.824457	< 0.05	0.5
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.45422399	103.82441	< 0.05	0.2
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.454174034	103.824584	< 0.05	0.3
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.454045959	103.824793	< 0.05	0.1
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.45388402	103.824458	< 0.05	0.2
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.456592468	103.824232	1.6	20
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.456628335	103.824213	0.4	12
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.454708132	103.825481	0.5	8
Lindera lucida	Lauraceae	Native	Vulnerable	Tree	1.453861	103.824395	< 0.05	0.5
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.456403034	103.82341	0.05	2.5
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.456796983	103.821492	< 0.05	0.3
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.454508975	103.825397	0.25	5

Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.454347037	103.825255	0.25	8
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.454508975	103.825397	0.05	1.3
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.456697993	103.824708	0.05	2
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.454567984	103.824473	< 0.05	0.3
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.453285972	103.824455	2	2
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.454722965	103.826031	0.2	4.5
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.454487015	103.825484	0.05	1.8
Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	1.454364974	103.825277	0.2	8
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.456764964	103.824078	0.24	5
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.454471005	103.821669	< 0.05	1
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.454797983	103.821178	< 0.05	0.8
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.453863988	103.824112	< 0.05	1
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.454303032	103.824598	< 0.05	0.1
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.455284972	103.822786	< 0.05	0.3
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.455212971	103.821756	< 0.05	0.5
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.455235016	103.822077	0.05	0.3
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.454855986	103.822211	< 0.05	0.5 to 8
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.458004983	103.820526	< 0.05	0.1
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.459363019	103.820622	0.05	2
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.454621041	103.82171	0.1	4
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.454927335	103.822197	0.3	5
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.454913227	103.822301	0.4	12
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.454842226	103.822244	0.3	8
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.45482403	103.822211	0.3	6
Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	1.455564205	103.822619	0.5	6
Melicope cf *lunu-ankenda*	Rutaceae	Native	Endangered	Tree	1.456127018	103.823359	< 0.05	0.7
Melicope lunu-ankenda	Rutaceae	Native	Endangered	Tree	1.456124	103.823357	< 0.05	1
Melicope lunu-ankenda	Rutaceae	Native	Endangered	Tree	1.45587204	103.822559	0.01	1
Microlepia speluncae	Dennstaedtiaceae	Native	Vulnerable	Herb	1.456436	103.822496	-	-
Neoscortechinia sumatrensis	Euphorbiaceae	Native	Critically endangered	Tree	1.453967001	103.825345	0.05	1.4

Pittosporum ridleyi	Pittosporaceae	Native	Vulnerable	Tree	1.455027826	103.823986	0.6	10
Santiria laevigata	Burseraceae	Native	Vulnerable	Tree	1.453940012	103.825291	0.05	1.2
Tectaria cf *semipinnata*	Dryopteridaceae	Native	Endangered	Herb	1.457367959	103.821009	-	-
Trema tomentosum	Cannabaceae	Native	Vulnerable	Shrub	1.459265035	103.820484	0.1	3
Trema tomentosum	Cannabaceae	Native	Vulnerable	Shrub	1.459520012	103.820654	0.2	4
Uncaria cordata	Rubiaceae	Native	Endangered	Climber	1.455434002	103.826504	-	-
Uncaria cordata	Rubiaceae	Native	Endangered	Climber	1.455144994	103.826355	-	-
Uncaria cordata	Rubiaceae	Native	Endangered	Climber	1.456489032	103.821782		-
Uncaria cordata	Rubiaceae	Native	Endangered	Climber	1.456462964	103.821802		-
Uncaria cordata	Rubiaceae	Native	Endangered	Climber	1.455443976	103.826468	-	-
Uncaria cordata	Rubiaceae	Native	Endangered	Climber	1.455443976	103.826468	-	-
Uncaria cordata	Rubiaceae	Native	Endangered	Climber	1.455590995	103.826286	-	-
Uncaria cordata	Rubiaceae	Native	Endangered	Climber	1.455590995	103.826286	-	-

Appendix F
List and Location of Large Plant Species

Delivering a better world

Tag ID	Species	Family	Origin	Status	Habit	Northing	Easting	Girth/Spread (m)	Height (m)
SN0014	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49053.686	26333.799	20	16
SN0014A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49055.927	26340.558	20	16
SN0014B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49048.733	26329.741	20	16
SN0024	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48997.943	26361.483	3	30
SN0052	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49016.1	26396.225	6	20
SN0052A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49010.12	26397.373	6	20
SN0052B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49012.621	26398.983	6	20
SN0063	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49028.457	26365.432	10	20
SN0063A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49027.614	26371.417	10	20
SN0063B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49026.36	26356.186	10	20
SN0064	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49031.187	26345.261	10	20
SN0064A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49036.344	26353.38	10	20
SN0064B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49039.137	26354.501	10	20
SN0071	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	49044.07	26343.197	4	25
SN0075	*Ficus benjamina*	Moraceae	Cryptogenic	-	Strangler	49065.897	26343.051	3	20
SN0096	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48844.308	26544.885	3.6	40
SN0101	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48873.372	26537.296	3.8	40
SN0138	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48881.79599	26596.6485	3	30
SN0140	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48877.36585	26587.18936	3.0	30
SN0141	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48888.75658	26576.06106	3	25
SN0152	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48846.29856	26572.72231	3.1	30
SN0159	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48909.65666	26561.37173	3.5	30
SN0162	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48942.93903	26569.16178	4	30
SN0163	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48920.93607	26583.40596	3	20
SN0169	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48872.94489	26578.28664	3	30
SN0318	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48870.827	26650.835	3.3	25
SN0328	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48905.624	26621.307	3.2	40
SN0353	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48943.495	26570.157	3.2	40
SN0359	*Ficus benjamina*	Moraceae	Cryptogenic	-	Strangler	48514.709	26622.048	3	20
SN0359A	*Ficus benjamina*	Moraceae	Cryptogenic	-	Strangler	48515.458	26621.504	3	20

SN0359B	*Ficus benjamina*	Moraceae	Cryptogenic	-	Strangler	48518.877	26622.623	3	20
SN0391	*Cecropia pachystachya*	Urticaceae	Exotic	Naturalised	Tree	48621.305	26576.401	3	10
SN0403	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48459.988	26637.771	3	20
SN0429	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48486.856	26689.247	3	18
SN0431	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48482.581	26678.096	3.5	20
SN0432	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48482.379	26670.144	3.3	20
SN0433	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48483.466	26654.148	5.5	25
SN0180	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48947.651	26478.643	3	18
SN0182	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48966.38	26481.563	3	20
SN0191	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48973.938	26442.503	3.6	20
SN0196	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	49000.633	26448.781	3.8	20
SN0209	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48991.342	26462.851	12	20
SN0213	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48924.044	26511.175	4	20
SN0213A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48925.777	26514.159	4	20
SN0213B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48923.485	26512.081	4	20
SN0228	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48811.082	26641.526	4	30
SN0243	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48713.982	26701.168	3	30
SN0438	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48502.334	26635.113	12	16
SN0439	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48508.779	26658.654	3	18
SN0461	*Terminalia catappa*	Combretaceae	Native	Common	Tree	48514.774	26693.727	3.4	18
SN0462	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48521.859	26700.91	3.6	18
SN0463	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48540.683	26711.752	4.5	25
SN0467	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48538.162	26734.432	3	16
SN0472	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48518.104	26725.953	3.6	30
SN0474	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48517.297	26708.102	4	25
SN0481	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48483.003	26753.296	3	25
SN0605	*Nephelium lappaceum*	Sapindaceae	Cryptogenic	-	Tree	48671.635	26620.658	3	10
SN0609	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48633.749	26656.43	3.3	20
SN0612	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48629.688	26663.802	3.6	12
SN0636	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48617.724	26689.546	3.2	18
SN0644	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48569.553	26745.949	3.3	20

SN0584	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48688.589	26928.808	3	40
SN0653	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48673.564	26708.976	3.2	25
SN0656	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48643.542	26739.568	3.4	12
SN0658	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48620.877	26751.988	3.6	18
SN0710	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48651.566	26906.464	8	18
SN0710A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48649.828	26903.583	8	18
SN0710B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48648.474	26903.115	8	18
SN0713	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48667.691	26946.907	3.5	14
SN0714	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48664.486	26954.117	4	14
SN0715	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48655.138	26967.482	3	50
SN0718	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48663.457	27004.794	3.5	40
SN0722	*Samanea saman*	Fabaceae	Exotic	Casual	Tree	48625.969	27029.087	3	20
SN0724	*Samanea saman*	Fabaceae	Exotic	Casual	Tree	48610.11	27033.467	3.2	30
SN0725	*Samanea saman*	Fabaceae	Exotic	Casual	Tree	48609.478	27037.547	3	30
SN0737	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48678.702	27057.384	7	40
SN0855	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48405.158	26953.187	3	20
SN0992	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48493.898	26927.076	4	14
SN0992A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48494.929	26926.541	4	14
SN1043	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48422.077	27096.47	4.2	25
SN1065	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48523.625	27114.171	3.5	25
SN1066	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48532.992	27142.782	3.4	18
SN1067	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48526.165	27139.022	3.4	20
SN1072	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48490.983	27154.369	4.2	25
SN1076	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48469.38	27137.725	3.8	25
SN1080	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48463.704	27115.513	3.8	25
SN1114	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48453.152	26995.199	3	40
SN1121	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48453.809	27014.022	3.2	30
SN1123	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48467.455	27027.607	3.2	10
SN1124	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48447.18	27028.949	3.5	40
SN1146	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48459.428	27072.695	3.2	40
SN1147	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48469.217	27071.963	3.2	35

SN1148	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48470.062	27074.936	3.3	35
SN1149	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48469.206	27080.059	3.2	20
SN1151	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48482.316	27086.597	4.5	35
SN1153	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48520.96	27078.165	5.5	50
SN1156	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48496.925	27016.816	3.2	50
SN1163	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48495.281	26975.519	3.2	50
SN0764	*Syzygium grande*	Myrtaceae	Native	Common	Tree	48721.986	26954.314	3	20
SN0783	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48707.037	26985.011	3	18
SN0796	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48703.846	27044.66	3	30
SN0797	*Cyrtophyllum fragrans*	Gentianaceae	Native	Common	Tree	48707.148	27042.699	3.2	20
SN0801	*Cinnamomum iners*	Lauraceae	Native	Common	Tree	48749.743	27074.715	5.2	8
SN0803A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48733.426	27076.303	10	20
SN0803B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48733.639	27079.366	10	20
SN0803C	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48728.74	27079.371	10	20
SN0805	*Ficus benjamina*	Moraceae	Cryptogenic	-	Strangler	48717.883	27112.166	4	16
SN0809	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48671.645	27090.614	4.5	50
SN0814	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48686.965	27081.519	3.1	40
SN0934	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48568.31333	26856.49445	4	13
SN0940	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48590.64992	26856.82841	3.2	20
SN0942	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48606.35041	26845.36625	3	20
SN0943	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48602.25357	26901.67583	3.2	20
SN0944	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48588.32336	26896.89057	3.5	20
SN0946	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48570.74143	26912.02509	3.6	15
SN0948	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48579.91684	26935.72858	3	20
SN0950	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48578.36907	26946.30054	4.2	18
SN0954	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48554.04911	26942.85063	3	19
SN0955	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48536.57832	26956.20462	3.7	22
SN0956	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48528.3943	26964.10574	3.2	20
SN0964	*Spathodea campanulata*	Bignoniaceae	Exotic	Naturalised	Tree	48557.47861	26888.878	3.2	12
SN1165	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48663.05	27202.034	3.2	25
SN1174	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48621.249	27148.047	4	20

SN1181	*Samanea saman*	Fabaceae	Exotic	Casual	Tree	48654.43	27102.604	3.5	30
SN1191	*Samanea saman*	Fabaceae	Exotic	Casual	Tree	48607.939	27086.757	3	30
SN1194	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48610.731	27124.832	3	40
SN1302	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48591.437	27077.63	4	50
SN1303	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48557.651	27028.975	4	40
SN1305	*Pterocarpus indicus*	Fabaceae	Exotic	Casual	Tree	48534.786	27017.638	3	20
SN1310	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48528.382	26996.949	3	50
SN1210	*Cyrtophyllum fragrans*	Gentianaceae	Native	Common	Tree	48607.33996	27287.14067	3.2	16
SN1211	*Cyrtophyllum fragrans*	Gentianaceae	Native	Common	Tree	48609.25998	27286.89585	3	18
SN1230	*Cyrtophyllum fragrans*	Gentianaceae	Native	Common	Tree	48508.43996	27235.80516	3	16
SN1234	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48492.76005	27213.74865	4.5	25
SN1237	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48492.77996	27211.34492	9	18
SN1237A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48495.03004	27212.99193	9	18
SN1237B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48498.82995	27213.16999	9	18
SN1238	*Adenanthera pavonina*	Fabaceae	Exotic	Naturalised	Tree	48475.12004	27242.80481	3	15
SN1239	*Adenanthera pavonina*	Fabaceae	Exotic	Naturalised	Tree	48485.47	27232.90058	3.4	11
SN1240	*Adenanthera pavonina*	Fabaceae	Exotic	Naturalised	Tree	48559.76999	27265.38455	3	11
SN1243	*Ficus benjamina*	Moraceae	Cryptogenic	-	Strangler	48567.5332	27281.04221	6	15
SN1245	*Adenanthera pavonina*	Fabaceae	Exotic	Naturalised	Tree	48594.24997	27291.4807	4	12
SN1246	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48616.27995	27323.96451	10	13
SN1246A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48604.72998	27312.62466	10	13
SN1246B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48616.38002	27324.07579	10	13
SN1249	*Adenanthera pavonina*	Fabaceae	Exotic	Naturalised	Tree	48671.21002	27302.27545	4.6	13
SN1315	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48455.214	27204.021	10	20
SN1315A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48456.389	27208.287	10	20
SN1315B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48461.41	27201.818	10	20
SN1322	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48451.844	27180.32	3	50
SN1324	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48442.257	27174.753	12	20
SN1324A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48440.808	27174.581	12	20
SN1324B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48437.701	27175.158	12	20
SN1327	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48425.803	27175.778	10	16

SN1327A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48425.34	27171.523	10	16
SN1327B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48433.925	27174.238	10	16
SN1352	*Peltophorum pterocarpum*	Fabaceae	Native	Critically endangered	Tree	48415.355	27184.857	3.2	20
SN1355	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48491.113	27185.347	20	25
SN1355A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48487.083	27188.493	20	25
SN1355B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48494.003	27191.848	20	25
SN1358	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48514.365	27203.29	3	50
SN1379	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48552.97	27204.684	8	25
SN1379A	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48555.927	27202.896	8	25
SN1379B	*Ficus microcarpa*	Moraceae	Native	Common	Strangler	48553.832	27200.133	8	25
SN1266	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48589.17997	27124.68852	4	25
SN1269	*Falcataria falcata*	Fabaceae	Exotic	Naturalised	Tree	48523.625	27114.171	3.5	25
Others	*Bambusa vulgaris*	Poaceae	Exotic	Casual	Shrub	48609.44445	27270.69385	25	18
Others	*Bambusa* cf *heterostachya*	Poaceae	Exotic	Casual	Shrub	48564.21543	27196.46387	15	10
Others	*Bambusa vulgaris*	Poaceae	Exotic	Casual	Shrub	48546.96706	27225.39835	20	15
Others	*Bambusa vulgaris*	Poaceae	Exotic	Casual	Shrub	48509.26431	27035.88727	8	15
Others	*Bambusa vulgaris*	Poaceae	Exotic	Casual	Shrub	48513.79652	27033.43411	10	12

Appendix G
List of Plant Species Along Stream

Delivering a better world

Species	Origin	Status	SM01	SM02	SM03	SM04	SM05	SM06	SM07	SM08	SM09	SM10	SM11	SM12	SM13	SM14	SM15	SM16	SM17	SM18	SM19	SM20	SM21
Acacia auriculiformis	Exotic	Naturalised																			Y		
Acmella oleracea	Exotic	-	Y		Y																		
Acrostichum aureum	Native	Common	Y	Y		Y	Y				Y												
Adenanthera pavonina	Exotic	Naturalised																					
Adiantum latifolium	Exotic	Naturalised	Y	Y	Y		Y		Y	Y	Y	Y			Y				Y				
Alocasia odora	Exotic	-				Y				Y													
Andira inermis	Exotic	Casual																				Y	
Asplenium nidus	Native	Common										Y											
Asystasia gangetica subsp. micrantha	Exotic	Naturalised		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y			Y	Y		Y	Y	Y	Y
Axonopus compressus	Exotic	Naturalised		Y		Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y		Y	Y		Y
Carica papaya	Exotic	Casual				Y																	
Caryota mitis	Native	Common					Y						Y	Y		Y	Y	Y	Y	Y	Y	Y	Y
Cecropia pachystachya	Exotic	Naturalised				Y		Y		Y	Y	Y	Y		Y						Y	Y	Y
Christella dentata	Native	Common	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y
Cinnamomum iners	Native	Common											Y	Y		Y	Y		Y	Y	Y	Y	
Cissus hastata	Native	Common		Y																			
Claoxylon indicum	Native	Common										Y					Y	Y	Y				
Colocasia esculenta	Exotic	Casual	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y
Commelina diffusa	Cryptogenic	-	Y	Y	Y																		
Cordyline fruticosa	Exotic	Casual			Y																		
Cuphea calophylla	Exotic	-						Y	Y														
Dillenia suffruticosa	Native	Common				Y	Y				Y	Y			Y		Y	Y	Y	Y	Y	Y	Y
Dioscorea alata	Exotic	-											Y				Y						
Drynaria quercifolia	Native	Common	Y						Y														
Elaeis guineensis	Exotic	Casual		Y																			
Epipremnum aureum	Exotic	Casual	Y	Y			Y								Y	Y	Y	Y	Y				
Epipremnum pinnatum	Exotic	Naturalised					Y					Y					Y	Y	Y				
Falcataria falcata	Exotic	Naturalised												Y		Y		Y	Y	Y	Y	Y	Y
Ficus fistulosa	Native	Common				Y	Y		Y	Y			Y								Y		Y
Ficus hispida	Exotic	Casual																					Y
Ficus microcarpa	Native	Common			Y			Y	Y									Y					
Ficus variegata	Native	Common					Y	Y				Y	Y							Y	Y	Y	

Flagellaria indica	Native	Common																			Y		
Hippobroma longiflora	Exotic	Naturalised	Y				Y	Y	Y	Y	Y	Y											
Hopea odorata	Exotic	Cultivated					Y	Y		Y	Y												
Imperata cylindrica	Native	Common				Y				Y													
Ipomoea cairica	Exotic	Naturalised																Y			Y		
Kyllinga polyphylla	Exotic	Naturalised									Y												
Lepistemon binectarifer	Data Deficient	-							Y	Y	Y	Y								Y	Y	Y	Y
Saribus rotundifolius	Exotic	Casual																	Y				
Mallotus paniculatus	Native	Common			Y												Y						
Mangifera indica	Exotic	Casual																	Y				
Manihot esculenta	Exotic	Naturalised				Y		Y													Y	Y	
Melastoma malabathricum	Native	Common											Y										
Miconia crenata	Exotic	Naturalised				Y	Y		Y	Y		Y											
Mikania micrantha	Exotic	Naturalised	Y				Y	Y		Y	Y	Y	Y	Y			Y	Y	Y	Y		Y	Y
Monochoria hastata	Cryptogenic	-											Y										
Mucuna pruriens var. pruriens	Exotic	Naturalised		Y		Y		Y	Y	Y	Y	Y	Y	Y				Y		Y	Y	Y	
Nelsonia canescens	Exotic	Casual			Y																		
Nephrolepis biserrata	Native	Common	Y			Y															Y	Y	
Ottochloa nodosa	Native	Common	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y
Oxalis barrelieri	Exotic	Naturalised	Y																				
Oxyceros longiflorus	Native	Common														Y	Y						
Paederia foetida	Native	Common	Y			Y	Y	Y	Y	Y	Y	Y											
Passiflora foetida	Exotic	Naturalised																					
Peperomia pellucida	Exotic	Naturalised	Y		Y		Y																
Emblica urinaria	Exotic	Naturalised			Y	Y	Y			Y	Y	Y											
Pilea microphylla	Exotic	Naturalised	Y									Y											
Piper aduncum	Exotic	Naturalised												Y			Y					Y	
Piper betle	Exotic	Casual			Y		Y																
Piper sarmentosum	Native	Common		Y	Y		Y																
Pipturus argenteus	Cryptogenic	-						Y	Y														
Ptychosperma macarthurii	Exotic	Naturalised							Y							Y			Y				
Ruellia blechum	Exotic	Casual			Y	Y			Y		Y	Y	Y		Y	Y		Y	Y		Y	Y	Y
Russelia equisetiformis	Exotic	Cultivated			Y					Y													

Spathodea campanulata	Exotic	Naturalised			Y	Y	Y	Y	Y	Y							Y	Y		Y	Y	Y	Y
Spermacoce ocymifolia	Exotic	Naturalised													Y								
Spermacoce remota	Exotic	Naturalised											Y		Y								
Sphagneticola trilobata	Exotic	Naturalised	Y	Y		Y		Y		Y		Y	Y	Y									
Stenochlaena palustris	Native	Common											Y	Y	Y	Y		Y	Y	Y	Y	Y	Y
Strobilanthes reptans	Exotic	Naturalised	Y				Y					Y											
Syngonium angustatum	Exotic	Naturalised	Y		Y				Y	Y		Y			Y	Y			Y		Y	Y	
Syzygium grande	Native	Common												Y		Y			Y				
Syzygium myrtifolium	Native	Critically endangered		Y													Y	Y	Y				
Syzygium polyanthum	Native	Common																Y	Y		Y		
Terminalia catappa	Native	Common		Y				Y						Y		Y	Y			Y		Y	
Tinospora crispa	Exotic	Casual																				Y	
Vandellia diffusa	Exotic	-		Y		Y			Y	Y													
Xanthosoma sagittifolium	Exotic	Cultivated			Y				Y											Y	Y		
Youngia japonica	Exotic	Naturalised			Y																		

Appendix H
List and Location of All Tree Specimens

Delivering a better world

Tag ID	Species	Family	Origin	Status	Habit	Northing (DGPS)	Easting (DGPS)	Girth/ spread (m)	Height (m)
SN0001	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	49165.863	26115.79386	1	10
SN0002	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49088.23994	26264.24559	1.8	8
SN0003	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49079.8336	26262.46499	1	7
SN0004	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49079.61099	26296.51777	1.3	8
SN0005	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49074.19843	26268.14041	1.2	9
SN0006	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	49076.29299	26293.29052	2.8	20
SN0007	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49081.60367	26295.96136	1.1	10
SN0008	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	49090.12126	26295.73885	1.6	18
SN0009	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49090.55675	26306.42208	2.6	12
SN0010	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	49093.87469	26318.10688	2.8	6
SN0011	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	49076.2929	26307.20097	2.2	20
SN0012	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	49059.26695	26314.65685	2.3	22
SN0013	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	49072.97466	26322.89193	1	10
SN0014	Ficus microcarpa	Moraceae	Native	Common	Strangler	49053.686	26333.799	20	16
SN0014A	Ficus microcarpa	Moraceae	Native	Common	Strangler	49055.927	26340.558	20	16
SN0014B	Ficus microcarpa	Moraceae	Native	Common	Strangler	49048.733	26329.741	20	16
SN0015	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49035.903	26315.681	1.5	10
SN0016	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49032.898	26315.795	2.5	16
SN0017	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49031.904	26315.713	1.5	16
SN0018	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	49028.112	26329.018	1.1	14
SN0019	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	49025.614	26329.354	1.2	11
SN0020	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	49019.486	26331.78	1.1	14
SN0021	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	49013.898	26353.074	1.5	25
SN0022	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	49006.404	26358.172	2	8
SN0023	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	49004.063	26357.739	1.4	10
SN0024	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48997.943	26361.483	3	30
SN0025	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48993.39	26367.038	1.4	10
SN0026	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48991.708	26376.62	1.1	12
SN0027	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48987.655	26374.512	1.7	10
SN0028	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48986.83	26382.481	1.4	17
SN0029	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48982.742	26392.541	1.1	16

SN0030	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48974.296	26393.392	2.2	16
SN0031	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48977.424	26400.761	1.8	14
SN0032	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48983.109	26401.772	2.3	30
SN0033	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48987.895	26406.866	1.7	18
SN0034	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48991.077	26420.816	2.8	30
SN0035	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48962.654	26409.04	1	16
SN0036	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48956.678	26411.689	2.6	16
SN0037	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48952.638	26415.836	1.5	16
SN0038	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48959.194	26421.476	2.2	18
SN0039	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48950.902	26427.547	1.6	16
SN0040	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48942.357	26430.587	1.8	16
SN0041	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48961.413	26431.9	1	16
SN0042	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48959.524	26430.068	1.5	16
SN0043	Terminalia catappa	Combretaceae	Native	Common	Tree	48968.346	26432.114	1.1	18
SN0044	Terminalia catappa	Combretaceae	Native	Common	Tree	48983.99	26430.101	1.6	18
SN0045	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48990.933	26429.819	1.7	20
SN0046	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48997.147	26427.383	1	16
SN0047	Terminalia catappa	Combretaceae	Native	Common	Tree	49001.643	26413.825	2.8	25
SN0048	Terminalia catappa	Combretaceae	Native	Common	Tree	48995.864	26402.557	2.1	30
SN0049	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49001.33	26393.284	2.4	20
SN0050	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	49003.904	26388.157	2.4	35
SN0051	Terminalia catappa	Combretaceae	Native	Common	Tree	49006.623	26394.674	1	20
SN0052	Ficus microcarpa	Moraceae	Native	Common	Strangler	49016.1	26396.225	6	20
SN0052A	Ficus microcarpa	Moraceae	Native	Common	Strangler	49010.12	26397.373	6	20
SN0052B	Ficus microcarpa	Moraceae	Native	Common	Strangler	49012.621	26398.983	6	20
SN0053	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49032.198	26408.746	2.5	16
SN0054	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	49035.476	26419.931	2.7	20
SN0055	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49031.384	26399.116	1.2	18
SN0056	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	49048.12	26397.132	1	8
SN0057	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49045.221	26399.137	1.3	18
SN0058	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49041.648	26383.549	1.4	20
SN0059	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49035.908	26388.132	2	20
SN0060	Terminalia catappa	Combretaceae	Native	Common	Tree	49032.597	26383.441	1.8	18

SN0061	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49020.161	26383.951	2.7	25
SN0062	Terminalia catappa	Combretaceae	Native	Common	Tree	49023.695	26381.008	1.6	20
SN0063	Ficus microcarpa	Moraceae	Native	Common	Strangler	49028.457	26365.432	10	20
SN0063A	Ficus microcarpa	Moraceae	Native	Common	Strangler	49027.614	26371.417	10	20
SN0063B	Ficus microcarpa	Moraceae	Native	Common	Strangler	49026.36	26356.186	10	20
SN0064	Ficus microcarpa	Moraceae	Native	Common	Strangler	49031.187	26345.261	10	20
SN0064A	Ficus microcarpa	Moraceae	Native	Common	Strangler	49036.344	26353.38	10	20
SN0064B	Ficus microcarpa	Moraceae	Native	Common	Strangler	49039.137	26354.501	10	20
SN0065	Terminalia catappa	Combretaceae	Native	Common	Tree	49052.378	26361.058	1.5	20
SN0066	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49060.657	26366.177	1.1	18
SN0067	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49057.465	26374.29	1.1	18
SN0068	Syzygium grande	Myrtaceae	Native	Common	Tree	49051.118	26347.313	1.7	20
SN0069	Terminalia catappa	Combretaceae	Native	Common	Tree	49051.753	26347.03	1.5	20
SN0070	Calophyllum inophyllum	Calophyllaceae	Native	Endangered	Tree	49048.289	26341.323	2.3	20
SN0071	Ficus microcarpa	Moraceae	Native	Common	Strangler	49044.07	26343.197	4	25
SN0072	Terminalia catappa	Combretaceae	Native	Common	Tree	49065.859	26334.617	1.3	18
SN0073	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49070.224	26334.062	1.7	20
SN0074	Terminalia catappa	Combretaceae	Native	Common	Tree	49070.44	26334.671	1	16
SN0075	Ficus benjamina	Moraceae	Cryptogenic	-	Strangler	49065.897	26343.051	3	20
SN0076	Syzygium grande	Myrtaceae	Native	Common	Tree	49074.552	26356.116	1.9	20
SN0077	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	49077.966	26353.468	1.3	16
SN0078	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48773.871	26597.884	1.4	20
SN0078A	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48720.278	26633.795	1.2	14
SN0079	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48779.931	26593.944	1.4	25
SN0079A	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48791.148	26604.616	2.6	30
SN0080	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48764.881	26603.046	1.8	30
SN0081	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48768.523	26603.794	1.7	14
SN0082	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48761.782	26605.314	1.1	25
SN0083	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48764.782	26610.942	2.5	30
SN0084	Terminalia catappa	Combretaceae	Native	Common	Tree	48752.89	26619.308	1.1	14
SN0085	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48748.119	26621.969	2	30
SN0086	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48737.153	26631.645	1.3	10
SN0087	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48732.335	26634.972	1.4	16

SN0088	Syzygium grande	Myrtaceae	Native	Common	Tree	48733.615	26640.269	1	16
SN0089	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48722.7	26620.453	2.9	20
SN0090	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48750.435	26601.606	1.6	10
SN0090A	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48820.169	26553.323	2.2	35
SN0091	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48817.777	26540.589	2.4	10
SN0092	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48821.219	26544.72	2	16
SN0093	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48827.806	26542.949	1.8	18
SN0093A	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48820.191	26547.721	1.4	16
SN0094	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48846.733	26534.238	1	14
SN0095	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48848.616	26537.401	1.7	14
SN0096	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48844.308	26544.885	3.6	40
SN0097	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48845.485	26539.346	1.2	10
SN0098	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48857.985	26537.111	1	10
SN0099	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48857.935	26532.569	2.2	12
SN0100	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48858.664	26527.814	1	12
SN0100A	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48855.076	26522.369	1.3	20
SN0100B	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48864.59	26527.549	1.2	12
SN0101	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48873.372	26537.296	3.8	40
SN0102	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48873.291	26534.469	2.7	40
SN0103	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48886.161	26533.115	1.8	40
SN0103A	Syzygium grande	Myrtaceae	Native	Common	Tree	48899.202	26524.792	2.1	30
SN0104	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48879.283	26523.054	1.8	14
SN0105	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48877.465	26518.925	1.4	14
SN0106	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48889.434	26509.406	1.2	16
SN0107	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48887.26	26509.924	1.8	18
SN0108	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48890.953	26503.655	2.3	16
SN0109	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48891.31	26501.792	1	16
SN0110	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48895.413	26501.121	1.3	18
SN0111	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48895.302	26500.593	1	30
SN0112	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48895.02	26502.7	1.1	14
SN0113	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48895.909	26506.491	1.6	18
SN0114	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48899.697	26494.324	2.5	10

SN0115	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48894.847	26486.595	1	10
SN0116	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48887.02	26492.672	1.1	12
SN0117	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48901.316	26494.142	1.2	16
SN0118	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48903.057	26492.118	1.8	12
SN0119	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48907.049	26491.189	2	14
SN0120	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48907.96	26486.133	1.1	18
SN0121	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48908.969	26486.467	1.8	10
SN0122	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48914.612	26480.336	1.1	14
SN0123	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48911.4	26477.703	1	15
SN0124	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48908.144	26471.748	1.1	10
SN0125	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48906.7	26474.478	1.8	14
SN0126	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48906.234	26477.879	1.7	12
SN0127	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48912.159	26473.822	1.5	12
SN0128	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48918.888	26473.684	2.2	14
SN0129	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48916.582	26460.039	1.8	12
SN0130	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48928.241	26449.893	1.6	14
SN0131	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48930.633	26455.261	1.4	16
SN0132	Terminalia catappa	Combretaceae	Native	Common	Tree	48860.00624	26607.10904	2.8	20
SN0133	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48846.07605	26598.76269	2	18
SN0134	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48869.19112	26592.64222	2.2	30
SN0135	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48876.37407	26592.75354	1	17
SN0136	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48875.15998	26588.63604	2	16
SN0137	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48875.92926	26587.96834	2.2	18
SN0138	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48881.79599	26596.6485	3	30
SN0139	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48881.79599	26596.6485	2.6	30
SN0140	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48877.36585	26587.18936	3.0	30
SN0141	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48888.75658	26576.06106	3	25
SN0142	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48885.21609	26573.50151	2.6	30
SN0143	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48878.91371	26561.70541	1	15
SN0144	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48871.95322	26566.04543	1.2	25
SN0145	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48869.51569	26567.82596	1.6	25
SN0146	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48866.42005	26563.81973	2.8	30

SN0147	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48866.42005	26563.81973	1.1	18
SN0148	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48865.09469	26565.82283	1.5	30
SN0149	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48859.57081	26565.04381	1.1	20
SN0150	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48855.02937	26568.38229	1.6	30
SN0151	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48847.84642	26566.93556	2.7	20
SN0152	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48846.29856	26572.72231	3.1	30
SN0153	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48849.06047	26579.39934	1.2	25
SN0154	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48860.00639	26580.17839	1.3	20
SN0155	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48862.44389	26583.40563	1.6	20
SN0156	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48857.80045	26594.53397	2.5	10
SN0157	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48860.34005	26570.49671	1.8	6
SN0158	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48871.84201	26560.25868	1.1	20
SN0159	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48909.65666	26561.37173	3.5	30
SN0160	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48923.47564	26564.59904	2	10
SN0161	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48929.2313	26563.7088	1	11
SN0162	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48942.93903	26569.16178	4	30
SN0163	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48920.93607	26583.40596	3	20
SN0164	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48931.54829	26582.96089	2.2	12
SN0165	Terminalia catappa	Combretaceae	Native	Common	Tree	48930.89025	26584.29629	1.1	9
SN0166	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48949.79745	26587.96876	1.8	16
SN0167	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48968.03747	26586.2996	1.2	18
SN0168	Terminalia catappa	Combretaceae	Native	Common	Tree	48982.63504	26584.07401	1.4	16
SN0169	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48872.94489	26578.28664	3	30
SN0170	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48871.61956	26575.17069	1.1	20
SN0171	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48869.40439	26578.73176	1.3	20
SN0172	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48931.711	26437.673	1.6	15
SN0173	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48930.31	26440.622	1.2	13
SN0174	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48933.289	26448.115	1.4	15
SN0175	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48933.512	26448.725	1.1	15
SN0176	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48936.295	26455.724	1.1	16
SN0177	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48938.568	26457.682	2.2	16
SN0178	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48946.155	26456.938	1.4	18

SN0179	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48936.545	26469.641	2.7	25
SN0180	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48947.651	26478.643	3	18
SN0181	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48955.53	26476.652	1.3	16
SN0182	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48966.38	26481.563	3	20
SN0183	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48965.79	26471.039	1.8	18
SN0184	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48969.466	26465.265	1.1	18
SN0185	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48967.56	26465.742	2.6	20
SN0186	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48965.395	26460.601	2.7	20
SN0187	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48957.671	26443.409	2.5	25
SN0188	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48948.918	26440.341	1	16
SN0189	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48942.487	26439.506	1.3	15
SN0190	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48938.865	26439.098	1.2	18
SN0191	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48973.938	26442.503	3.6	20
SN0192	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48992.219	26442.636	1.9	20
SN0193	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48988.932	26442.312	1.6	20
SN0194	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48981.222	26447.475	2	17
SN0195	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48996.208	26443.712	1.2	20
SN0196	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49000.633	26448.781	3.8	20
SN0197	Terminalia catappa	Combretaceae	Native	Common	Tree	48999.571	26441.049	1.2	18
SN0198	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	49003.882	26433.448	1.6	17
SN0199	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49002.492	26426.128	1	16
SN0200	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49447.679	27293.267	1.7	18
SN0201	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49029.137	26421.905	2.1	18
SN0202	Terminalia catappa	Combretaceae	Native	Common	Tree	49028.336	26428.024	1.3	18
SN0203	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49032.537	26428.006	2.5	20
SN0204	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	49020.725	26426.416	1.4	20
SN0205	Terminalia catappa	Combretaceae	Native	Common	Tree	49014.545	26416.635	2	18
SN0206	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	49007.938	26444.131	1.1	15
SN0207	Terminalia catappa	Combretaceae	Native	Common	Tree	49012.729	26455.453	2.4	17
SN0208	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	49007.729	26451.361	1	18
SN0209	Ficus microcarpa	Moraceae	Native	Common	Strangler	48991.342	26462.851	12	20
SN0210	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48927.759	26494.895	1.4	18

SN0211	Terminalia catappa	Combretaceae	Native	Common	Tree	48921.213	26506.594	1.6	20
SN0212	Mangifera odorata	Anacardiaceae	Native	Critically endangered	Tree	48924.113	26507.821	1.6	18
SN0213	Ficus microcarpa	Moraceae	Native	Common	Strangler	48924.044	26511.175	4	20
SN0213A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48925.777	26514.159	4	20
SN0213B	Ficus microcarpa	Moraceae	Native	Common	Strangler	48923.485	26512.081	4	20
SN0214	Syzygium grande	Myrtaceae	Native	Common	Tree	48907.603	26517.935	1	16
SN0214A	Syzygium grande	Myrtaceae	Native	Common	Tree	48896.15	26531.372	2.6	20
SN0215	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48783.077	26687.248	1.3	10
SN0216	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48789.918	26668.102	1.2	12
SN0217	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48772.911	26650.948	2.8	25
SN0218	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48777.662	26642.638	2	25
SN0219	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48778.257	26642.299	1.1	12
SN0220	Terminalia catappa	Combretaceae	Native	Common	Tree	48763.679	26638.834	1	10
SN0220A	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48738.929	26647.606	1.7	14
SN0220B	Vitex pinnata	Lamiaceae	Native	Common	Tree	48740.024	26659.573	1.4	12
SN0220C	Cinnamomum iners	Lauraceae	Native	Common	Tree	48746.368	26657.456	1.2	14
SN0221	Terminalia catappa	Combretaceae	Native	Common	Tree	48801.584	26630.354	1.5	20
SN0222	Terminalia catappa	Combretaceae	Native	Common	Tree	48803.147	26628.136	1	20
SN0223	Syzygium grande	Myrtaceae	Native	Common	Tree	48803.257	26626.237	1.2	25
SN0224	Syzygium grande	Myrtaceae	Native	Common	Tree	48803.538	26623.809	1.2	14
SN0225	Syzygium grande	Myrtaceae	Native	Common	Tree	48806.189	26623.313	1.7	25
SN0226	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48799.793	26621.748	1.1	7
SN0227	Leucaena leucocephala	Fabaceae	Exotic	Naturalised	Tree	48816.547	26640.06	1.1	10
SN0228	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48811.082	26641.526	4	30
SN0229	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48795.467	26671.75	1	8
SN0230	Cocos nucifera	Arecaceae	Exotic	Naturalised	Tree	48803.29	26685.358	1	12
SN0231	Cocos nucifera	Arecaceae	Exotic	Naturalised	Tree	48805.193	26681.352	1	8
SN0232	Cocos nucifera	Arecaceae	Exotic	Naturalised	Tree	48799.937	26688.21	1.1	10
SN0233	Cocos nucifera	Arecaceae	Exotic	Naturalised	Tree	48799.125	26688.119	1.1	12
SN0234	Cocos nucifera	Arecaceae	Exotic	Naturalised	Tree	48796.057	26688.278	1.2	8
SN0235	Azadirachta indica	Meliaceae	Exotic	Casual	Tree	48754.443	26722.205	1	10
SN0236	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48753.022	26717.714	1	14

SN0237	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48744.49	26708.939	1.6	14
SN0238	Cinnamomum iners	Lauraceae	Native	Common	Tree	48742.325	26698.053	1.1	10
SN0239	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48730.359	26696.036	1.3	18
SN0240	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48728.953	26692.99	1.5	14
SN0241	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48731.014	26691.685	1	18
SN0242	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48724.028	26699.8	1.2	16
SN0243	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48713.982	26701.168	3	30
SN0244	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48717.284	26691.275	1	18
SN0245	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48711.407	26687.818	2.9	40
SN0246	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48701.969	26693.065	1	12
SN0247	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48700.274	26694.359	1	12
SN0248	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48702.216	26704.052	1.8	40
SN0249	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48707.929	26714.122	2	40
SN0250	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48715.727	26719.318	1.6	40
SN0251	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48716.591	26722.317	1.5	30
SN0252	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48715.031	26720.623	1	14
SN0253	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48714.188	26724.885	1	16
SN0254	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48720	26729.389	1.1	16
SN0255	Terminalia catappa	Combretaceae	Native	Common	Tree	48722.667	26724.577	1	20
SN0256	Terminalia catappa	Combretaceae	Native	Common	Tree	48722.169	26720.141	1	20
SN0257	Terminalia catappa	Combretaceae	Native	Common	Tree	48737.314	26724.032	1.3	20
SN0258	Cinnamomum iners	Lauraceae	Native	Common	Tree	48742.066	26736.25	1	12
SN0259	Ficus microcarpa	Moraceae	Native	Common	Strangler	48737.174	26741.675	1.5	10
SN0260	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48715.534	26739.006	1.3	18
SN0261	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48710.178	26742.642	1	14
SN0262	Macaranga conifera	Euphorbiaceae	Native	Common	Tree	48708.424	26749.625	1.1	16
SN0263	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48694.61	26744.334	1.4	20
SN0264	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48690.984	26753.614	1.4	16
SN0265	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48689.845	26754.492	2	40
SN0266	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48680.159	26742.839	1.8	40
SN0267	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48678.526	26739.194	2	40
SN0268	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48673.28	26723.588	2	30

SN0269	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48685.329	26718.694	1.8	40
SN0269A	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48687.121	26715.382	1.8	40
SN0270	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48687.014	26719.246	1.4	30
SN0271	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48695.507	26721.209	1.5	40
SN0272	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48687.714	26732.839	1	14
SN0273	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48674.312	26759.087	1.3	40
SN0274	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48673.301	26759.047	1	15
SN0275	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48668.467	26770.991	1.1	10
SN0276	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48701.201	26766.672	2	16
SN0277	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48701.265	26763.628	1	14
SN0278	Litsea elliptica	Lauraceae	Native	Common	Tree	48703.021	26759.911	1	15
SN0279	Cinnamomum iners	Lauraceae	Native	Common	Tree	48726.377	26759.864	1.4	14
SN0280	Litsea elliptica	Lauraceae	Native	Common	Tree	48717.201	26768.394	1.1	18
SN0281	Mallotus paniculatus	Euphorbiaceae	Native	Common	Tree	48721.57	26774.866	1.2	7
SN0282	Syzygium grande	Myrtaceae	Native	Common	Tree	48716.861	26786.586	1.5	20
SN0283	Syzygium grande	Myrtaceae	Native	Common	Tree	48715.938	26788.816	1.5	25
SN0284	Cinnamomum iners	Lauraceae	Native	Common	Tree	48707.329	26778.222	1.7	14
SN0285	Cinnamomum iners	Lauraceae	Native	Common	Tree	48704.682	26779.01	1.3	14
SN0286	Cinnamomum iners	Lauraceae	Native	Common	Tree	48704.666	26789.57	1.6	18
SN0287	Cinnamomum iners	Lauraceae	Native	Common	Tree	48704.352	26792.793	1.1	12
SN0288	Cinnamomum iners	Lauraceae	Native	Common	Tree	48718.364	26798.309	1	8
SN0289	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48716.505	26798.734	1.1	12
SN0290	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48710.888	26798.236	1.6	14
SN0291	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48697.099	26797.633	2.2	40
SN0292	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48692.939	26798.983	1.1	25
SN0293	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48690.509	26798.001	1.8	40
SN0294	Cinnamomum iners	Lauraceae	Native	Common	Tree	48684.52	26804.381	1.1	12
SN0295	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48683.435	26807.228	1.4	30
SN0296	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48679.235	26808.678	1.6	30
SN0297	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48673.343	26807.22	1.5	30
SN0298	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48669.222	26807.963	1.5	20
SN0299	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48661.511	26801.352	1	1.8

SN0300	Syzygium grande	Myrtaceae	Native	Common	Tree	48813.835	26621.581	1.3	20
SN0301	Syzygium grande	Myrtaceae	Native	Common	Tree	48817.269	26622.175	1.3	14
SN0302	Syzygium grande	Myrtaceae	Native	Common	Tree	48819.567	26620.905	1.5	2
SN0303	Syzygium grande	Myrtaceae	Native	Common	Tree	48817.348	26622.713	2.2	20
SN0304	Syzygium grande	Myrtaceae	Native	Common	Tree	48816.415	26623.717	1.3	10
SN0305	Syzygium grande	Myrtaceae	Native	Common	Tree	48819.758	26622.812	1.6	20
SN0306	Terminalia catappa	Combretaceae	Native	Common	Tree	48823.22	26617.264	1.2	20
SN0307	Terminalia catappa	Combretaceae	Native	Common	Tree	48829.034	26607.355	1.2	20
SN0308	Terminalia catappa	Combretaceae	Native	Common	Tree	48831.642	26622.197	2	20
SN0309	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48828.615	26652.312	1.6	14
SN0310	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48837.035	26653.576	2.2	14
SN0311	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48840.666	26661.043	2.2	16
SN0312	Ficus microcarpa	Moraceae	Native	Common	Strangler	48851.646	26662.373	1	14
SN0313	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48846.455	26651.542	2.3	18
SN0314	Cocos nucifera	Arecaceae	Exotic	Naturalised	Tree	48855.584	26654.195	1.1	10
SN0315	Terminalia catappa	Combretaceae	Native	Common	Tree	48860.905	26656.699	1.2	16
SN0316	Cinnamomum iners	Lauraceae	Native	Common	Tree	48870.306	26655.437	1	10
SN0317	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48872.721	26653.176	1.3	18
SN0318	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48870.827	26650.835	3.3	25
SN0319	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48889.347	26650.37	1.1	16
SN0320	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48890.617	26649.061	1.6	35
SN0321	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48894.604	26650.8	1.3	14
SN0322	Terminalia catappa	Combretaceae	Native	Common	Tree	48913.844	26652.836	1.6	18
SN0323	Terminalia catappa	Combretaceae	Native	Common	Tree	48913.239	26651.14	1.3	18
SN0324	Terminalia catappa	Combretaceae	Native	Common	Tree	48909.119	26641.288	1.6	18
SN0325	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48870.736	26623.883	1	14
SN0326	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48903.071	26600.427	1.2	16
SN0327	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48906.181	26612.695	1.3	12
SN0328	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48905.624	26621.307	3.2	40
SN0329	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48910.16	26624.073	1.6	14
SN0330	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48932.82	26635.67	1.2	14
SN0331	Terminalia catappa	Combretaceae	Native	Common	Tree	48936.131	26626.36	1.8	16

SN0332	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48943.644	26622.922	1.5	12
SN0333	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48951.416	26623.247	2	40
SN0334	Terminalia catappa	Combretaceae	Native	Common	Tree	48953.619	26623.026	1	18
SN0335	Vitex pinnata	Lamiaceae	Native	Common	Tree	48970.906	26626.706	1.8	12
SN0336	Syzygium grande	Myrtaceae	Native	Common	Tree	48981.503	26602.665	1.1	18
SN0337	Terminalia catappa	Combretaceae	Native	Common	Tree	48976.834	26603.328	1.1	16
SN0338	Syzygium grande	Myrtaceae	Native	Common	Tree	48980.115	26600.774	1	16
SN0339	Terminalia catappa	Combretaceae	Native	Common	Tree	48982.989	26587.835	1.4	20
SN0340	Syzygium grande	Myrtaceae	Native	Common	Tree	49015.269	26602.631	1	20
SN0341	Terminalia catappa	Combretaceae	Native	Common	Tree	49013.897	26607.016	2.6	20
SN0342	Cocos nucifera	Arecaceae	Exotic	Naturalised	Tree	49020.141	26605.55	1.3	18
SN0343	Terminalia catappa	Combretaceae	Native	Common	Tree	49015.221	26600.343	1.3	16
SN0344	Cocos nucifera	Arecaceae	Exotic	Naturalised	Tree	49018.106	26605.791	1.2	10
SN0345	Cinnamomum iners	Lauraceae	Native	Common	Tree	48991.2	26643.271	1.5	10
SN0346	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	49005.51	26622.628	1.4	16
SN0347	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	49004.556	26615.785	1.3	14
SN0348	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48997.757	26619.394	1.7	18
SN0349	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48976.206	26581.069	1.2	16
SN0350	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48959.48	26595.398	1.6	18
SN0351	Terminalia catappa	Combretaceae	Native	Common	Tree	48947.112	26617.892	1.6	18
SN0352	Leucaena leucocephala	Fabaceae	Exotic	Naturalised	Tree	48939.135	26623.511	1.1	12
SN0353	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48943.495	26570.157	3.2	40
SN0354	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48483.391	26585.778	2.8	20
SN0355	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48496.638	26579.404	1.5	16
SN0356	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48497.088	26615.081	1.9	9
SN0357	Artocarpus heterophyllus	Moraceae	Exotic	Casual	Tree	48500.602	26617.875	1.5	9
SN0358	Cinnamomum iners	Lauraceae	Native	Common	Tree	48501.526	26622.541	1.2	12
SN0359	Ficus benjamina	Moraceae	Cryptogenic	-	Strangler	48514.709	26622.048	3	20
SN0359A	Ficus benjamina	Moraceae	Cryptogenic	-	Strangler	48515.458	26621.504	3	20
SN0359B	Ficus benjamina	Moraceae	Cryptogenic	-	Strangler	48518.877	26622.623	3	20
SN0360	Mangifera indica	Anacardiaceae	Exotic	Casual	Tree	48517.964	26630.285	1.7	18
SN0361	Artocarpus heterophyllus	Moraceae	Exotic	Casual	Tree	48524.623	26631.156	1.2	10

SN0362	Terminalia catappa	Combretaceae	Native	Common	Tree	48529.875	26619.575	1.4	12
SN0363	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48533.476	26612.831	1.6	12
SN0364	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48528.314	26615.94	1.2	13
SN0365	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48522.519	26613.502	1	9
SN0366	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48518.871	26611.233	1.2	10
SN0367	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48531.33	26606.496	1.1	9
SN0368	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48517.242	26588.065	2.7	12
SN0369	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48504.685	26565.967	1.5	14
SN0370	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48519.548	26547.299	2.8	19
SN0371	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48521.337	26545.047	1.6	19
SN0372	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48525.646	26540.314	2	16
SN0373	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48537.072	26537.645	1.4	8
SN0374	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48537.015	26549.662	1.6	10
SN0375	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48539.78	26558.488	1.6	10
SN0376	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48572.938	26546.77	2	10
SN0377	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48573.956	26559.507	2.4	12
SN0378	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48567.795	26565.733	1.3	13
SN0379	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48567.975	26571.369	1.2	10
SN0380	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48566.059	26585.717	1.4	11
SN0381	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48565.265	26584.479	1.6	11
SN0382	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48566.244	26586.441	1.2	11
SN0383	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48569.019	26589.842	1.3	14
SN0384	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48571.477	26583.379	2.4	16
SN0385	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48579.366	26584.382	1.3	14
SN0386	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48579.412	26580.784	1.4	7
SN0387	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48579.542	26578.688	1.1	10
SN0388	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48590.125	26577.749	1.4	13
SN0389	Terminalia catappa	Combretaceae	Native	Common	Tree	48605.625	26568.775	1.4	14
SN0390	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48612.082	26577.276	1.3	12
SN0391	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48621.305	26576.401	3	10
SN0392	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48610.196	26580.736	1.6	7
SN0393	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48609.417	26578.377	2.7	10

SN0394	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48609.219	26576.236	1.3	6
SN0395	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48583.028	26589.31	1.4	13
SN0396	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48579.388	26595.65	1.5	12
SN0397	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48568.862	26594.31	1.6	13
SN0398	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48569.817	26598.857	2.2	13
SN0399	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48583.5	26602.202	1.4	12
SN0400	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48564.353	26598.573	1.5	11
SN0401	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48560.47	26598.632	1.1	8
SN0402	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48496.641	26615.628	1.3	14
SN0403	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48459.988	26637.771	3	20
SN0404	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48461.347	26643.724	2	20
SN0405	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48452.99	26647.036	2.1	18
SN0406	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48452.731	26653.016	1	4
SN0407	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48450.89	26663.864	2.7	20
SN0408	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48455.847	26661.972	2.2	10
SN0409	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48455.41	26674.494	1.2	10
SN0410	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48457.362	26676.691	1	10
SN0411	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48456.607	26684.904	1.5	18
SN0412	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48444.987	26685.319	1.8	12
SN0413	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48443.767	26685.267	1.4	10
SN0414	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48445.137	26690.307	1.1	12
SN0415	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48446.179	26692.046	2.4	16
SN0416	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48453.357	26693.576	1.4	16
SN0417	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48460.694	26695.253	2.2	11
SN0418	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48449.955	26703.102	2.2	13
SN0419	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48454.219	26708.667	1.8	18
SN0420	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48455.563	26716.313	1.3	12
SN0421	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48458.383	26719.038	2	18
SN0422	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48456.052	26721.393	2.9	20
SN0423	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48459.01	26724.859	1.6	13
SN0424	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48459.487	26726.301	1	12
SN0425	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48460.645	26727.801	1.2	8

SN0426	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48461.352	26729.284	1.1	8
SN0427	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48462.999	26728.324	1.3	18
SN0428	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48475.575	26700.498	1.5	12
SN0429	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48486.856	26689.247	3	18
SN0430	Cinnamomum iners	Lauraceae	Native	Common	Tree	48486.424	26684.48	1.1	11
SN0431	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48482.581	26678.096	3.5	20
SN0432	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48482.379	26670.144	3.3	20
SN0433	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48483.466	26654.148	5.5	25
SN0434	Artocarpus heterophyllus	Moraceae	Exotic	Casual	Tree	48482.697	26636.895	1	8
SN0435	Terminalia catappa	Combretaceae	Native	Common	Tree	48478.661	26642.457	1	10
SN0436	Artocarpus heterophyllus	Moraceae	Exotic	Casual	Tree	48536.097	26629.709	2.8	12
SN0437	Terminalia catappa	Combretaceae	Native	Common	Tree	48510.844	26634.149	1.6	16
SN0438	Ficus microcarpa	Moraceae	Native	Common	Strangler	48502.334	26635.113	12	16
SN0439	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48508.779	26658.654	3	18
SN0440	Terminalia catappa	Combretaceae	Native	Common	Tree	48519.019	26653.745	1.8	15
SN0441	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48518.144	26659.956	2.2	15
SN0442	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48528.539	26643.539	1.1	15
SN0443	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48531.049	26645.616	1.3	14
SN0444	Terminalia catappa	Combretaceae	Native	Common	Tree	48531.915	26642.629	1.4	16
SN0445	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48540.751	26648.167	1	12
SN0446	Leucaena leucocephala	Fabaceae	Exotic	Naturalised	Tree	48560.408	26640.442	1.1	12
SN0447	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48570.357	26629.339	1.3	16
SN0448	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48572.059	26624.57	1.4	17
SN0449	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48573.943	26621.714	2	15
SN0450	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48554.881	26661.772	1.3	13
SN0451	Terminalia catappa	Combretaceae	Native	Common	Tree	48553.65	26668.531	2	17
SN0452	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48546.028	26684.066	2	18
SN0453	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48549.918	26684.9	1.6	15
SN0454	Terminalia catappa	Combretaceae	Native	Common	Tree	48546.802	26690.125	1.7	16
SN0455	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48536.781	26686.319	1.8	16
SN0456	Cinnamomum iners	Lauraceae	Native	Common	Tree	48535.214	26684.255	1	13
SN0457	Terminalia catappa	Combretaceae	Native	Common	Tree	48526.372	26675.824	1.9	18

SN0458	Mangifera indica	Anacardiaceae	Exotic	Casual	Tree	48515.484	26672.839	2.2	16
SN0459	Terminalia catappa	Combretaceae	Native	Common	Tree	48506.28	26674.375	1.1	15
SN0460	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48499.71	26672.737	1.5	15
SN0461	Terminalia catappa	Combretaceae	Native	Common	Tree	48514.774	26693.727	3.4	18
SN0462	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48521.859	26700.91	3.6	18
SN0463	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48540.683	26711.752	4.5	25
SN0464	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48537.511	26719.571	1.2	12
SN0465	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48551.499	26724.444	2	15
SN0466	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48539.507	26740.134	1.6	10
SN0467	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48538.162	26734.432	3	16
SN0468	Syzygium grande	Myrtaceae	Native	Common	Tree	48539.201	26733.802	1.8	18
SN0469	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48538.495	26732.556	1.3	12
SN0470	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48526.325	26730.495	1.8	12
SN0471	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48526.632	26723.547	2.8	14
SN0472	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48518.104	26725.953	3.6	30
SN0473	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48518.654	26714.837	2.2	20
SN0474	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48517.297	26708.102	4	25
SN0475	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48512.133	26700.347	1.7	16
SN0476	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48510.02	26699.567	1.3	13
SN0477	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48511.476	26696.085	2	14
SN0478	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48501.554	26725.362	1.3	12
SN0479	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48514.379	26733.558	1.4	14
SN0480	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48512.324	26736.534	1.5	15
SN0480A	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48525.698	26758.5	1.5	14
SN0481	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48483.003	26753.296	3	25
SN0482	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48500.005	26755.967	2.2	20
SN0483	Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	48504.754	26762.34	0.3	5
SN0484	Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	48503.194	26773.88	0.4	12
SN0485	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48519.354	26780.889	2	14
SN0486	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48527.68	26795.143	1.1	16
SN0487	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48538.578	26805.276	2.4	17
SN0488	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48533.345	26807.73	1.3	10

SN0489	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48509.864	26787.757	1.6	16
SN0490	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48508.826	26785.806	2.4	20
SN0491	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48504.103	26779.47	2.4	14
SN0492	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48501.04	26771.878	1.1	13
SN0493	Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	48495.343	26767.622	0.3	8
SN0494	Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	48493.331	26763.858	0.3	6
SN0495	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48709.122	26670.445	2	8
SN0496	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48702.35	26666.876	1	14
SN0497	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48699.039	26658.484	1.2	16
SN0498	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48675.64	26644.818	1	8
SN0499	Artocarpus heterophyllus	Moraceae	Exotic	Casual	Tree	48666.886	26638.045	1	13
SN0500	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48656.529	26641.83	2.5	18
SN0501	Syzygium grande	Myrtaceae	Native	Common	Tree	48664.728	26790.886	2	30
SN0502	Terminalia catappa	Combretaceae	Native	Common	Tree	48664.282	26792.461	1.5	20
SN0503	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48656.438	26796.9	1.2	30
SN0504	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48654.779	26800.6	1.2	30
SN0505	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48632.77	26799.986	1.3	20
SN0506	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48627.403	26790.542	1.3	20
SN0507	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48627.064	26788.181	1	16
SN0508	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48642.882	26804.857	1	16
SN0509	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48649.16	26814.358	1.6	30
SN0510	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48651.828	26809.428	1.5	16
SN0511	Macaranga conifera	Euphorbiaceae	Native	Common	Tree	48658.844	26814.351	1	16
SN0512	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48665.363	26820.101	2	40
SN0513	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48663.147	26824.366	1.8	40
SN0514	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48659.742	26826.069	1.3	18
SN0515	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48661.108	26830.526	1	18
SN0516	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48661.523	26833.521	1.1	18
SN0517	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48672.926	26832.182	2	40
SN0518	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48673.785	26833.493	1.5	16
SN0519	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48682.709	26834.6	1.5	40
SN0520	Litsea elliptica	Lauraceae	Native	Common	Tree	48681.484	26832.881	1	18

SN0521	Macaranga conifera	Euphorbiaceae	Native	Common	Tree	48684.561	26825.187	1.2	18
SN0522	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48683.098	26821.062	1	16
SN0523	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48698.966	26836.294	1.2	16
SN0524	Cinnamomum iners	Lauraceae	Native	Common	Tree	48705.587	26830.158	1.5	12
SN0525	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48699.396	26819.43	1.4	40
SN0526	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48696.428	26817.216	1.4	30
SN0527	Cinnamomum iners	Lauraceae	Native	Common	Tree	48695.422	26811.956	1.1	18
SN0528	Cinnamomum iners	Lauraceae	Native	Common	Tree	48705.406	26810.796	1.2	16
SN0529	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48711.392	26810.495	1.7	16
SN0530	Cinnamomum iners	Lauraceae	Native	Common	Tree	48711.584	26815.038	1.3	16
SN0531	Cinnamomum iners	Lauraceae	Native	Common	Tree	48715.898	26815.902	1	8
SN0532	Cinnamomum iners	Lauraceae	Native	Common	Tree	48716.661	26821.249	1	8
SN0533	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48715.634	26828.054	2.6	18
SN0534	Cinnamomum iners	Lauraceae	Native	Common	Tree	48714.061	26834.954	1	8
SN0535	Cinnamomum iners	Lauraceae	Native	Common	Tree	48713.832	26840.9	1.6	15
SN0536	Cinnamomum iners	Lauraceae	Native	Common	Tree	48717.388	26842.597	1.7	10
SN0537	Cinnamomum iners	Lauraceae	Native	Common	Tree	48719.258	26845.565	1.8	8
SN0538	Cinnamomum iners	Lauraceae	Native	Common	Tree	48722.359	26858.142	1.3	10
SN0539	Artocarpus heterophyllus	Moraceae	Exotic	Casual	Tree	48719.452	26862.186	1.3	15
SN0540	Cinnamomum iners	Lauraceae	Native	Common	Tree	48723.453	26865.127	1	8
SN0541	Cinnamomum iners	Lauraceae	Native	Common	Tree	48724.463	26868.072	1	8
SN0542	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48722.145	26868.387	1.8	18
SN0543	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48716.12	26865.67	1	16
SN0544	Cinnamomum iners	Lauraceae	Native	Common	Tree	48713.055	26862.097	1.4	18
SN0545	Cinnamomum iners	Lauraceae	Native	Common	Tree	48710.366	26862.384	1	14
SN0546	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48707.423	26859.064	2.1	40
SN0547	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48705.403	26855.909	1.8	40
SN0548	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48703.953	26849.788	1.3	15
SN0549	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48699.795	26846.583	1	18
SN0550	Macaranga conifera	Euphorbiaceae	Native	Common	Tree	48694.802	26850.108	1.3	20
SN0551	Litsea elliptica	Lauraceae	Native	Common	Tree	48690.452	26845.667	1.2	20
SN0552	Litsea elliptica	Lauraceae	Native	Common	Tree	48688.395	26844.39	1	20

SN0553	Cinnamomum iners	Lauraceae	Native	Common	Tree	48686.858	26846.244	1.2	18
SN0554	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48679.278	26849.578	1.9	50
SN0555	Cinnamomum iners	Lauraceae	Native	Common	Tree	48677.829	26854.8	1.3	16
SN0556	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48657.648	26848.828	1.5	30
SN0557	Cinnamomum iners	Lauraceae	Native	Common	Tree	48657.93	26854.239	1.1	12
SN0558	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48655.88	26857.851	1.4	15
SN0559	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48658.414	26860.822	1.3	30
SN0560	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48657.149	26862.888	1.3	30
SN0561	Syzygium cerasiforme	Myrtaceae	Native	Common	Tree	48657.909	26873.451	1	12
SN0562	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48668.358	26873.772	1.8	18
SN0563	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48673.325	26872.835	1.8	18
SN0564	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48678.688	26873.196	2	18
SN0565	Macaranga conifera	Euphorbiaceae	Native	Common	Tree	48683.97	26867.88	1.3	20
SN0566	Macaranga conifera	Euphorbiaceae	Native	Common	Tree	48685.15	26865.533	1.1	20
SN0567	Cinnamomum iners	Lauraceae	Native	Common	Tree	48687.764	26866.333	1.3	16
SN0568	Cinnamomum iners	Lauraceae	Native	Common	Tree	48697.52	26867.735	1.2	20
SN0569	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48702.783	26874.021	1	18
SN0570	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48714.999	26880.868	1.3	18
SN0571	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48718.688	26885.798	1.2	18
SN0572	Syzygium grande	Myrtaceae	Native	Common	Tree	48720.412	26888.999	2	20
SN0573	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48719.455	26903.566	1.5	40
SN0574	Cinnamomum iners	Lauraceae	Native	Common	Tree	48720.782	26917.747	1.3	15
SN0575	Cinnamomum iners	Lauraceae	Native	Common	Tree	48721.539	26916.617	1.3	6
SN0576	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48726.41	26920.364	1	15
SN0577	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48726.164	26925.148	1.7	18
SN0578	Syzygium grande	Myrtaceae	Native	Common	Tree	48726.542	26929.065	1.1	18
SN0579	Syzygium grande	Myrtaceae	Native	Common	Tree	48703.875	26937.206	1.2	20
SN0580	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48706.321	26935.256	2.2	30
SN0581	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48700.553	26939.587	2.5	40
SN0582	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48697.067	26936.039	2.6	40
SN0583	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48689.618	26931.546	1.5	40
SN0584	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48688.589	26928.808	3	40

SN0585	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48687.433	26925.748	1.3	40
SN0586	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48696.064	26922.575	1.8	40
SN0587	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48682.528	26911.568	2	40
SN0588	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48681.38	26910.258	1.8	40
SN0589	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48679.092	26910.784	1.3	16
SN0590	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48677.821	26909.219	1	16
SN0591	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48674.744	26907.942	1	16
SN0592	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48674.137	26903.339	1.4	40
SN0593	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48675.415	26901.681	2.5	30
SN0594	Cinnamomum iners	Lauraceae	Native	Common	Tree	48670.837	26896.276	1.2	16
SN0595	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48687.895	26890.339	1.5	18
SN0596	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48695.317	26898.708	2	40
SN0597	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48693.971	26899.924	1.9	40
SN0598	Syzygium grande	Myrtaceae	Native	Common	Tree	48715.826	26922.671	1	20
SN0599	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48667.833	26848.172	1.4	14
SN0600	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48657.54954	26640.60433	2.2	18
SN0601	Syzygium grande	Myrtaceae	Native	Common	Tree	48657.321	26636.001	1.6	17
SN0602	Terminalia catappa	Combretaceae	Native	Common	Tree	48652.323	26635.459	2.4	18
SN0603	Terminalia catappa	Combretaceae	Native	Common	Tree	48667.109	26632.528	1.2	12
SN0604	Terminalia catappa	Combretaceae	Native	Common	Tree	48668.747	26626.403	1.1	12
SN0605	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48671.635	26620.658	3	10
SN0606	Mangifera indica	Anacardiaceae	Exotic	Casual	Tree	48659.234	26614.767	2.4	8
SN0607	Terminalia catappa	Combretaceae	Native	Common	Tree	48642.468	26641.948	2.1	13
SN0608	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48633.344	26647.093	1.2	10
SN0609	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48633.749	26656.43	3.3	20
SN0610	Syzygium grande	Myrtaceae	Native	Common	Tree	48628.241	26653.343	2	16
SN0611	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48624.965	26658.557	1.2	12
SN0612	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48629.688	26663.802	3.6	12
SN0613	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48628.814	26667.499	1.2	12
SN0614	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48632.525	26663.972	2.6	22
SN0615	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48646.032	26677.857	1	16
SN0616	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48649.64	26679.529	1.5	12

SN0617	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48649.793	26678.435	1.5	20
SN0618	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48649.107	26685.131	1.4	20
SN0619	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48646.293	26685.746	1.8	20
SN0620	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48642.289	26684.536	1.5	14
SN0620A	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48650.981	26671.046	1.5	20
SN0621	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48641.91	26709.496	1	6
SN0622	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48638.975	26701.988	1.4	20
SN0623	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48632.155	26699.169	2.4	20
SN0624	Durio zibethinus	Malvaceae	Exotic	Casual	Tree	48618.563	26682.736	1.5	18
SN0625	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48618.975	26682.834	1.4	12
SN0626	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48601.413	26672.202	1.6	6
SN0627	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48602.44	26669.947	2	10
SN0628	Leucaena leucocephala	Fabaceae	Exotic	Naturalised	Tree	48595.784	26683.545	1.2	11
SN0629	Leucaena leucocephala	Fabaceae	Exotic	Naturalised	Tree	48594.611	26686.286	1	11
SN0630	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48593.142	26683.747	1.6	16
SN0631	Leucaena leucocephala	Fabaceae	Exotic	Naturalised	Tree	48585.927	26690.572	1.2	11
SN0632	Leucaena leucocephala	Fabaceae	Exotic	Naturalised	Tree	48598.573	26696.087	1	11
SN0633	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48585.732	26708.116	1.9	18
SN0634	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48596.166	26713.953	1.4	10
SN0635	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48610.991	26707.995	1.8	18
SN0636	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48617.724	26689.546	3.2	18
SN0637	Syzygium grande	Myrtaceae	Native	Common	Tree	48618.561	26688.043	1.1	17
SN0638	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48606.002	26727.542	1.2	12
SN0639	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48602.725	26727.879	2.4	20
SN0640	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48596.914	26738.587	2.3	18
SN0641	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48557.458	26695.396	2.2	20
SN0642	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48549.465	26726.136	1.7	14
SN0643	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48557.514	26741.557	1.1	13
SN0644	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48569.553	26745.949	3.3	20
SN0645	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48570.357	26739.175	1	12
SN0646	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48687.145	26699.725	1.8	22
SN0647	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48681.241	26696.183	1.5	22

SN0648	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48680.359	26699.043	1.1	14
SN0649	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48676.403	26700.555	1	10
SN0650	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48674.796	26699.227	1.8	8
SN0651	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48671.342	26702.221	1.9	15
SN0652	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48671.65	26699.791	1.2	8
SN0653	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48673.564	26708.976	3.2	25
SN0654	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48655.383	26710.611	1.8	14
SN0655	Terminalia catappa	Combretaceae	Native	Common	Tree	48660.813	26719.094	1.4	14
SN0656	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48643.542	26739.568	3.4	12
SN0657	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48635.328	26722.348	2.2	20
SN0657A	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48637.056	26715.896	2.6	19
SN0658	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48620.877	26751.988	3.6	18
SN0659	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48612.155	26766.737	1.7	13
SN0660	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48600.572	26767.278	2.9	20
SN0661	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48597.661	26761.977	1.3	14
SN0662	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48595.927	26765.985	1	15
SN0663	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48594.153	26767.233	1.4	16
SN0664	Terminalia catappa	Combretaceae	Native	Common	Tree	48598.465	26768.214	1	16
SN0665	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48598.399	26780.388	2.4	12
SN0666	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48589.84	26770.949	1.5	18
SN0667	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48589.889	26751.556	2.8	25
SN0668	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48587.89	26750.613	2.5	25
SN0669	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48574.958	26749.004	1.2	12
SN0670	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48575.143	26754.338	1.4	12
SN0671	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48575.202	26757.602	1.3	13
SN0672	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48576.68	26763.321	2.2	16
SN0673	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48573.028	26764.838	1.2	12
SN0674	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48574.565	26765.178	1.8	14
SN0675	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48573.25	26765.726	1.8	14
SN0676	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48569.962	26765.056	1.2	12
SN0677	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48568.55	26761.145	2	16
SN0678	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48565.894	26757.17	1.6	16

SN0679	Ficus benjamina	Moraceae	Cryptogenic	-	Strangler	48556.094	26779.609	1.2	10
SN0680	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48567.26	26786.268	1.4	15
SN0681	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48572.035	26791.638	1.3	12
SN0682	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48573.861	26790.299	1	16
SN0683	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48571.28	26800.291	1.8	18
SN0684	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48568.353	26800.988	1.3	16
SN0685	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48577.636	26801.575	1.8	15
SN0686	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48582.605	26789.891	1.8	18
SN0687	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48578.856	26786.608	1.1	17
SN0688	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48576.115	26782.822	1.2	15
SN0689	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48575.886	26779.712	1.3	13
SN0690	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48586.976	26777.587	1.5	14
SN0691	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48588.229	26781.46	1.6	14
SN0692	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48588.275	26784.025	1.1	12
SN0693	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48591.297	26789.095	2	25
SN0694	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48585.263	26790.753	1.6	16
SN0695	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48608.608	26788.426	1.3	8
SN0696	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48610.442	26784.673	1.6	16
SN0697	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48611.862	26786.637	1	13
SN0698	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48611.916	26789.569	1.8	18
SN0699	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48613.213	26785.46	1.5	8
SN0700	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48617.154	26801.803	1.8	18
SN0701	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48647.401	26734.481	1.7	18
SN0702	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48643.528	26743.984	1.2	18
SN0703	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48637.253	26746.424	1.4	18
SN0704	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48628.398	26754.318	1.8	30
SN0705	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48627.944	26757.855	1.8	25
SN0706	Alstonia macrophylla	Apocynaceae	Exotic	Naturalised	Tree	48626.792	26765.261	0.8	20
SN0707	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48617.038	26803.914	2	40
SN0708	Alstonia angustiloba	Apocynaceae	Native	Common	Tree	48650.084	26882.285	2.1	22
SN0709	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48650.166	26883.382	1.3	12
SN0710	Ficus microcarpa	Moraceae	Native	Common	Strangler	48651.566	26906.464	8	18

SN0710A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48649.828	26903.583	8	18
SN0710B	Ficus microcarpa	Moraceae	Native	Common	Strangler	48648.474	26903.115	8	18
SN0711	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48660.297	26933.35	2.7	40
SN0712	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48663.411	26938.706	1	12
SN0713	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48667.691	26946.907	3.5	14
SN0714	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48664.486	26954.117	4	14
SN0715	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48655.138	26967.482	3	50
SN0716	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48656.995	26973.023	1.3	16
SN0717	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48657.232	26980.669	2	20
SN0718	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48663.457	27004.794	3.5	40
SN0719	Samanea saman	Fabaceae	Exotic	Casual	Tree	48628.483	27033.084	1.5	40
SN0720	Roystonea oleracea	Arecaceae	Exotic	Cultivated	Tree	48623.914	27031.676	1	20
SN0721	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48624.625	27027.98	1.1	18
SN0722	Samanea saman	Fabaceae	Exotic	Casual	Tree	48625.969	27029.087	3	20
SN0723	Roystonea oleracea	Arecaceae	Exotic	Cultivated	Tree	48613.101	27035.333	1.2	20
SN0724	Samanea saman	Fabaceae	Exotic	Casual	Tree	48610.11	27033.467	3.2	30
SN0725	Samanea saman	Fabaceae	Exotic	Casual	Tree	48609.478	27037.547	3	30
SN0726	Khaya senegalensis	Meliaceae	Exotic	Cultivated	Tree	48605.385	27036.827	1.3	20
SN0727	Samanea saman	Fabaceae	Exotic	Casual	Tree	48610.596	27052.479	1.7	30
SN0728	Samanea saman	Fabaceae	Exotic	Casual	Tree	48616.749	27058.232	1.5	40
SN0729	Samanea saman	Fabaceae	Exotic	Casual	Tree	48619.49	27055.332	2.2	40
SN0730	Roystonea oleracea	Arecaceae	Exotic	Cultivated	Tree	48632.322	27056.734	1.2	22
SN0731	Samanea saman	Fabaceae	Exotic	Casual	Tree	48631.978	27058.368	2.5	40
SN0732	Samanea saman	Fabaceae	Exotic	Casual	Tree	48635.855	27059.305	1.5	40
SN0733	Roystonea oleracea	Arecaceae	Exotic	Cultivated	Tree	48640.566	27058.372	1.2	20
SN0734	Roystonea oleracea	Arecaceae	Exotic	Cultivated	Tree	48640.95	27052.037	1.2	22
SN0735	Samanea saman	Fabaceae	Exotic	Casual	Tree	48652.494	27053.079	1.2	16
SN0736	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48651.212	27059.9	1.1	14
SN0737	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48678.702	27057.384	7	40
SN0738	Syzygium grande	Myrtaceae	Native	Common	Tree	48682.318	27047.517	1.2	20
SN0739	Terminalia catappa	Combretaceae	Native	Common	Tree	48676.163	27036.97	1.2	16
SN0740	Terminalia catappa	Combretaceae	Native	Common	Tree	48677.972	27026.109	2	20

SN0741	Terminalia catappa	Combretaceae	Native	Common	Tree	48684.124	27015.011	1.8	25
SN0742	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48686.196	27006.938	2.2	50
SN0743	Lindera lucida	Lauraceae	Native	Vulnerable	Tree	48688.876	26988.797	1.6	20
SN0744	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48690.668	26985.761	2.1	40
SN0745	Lindera lucida	Lauraceae	Native	Vulnerable	Tree	48692.842	26986.66	0.4	12
SN0746	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48690.527	26983.113	1.5	30
SN0747	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48689.767	26983.072	1.4	40
SN0748	Cinnamomum iners	Lauraceae	Native	Common	Tree	48686.709	26965.669	1.2	14
SN0749	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48631.969	26816.451	1	12
SN0750	Syzygium grande	Myrtaceae	Native	Common	Tree	48640.475	26793.231	1.1	25
SN0751	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48647.942	26793.687	1.6	30
SN0752	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48654.378	26778.638	1	16
SN0753	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48657.393	26764.398	1.5	40
SN0754	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48657.45	26755.099	1.8	40
SN0755	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48666.296	26750.893	2.1	40
SN0756	Cinnamomum iners	Lauraceae	Native	Common	Tree	48732.653	26973.819	1	10
SN0757	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48732.46	26973.602	1.3	12
SN0758	Cinnamomum iners	Lauraceae	Native	Common	Tree	48729.02	26972.689	1	16
SN0759	Syzygium grande	Myrtaceae	Native	Common	Tree	48728.818	26974.026	2	15
SN0760	Cinnamomum iners	Lauraceae	Native	Common	Tree	48727.628	26962.747	2.5	10
SN0761	Cinnamomum iners	Lauraceae	Native	Common	Tree	48726.976	26960.362	1.1	8
SN0762	Syzygium grande	Myrtaceae	Native	Common	Tree	48723.839	26959.718	1.8	18
SN0763	Ficus microcarpa	Moraceae	Native	Common	Strangler	48727.457	26955.169	1.5	10
SN0764	Syzygium grande	Myrtaceae	Native	Common	Tree	48721.986	26954.314	3	20
SN0765	Cinnamomum iners	Lauraceae	Native	Common	Tree	48727.556	26951.769	1.5	10
SN0766	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48710.065	26956.165	2.5	8
SN0767	Cinnamomum iners	Lauraceae	Native	Common	Tree	48698.334	26959.141	1.4	8
SN0768	Cinnamomum iners	Lauraceae	Native	Common	Tree	48692.803	26960.271	1.1	14
SN0769	Cinnamomum iners	Lauraceae	Native	Common	Tree	48694.822	26965.825	1.5	16
SN0770	Syzygium grande	Myrtaceae	Native	Common	Tree	48706.613	26972.334	1.3	22
SN0771	Cinnamomum iners	Lauraceae	Native	Common	Tree	48708.295	26974.954	1	12
SN0772	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48715.284	26981.419	1.2	22

SN0773	Mangifera indica	Anacardiaceae	Exotic	Casual	Tree	48726.472	26982.336	1.4	18
SN0774	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48729.586	26979.549	1.4	18
SN0775	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48729.418	26978.411	1.1	8
SN0776	Syzygium grande	Myrtaceae	Native	Common	Tree	48730.892	26992.926	1.2	18
SN0777	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48730.207	27003.845	1.6	30
SN0778	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48725.504	27000.242	1.9	30
SN0779	Cinnamomum iners	Lauraceae	Native	Common	Tree	48720.554	26996.93	1.1	12
SN0780	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48719.193	26993.895	1	16
SN0781	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48717.21	26994.212	1.1	20
SN0782	Cinnamomum iners	Lauraceae	Native	Common	Tree	48711.185	26995.686	1.2	14
SN0783	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48707.037	26985.011	3	18
SN0784	Cinnamomum iners	Lauraceae	Native	Common	Tree	48707.676	26998.326	1.2	16
SN0785	Cinnamomum iners	Lauraceae	Native	Common	Tree	48726.536	27018.541	1.5	18
SN0786	Azadirachta indica	Meliaceae	Exotic	Casual	Tree	48726.037	27022.086	1.8	16
SN0787	Ficus benjamina	Moraceae	Cryptogenic	-	Strangler	48735.356	27027.628	1.1	12
SN0788	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48744.095	27044.361	1.1	14
SN0789	Cinnamomum iners	Lauraceae	Native	Common	Tree	48727.242	27054.183	1	8
SN0790	Azadirachta indica	Meliaceae	Exotic	Casual	Tree	48718.765	27066.201	1	16
SN0791	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48713.737	27066.815	1.8	16
SN0792	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48708.583	27064.359	2	12
SN0793	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48710.097	27060.35	1.1	16
SN0794	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48709.675	27058.235	1	16
SN0795	Macaranga conifera	Euphorbiaceae	Native	Common	Tree	48706.633	27059.101	1.4	10
SN0796	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48703.846	27044.66	3	30
SN0797	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48707.148	27042.699	3.2	20
SN0798	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48707.428	27031.219	1	18
SN0799	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48712.597	27023.01	1.1	18
SN0800	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48714.848	27030.761	1	16
SN0801	Cinnamomum iners	Lauraceae	Native	Common	Tree	48749.743	27074.715	5.2	8
SN0802	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48743.766	27076.457	1.5	16
SN0803A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48733.426	27076.303	10	20
SN0803B	Ficus microcarpa	Moraceae	Native	Common	Strangler	48733.639	27079.366	10	20
SN0803C	Ficus microcarpa	Moraceae	Native	Common	Strangler	48728.74	27079.371	10	20

SN0804	Cinnamomum iners	Lauraceae	Native	Common	Tree	48733.372	27071.872	1.3	12
SN0805	Ficus benjamina	Moraceae	Cryptogenic	-	Strangler	48717.883	27112.166	4	16
SN0806	Syzygium grande	Myrtaceae	Native	Common	Tree	48681.667	27105.877	1.3	6
SN0807	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48678.253	27104.192	1.6	16
SN0808	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48676.321	27095.774	1.8	20
SN0809	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48671.645	27090.614	4.5	50
SN0810	Senna siamea	Fabaceae	Exotic	Cultivated	Tree	48666.781	27087.52	1.4	10
SN0811	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48680.123	27071.384	1.4	10
SN0812	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48683.075	27067.649	1.2	18
SN0813	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48680.1	27063.379	2	40
SN0814	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48686.965	27081.519	3.1	40
SN0815	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48685.573	27086.236	1.4	14
SN0816	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48691.866	27082.551	1.1	12
SN0817	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48690.893	27094.426	1.8	12
SN0818	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48680.391	27098.881	1.7	16
SN0819	Cinnamomum iners	Lauraceae	Native	Common	Tree	48668.184	27114.582	1	10
SN0820	Cinnamomum iners	Lauraceae	Native	Common	Tree	48664.188	27109.811	1.5	20
SN0821	Cinnamomum iners	Lauraceae	Native	Common	Tree	48661.655	27118.507	1	16
SN0822	Cinnamomum iners	Lauraceae	Native	Common	Tree	48654.071	27115.77	1.4	22
SN0823	Cinnamomum iners	Lauraceae	Native	Common	Tree	48647.233	27114.363	1.5	22
SN0824	Cinnamomum iners	Lauraceae	Native	Common	Tree	48645.66	27120.04	1.8	8
SN0825	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48649.771	27123.789	1.2	18
SN0826	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48649.637	27124.001	1.6	20
SN0827	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48644.777	27130.498	1.6	12
SN0828	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48660.766	27130.319	1.8	20
SN0829	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48646.19	27136.969	1.8	10
SN0830	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48644.543	27144.78	1.8	12
SN0831	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48645.654	27154.657	1.8	12
SN0832	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48646.311	27157.205	1.8	12
SN0833	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48647.34	27153.992	1.8	12
SN0834	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48649.803	27149.947	2.1	20
SN0835	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48651.991	27151.67	2.5	20
SN0836	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48654.864	27148.635	1.6	20

SN0837	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48668.754	27141.515	1	5
SN0838	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48667.687	27141.535	1.3	20
SN0839	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48666.126	27142.005	1.8	10
SN0840	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48664.469	27142.184	1.8	20
SN0841	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48663.714	27141.553	1.6	20
SN0842	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48662.175	27140.644	1.1	20
SN0843	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48675.367	27133.881	1.8	10
SN0844	Terminalia catappa	Combretaceae	Native	Common	Tree	48373.811	26944.216	1.4	12
SN0845	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48367.902	26950.381	1.2	10
SN0846	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48370.589	26954.892	1	12
SN0847	Cinnamomum iners	Lauraceae	Native	Common	Tree	48372.882	26953.666	1	7
SN0848	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48377.268	26955.746	1.1	12
SN0849	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48385.829	26951.81	1.8	22
SN0850	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48387.553	26956.773	1.4	18
SN0851	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48390.545	26959.545	1.1	16
SN0852	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48397.443	26961.429	1.2	14
SN0853	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48402.074	26960.284	1.2	14
SN0854	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48406.222	26957.077	1.3	14
SN0855	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48405.158	26953.187	3	20
SN0856	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48406.063	26962.767	1.4	15
SN0857	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48405.333	26975.541	1.2	14
SN0858	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48409.01	26979.385	2.4	20
SN0859	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48404.369	26987.808	1.5	18
SN0860	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48400.002	26997.532	1.3	18
SN0861	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48665.35	27166.741	2.1	25
SN0862	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48667.572	27170.097	1.1	16
SN0863	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48675.711	27169.37	2.7	18
SN0864	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48689.278	27161.359	1.5	10
SN0865	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48671.522	27159.082	1.1	16
SN0866	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48672.418	27161.159	1.2	16
SN0867	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48664.168	27177.584	1	14
SN0868	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48667.175	27177.882	1.5	16
SN0869	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48655.174	27182.122	1.2	10

SN0870	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48658.202	27197.93	1.5	25
SN0871	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48393.267	26989.411	1.3	14
SN0872	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48390.007	26990.575	1.1	16
SN0873	Alstonia angustiloba	Apocynaceae	Native	Common	Tree	48389.379	26983.305	1.4	17
SN0874	Alstonia angustiloba	Apocynaceae	Native	Common	Tree	48407.257	26999.848	1.8	18
SN0875	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48384.005	26997.966	1.4	19
SN0876	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48380.082	27010.53	2.1	15
SN0877	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48382.216	27009.536	1.1	14
SN0878	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48386.15	27021.31	1.1	18
SN0879	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48389.377	27021.541	1.8	14
SN0880	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48393.094	27027.846	2.5	25
SN0881	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48383.043	27029.771	1.8	20
SN0882	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48376.143	27029.092	1.9	22
SN0883	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48376.082	27021.886	1.1	12
SN0884	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48372.819	27018.208	1.8	10
SN0885	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48363.015	27022.419	1.1	12
SN0886	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48357.736	27020.165	1.6	10
SN0887	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48356.525	27019.426	1.2	10
SN0888	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48347.206	27014.761	1	10
SN0889	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48346.029	27010.255	1.8	18
SN0890	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48343.589	27008.572	1.2	18
SN0891	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48326.031	27011.388	1	10
SN0892	Cinnamomum iners	Lauraceae	Native	Common	Tree	48338.595	27020.857	1.1	12
SN0893	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48376.562	27040.183	1.8	20
SN0894	Cinnamomum iners	Lauraceae	Native	Common	Tree	48375.206	27045.597	1.2	12
SN0895	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48381.058	27052.658	1.6	20
SN0896	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48390.81	27045.878	1.5	20
SN0897	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48392.746	27040.147	1.5	20
SN0898	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48405.337	27038.142	1.2	18
SN0899	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48402.308	27037.346	2.2	22
SN0900	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48398.406	27033.736	1.1	14
SN0901	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48614.927	26806.708	1.4	16
SN0902	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48609.174	26799.425	1.8	16

SN0903	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48606.908	26796.029	1.2	16
SN0904	Terminalia catappa	Combretaceae	Native	Common	Tree	48599.898	26799.787	1.2	15
SN0905	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48596.998	26805.393	1.8	12
SN0906	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48584.536	26802.226	1.1	15
SN0907	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48572.945	26810.55	2.7	16
SN0908	Macaranga griffithiana	Euphorbiaceae	Native	Vulnerable	Tree	48575.176	26809.28	0.5	6
SN0909	Alstonia angustiloba	Apocynaceae	Native	Common	Tree	48555.531	26825.124	1	10
SN0910	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48543.539	26821.444	1.4	16
SN0911	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48558.69303	26821.99643	1.1	13
SN0912	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48563.89249	26819.99334	1.2	12
SN0913	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48567.31254	26827.56066	1.3	13
SN0914	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48572.73447	26830.12021	1.6	12
SN0915	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48577.26667	26816.65489	1.8	13
SN0916	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48579.25935	26815.20821	2.2	15
SN0917	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48588.76867	26817.76778	1.8	14
SN0918	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48593.96811	26822.55301	1.8	15
SN0919	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48593.96811	26821.10632	1	14
SN0920	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48594.62617	26814.98572	2	12
SN0921	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48597.06379	26816.87755	2.5	10
SN0922	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48602.58768	26816.32116	1.2	13
SN0923	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48606.79556	26804.19124	1.6	13
SN0924	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48612.54178	26809.31033	1.3	13
SN0925	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48611.98568	26814.31809	1.1	11
SN0926	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48613.53355	26805.97182	2.5	10
SN0927	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48589.21345	26831.90083	1	15
SN0928	Terminalia catappa	Combretaceae	Native	Common	Tree	48587.77683	26838.244	1.2	15
SN0929	Terminalia catappa	Combretaceae	Native	Common	Tree	48582.46613	26839.02296	1.3	12
SN0930	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48574.94949	26833.90387	1.3	12
SN0931	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48585.7842	26828.78487	1.1	11
SN0932	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48573.83731	26837.57623	1.1	10
SN0933	Terminalia catappa	Combretaceae	Native	Common	Tree	48556.7003	26833.90379	1.1	12
SN0934	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48568.31333	26856.49445	4	13
SN0935	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48583.68012	26865.39723	1.8	12

SN0936	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48580.6957	26866.62134	2.4	15
SN0937	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48574.17085	26875.6353	2.2	13
SN0938	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48586.88695	26855.3817	2.2	15
SN0939	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48571.95578	26857.27346	1.1	12
SN0940	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48590.64992	26856.82841	3.2	20
SN0941	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48604.35769	26856.16077	2.2	20
SN0942	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48606.35041	26845.36625	3	20
SN0943	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48602.25357	26901.67583	3.2	20
SN0944	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48588.32336	26896.89057	3.5	20
SN0945	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48575.2736	26903.1224	2	16
SN0946	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48570.74143	26912.02509	3.6	15
SN0947	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48581.79841	26929.05156	1	10
SN0948	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48579.91684	26935.72858	3	20
SN0949	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48582.91053	26939.62353	1.5	12
SN0950	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48578.36907	26946.30054	4.2	18
SN0951	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48585.11638	26941.73793	2.2	15
SN0952	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48562.89105	26935.61722	2	13
SN0953	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48565.32854	26941.96041	1.2	13
SN0954	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48554.04911	26942.85063	3	19
SN0955	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48536.57832	26956.20462	3.7	22
SN0956	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48528.3943	26964.10574	3.2	20
SN0957	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48526.06811	26943.18437	1	11
SN0958	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48538.56181	26931.83347	1.8	18
SN0959	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48540.44328	26922.37435	2.1	11
SN0960	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48543.98375	26928.27241	1	11
SN0961	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48549.51695	26923.82108	1.4	15
SN0962	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48551.38907	26928.38373	1.3	16
SN0963	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48555.59687	26932.94638	1	12
SN0964	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48557.47861	26888.878	3.2	12
SN0965	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48552.72391	26882.08966	2	12
SN0966	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48550.5089	26877.74958	2.4	12
SN0967	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48562.12203	26877.74963	1	12
SN0968	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48563.89225	26873.96599	2	13

SN0969	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48566.32057	26876.41425	1.8	14
SN0970	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48544.54012	26863.95036	2.4	20
SN0971	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48549.5172	26865.39707	2.2	13
SN0972	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48530.49865	26862.39232	2	16
SN0973	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48526.29094	26863.50514	1.4	12
SN0974	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48517.3376	26879.75254	2	20
SN0975	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48511.14639	26881.31049	2.6	20
SN0976	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48507.04983	26876.74783	2.2	20
SN0977	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48504.62159	26880.97661	1	12
SN0978	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48499.42199	26886.54078	1.2	15
SN0979	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48494.00001	26898.11427	1.7	15
SN0980	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48493.11955	26886.65203	1.1	12
SN0981	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48508.27327	26868.95797	1.1	7
SN0982	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48513.46357	26865.06306	1.3	11
SN0983	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48482.86	26890.712	1	10
SN0984	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48481.861	26895.421	1.4	12
SN0985	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48485.409	26897.148	1.2	14
SN0986	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48486.438	26896.551	1.4	14
SN0987	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48487.705	26895.34	1.6	14
SN0988	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48490.776	26904.47	1.6	12
SN0989	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48476.479	26910.954	2.4	20
SN0990	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48490.241	26928.926	1.4	14
SN0991	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48493.319	26928.612	1.1	12
SN0992	Ficus microcarpa	Moraceae	Native	Common	Strangler	48493.898	26927.076	4	14
SN0992A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48494.929	26926.541	4	14
SN0993	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48505.483	26926.064	1.1	10
SN0994	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48504.199	26936.513	1.2	12
SN0995	Syzygium grande	Myrtaceae	Native	Common	Tree	48508.119	26938.71	1.1	18
SN0996	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48499.074	26948.398	1.2	14
SN0997	Terminalia catappa	Combretaceae	Native	Common	Tree	48510.423	26948.237	1.2	18
SN0998	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48492.193	26946.762	1.5	18
SN0999	Cinnamomum iners	Lauraceae	Native	Common	Tree	48486.335	26946.871	1.2	18
SN1000	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48482.273	26960.162	1.3	16

SN1001	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48471.259	26953.437	1.2	18
SN1002	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48476.326	26944.52	1.3	30
SN1003	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48476.634	26937.74	2	40
SN1004	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48477.149	26933.843	1.4	40
SN1005	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48471.482	26934.764	1.4	30
SN1006	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48467.752	26930.767	1.3	18
SN1007	Ficus benjamina	Moraceae	Cryptogenic	-	Strangler	48457.418	26920.801	2	12
SN1008	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48458.566	26913.968	1.6	12
SN1009	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48452.974	26915.693	1.1	9
SN1010	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48457.741	26898.692	1.4	40
SN1011	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48455.79	26896.803	2	40
SN1012	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48465.816	26894.388	2.2	40
SN1013	Casuarina equisetifolia	Casuarinaceae	Native	Common	Tree	48461.024	26890.482	1.8	40
SN1014	Casuarina equisetifolia	Casuarinaceae	Native	Common	Tree	48465.382	26889.001	1.7	40
SN1015	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48462.271	26935.09	1.4	12
SN1016	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48467.811	26940.178	1.8	30
SN1017	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48467.719	26942.213	1.1	20
SN1018	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48464.346	26942.717	2.2	30
SN1019	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48462.536	26945.314	1.8	30
SN1020	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48459.887	26942.466	1.2	14
SN1021	Vitex pinnata	Lamiaceae	Native	Common	Tree	48449.92	26947.937	1.3	14
SN1022	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48436.622	26948.304	1.8	40
SN1023	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48429.752	26949.473	2.2	40
SN1024	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48428.071	26937.701	2	20
SN1025	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48431.681	26933.986	1	20
SN1026	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48425.673	26919.026	2	30
SN1027	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48420.222	26937.301	1.4	20
SN1028	Macaranga hypoleuca	Euphorbiaceae	Native	Common	Tree	48417.765	26949.424	1.4	20
SN1029	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48395.564	26945.573	1.4	20
SN1030	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48399.776	26941.103	1.2	20
SN1031	Planchonella obovata	Sapotaceae	Native	Common	Tree	48373.155	27069.923	1	7
SN1032	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48412.213	27071.645	1.5	7
SN1033	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48417.55	27074.347	2	20

SN1034	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48421.793	27076.269	2.2	25
SN1035	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48421.066	27078.699	1.7	20
SN1036	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48417.782	27080.363	2.8	25
SN1037	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48414.848	27084.135	1.1	18
SN1038	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48419.875	27091.953	1.2	15
SN1039	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48413.007	27085.15	1	12
SN1040	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48402.371	27083.574	1.7	16
SN1041	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48397.905	27080.329	1	16
SN1042	Cinnamomum iners	Lauraceae	Native	Common	Tree	48394.713	27079.482	1	8
SN1043	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48422.077	27096.47	4.2	25
SN1044	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48437.133	27083.911	2.5	25
SN1045	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48436.545	27090.864	2.2	12
SN1046	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48440.494	27082.97	1.1	14
SN1047	Syzygium grande	Myrtaceae	Native	Common	Tree	48439.958	27090.875	1.2	16
SN1048	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48443.613	27088.664	1.2	16
SN1049	Syzygium grande	Myrtaceae	Native	Common	Tree	48445.425	27091.741	1.3	15
SN1050	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48447.555	27091.656	2	25
SN1051	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48450.371	27086.834	2.3	25
SN1052	Syzygium grande	Myrtaceae	Native	Common	Tree	48447.149	27083.94	1	14
SN1053	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48433.055	27097.335	1	12
SN1054	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48427.617	27100.569	1.6	12
SN1055	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48427.706	27101.575	2	10
SN1056	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48443.965	27104.172	2.2	20
SN1057	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48463.783	27103.271	2.6	20
SN1058	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48470.303	27096.37	1.8	12
SN1059	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48478.872	27109.799	1.6	20
SN1060	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48481.958	27111.607	1	13
SN1061	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48499.353	27112.941	2.4	25
SN1062	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48508.229	27113.37	2.6	25
SN1063	Cinnamomum iners	Lauraceae	Native	Common	Tree	48507.448	27117.83	1.1	14
SN1064	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48516.497	27112.337	2	10
SN1065	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48523.625	27114.171	3.5	25
SN1066	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48532.992	27142.782	3.4	18

SN1067	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48526.165	27139.022	3.4	20
SN1068	Cinnamomum iners	Lauraceae	Native	Common	Tree	48507.141	27138.907	1.3	16
SN1069	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48505.961	27145.93	2.2	16
SN1070	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48497.781	27147.768	1.2	6
SN1071	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48496.903	27149.57	2.1	14
SN1072	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48490.983	27154.369	4.2	25
SN1073	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48476.501	27122.41	1.2	12
SN1074	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48476.044	27121.832	1.5	9
SN1075	Cinnamomum iners	Lauraceae	Native	Common	Tree	48472.013	27134.778	1.2	14
SN1076	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48469.38	27137.725	3.8	25
SN1077	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48472.362	27139.69	1.4	14
SN1078	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48469.004	27118.418	1.6	19
SN1079	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48467.467	27110.105	1	16
SN1080	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48463.704	27115.513	3.8	25
SN1081	Cinnamomum iners	Lauraceae	Native	Common	Tree	48459.081	27126.858	1.2	12
SN1082	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48452.246	27138.729	1.1	14
SN1083	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48429.813	27117.877	2.5	10
SN1084	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48420.044	27120.489	1.2	10
SN1085	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48420.731	27119.96	1.1	10
SN1086	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48415.031	27120.692	1.5	13
SN1087	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48405.751	27124.455	1	13
SN1088	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48415.972	27108.366	1.3	16
SN1089	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48667.29001	27232.18892	1.3	20
SN1090	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48667.52995	27233.88043	1.2	18
SN1091	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48667.31997	27234.33669	1.5	18
SN1092	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48661.58004	27228.18268	1.7	18
SN1093	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48660.46998	27228.36073	1.4	20
SN1093A	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48670.11	27235.5497	1.8	18
SN1093B	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48623.20001	27229.19525	1.8	18
SN1094	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48640.07999	27252.10863	2.4	9
SN1095	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48641.49004	27251.31852	2.5	9
SN1096	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48648.22004	27263.92699	1.3	17
SN1097	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48664.57995	27263.15918	2.3	20

SN1098	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48662.57999	27259.99872	1.3	20
SN1099	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48663.37002	27267.1654	1.2	18
SN1100	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48671.81	27264.68379	1.7	20
SN1101	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48368.03	27003.77	1	15
SN1102	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48368.883	27004.176	2	17
SN1103	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48389.608	26966.93	1.5	18
SN1104	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48420.062	26969.483	2.2	30
SN1105	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48420.806	26966.781	1.4	20
SN1106	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48424.586	26965.301	1.3	16
SN1107	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48443.328	26961.718	1.8	30
SN1108	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48459.132	26963.699	1.1	18
SN1109	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48465.722	26963.59	1.6	12
SN1110	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48467.389	26967.061	1.6	20
SN1111	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48466.56	26972.454	1.1	20
SN1112	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48464.784	26988.907	1.1	12
SN1114	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48453.152	26995.199	3	40
SN1115	Cinnamomum iners	Lauraceae	Native	Common	Tree	48444.843	27001.681	1.7	14
SN1116	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48440.672	26994.261	1.8	30
SN1117	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48436.162	26987.669	2	25
SN1118	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48418.624	26998.594	1.2	20
SN1119	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48436.483	27014.091	1.6	30
SN1120	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48453.163	27015.519	1.3	20
SN1121	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48453.809	27014.022	3.2	30
SN1122	Cinnamomum iners	Lauraceae	Native	Common	Tree	48457.332	27019.929	1	16
SN1123	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48467.455	27027.607	3.2	10
SN1124	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48447.18	27028.949	3.5	40
SN1125	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48450.814	27037.548	1.5	20
SN1126	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48446.635	27039.288	1.2	20
SN1127	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48444.425	27046.908	2.1	40
SN1128	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48447.163	27050.758	1.8	40
SN1129	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48447.747	27058.263	1.5	30
SN1130	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48446.549	27062.334	2.1	35
SN1131	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48443.671	27062.653	1.8	35

SN1132	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48437.511	27054.702	2.4	35
SN1133	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48433.311	27050.73	1.1	12
SN1134	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48429.264	27051.641	1.6	35
SN1135	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48432.257	27039.295	2.4	40
SN1136	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48434.506	27024.881	1.6	35
SN1137	Cinnamomum iners	Lauraceae	Native	Common	Tree	48438.088	27023.377	1	16
SN1138	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48427.525	27023.7	2.1	16
SN1139	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48422.201	27033.149	1.8	40
SN1140	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48413.207	27042.796	1.8	35
SN1141	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48414.507	27049.321	1.6	30
SN1142	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48417.961	27056.597	1.5	30
SN1143	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48410.408	27063.178	1.8	12
SN1144	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48417.025	27068.669	1.5	35
SN1145	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48421.024	27070.635	1.6	30
SN1146	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48459.428	27072.695	3.2	40
SN1147	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48469.217	27071.963	3.2	35
SN1148	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48470.062	27074.936	3.3	35
SN1149	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48469.206	27080.059	3.2	20
SN1150	Syzygium grande	Myrtaceae	Native	Common	Tree	48468.272	27081.121	1.6	16
SN1151	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48482.316	27086.597	4.5	35
SN1152	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48517.058	27083.456	2.5	11
SN1153	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48520.96	27078.165	5.5	50
SN1154	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48511.535	27072.831	1.1	25
SN1155	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48472.044	27044.279	2.7	50
SN1156	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48496.925	27016.816	3.2	50
SN1157	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48505.146	27022.119	2.1	50
SN1158	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48509.208	27024.413	2.4	50
SN1159	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48502.548	26996.936	1.8	40
SN1160	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48503.148	26990.695	2.4	40
SN1161	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48506.082	26992.442	2.5	40
SN1162	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48515.094	26988.584	2.2	16
SN1163	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48495.281	26975.519	3.2	50
SN1164	Cinnamomum iners	Lauraceae	Native	Common	Tree	48489.068	26987.802	1.5	10

SN1165	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48663.05	27202.034	3.2	25
SN1166	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48651.552	27175.956	1.5	12
SN1167	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48648.371	27174.045	1	10
SN1168	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48635.517	27172.465	1.7	12
SN1169	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48631.946	27162.148	2	12
SN1170	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48624.17	27155.198	2	16
SN1171	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48619.237	27159.719	1.8	15
SN1172	Planchonella obovata	Sapotaceae	Native	Common	Tree	48621.513	27157.988	0.9	10
SN1173	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48622.03	27161.125	1.1	14
SN1174	Ficus microcarpa	Moraceae	Native	Common	Strangler	48621.249	27148.047	4	20
SN1175	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48627.885	27142.725	1.2	20
SN1176	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48627.154	27139.117	1.5	14
SN1177	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48625.348	27124.643	2.4	20
SN1178	Cinnamomum iners	Lauraceae	Native	Common	Tree	48627.577	27116.973	1.8	14
SN1179	Samanea saman	Fabaceae	Exotic	Casual	Tree	48637.527	27114.86	1.7	30
SN1180	Samanea saman	Fabaceae	Exotic	Casual	Tree	48642.853	27115.787	1.3	30
SN1181	Samanea saman	Fabaceae	Exotic	Casual	Tree	48654.43	27102.604	3.5	30
SN1182	Cinnamomum iners	Lauraceae	Native	Common	Tree	48656.715	27092.68	1	12
SN1183	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48656.271	27086.866	1.2	16
SN1184	Samanea saman	Fabaceae	Exotic	Casual	Tree	48645.081	27078.857	2.5	30
SN1185	Samanea saman	Fabaceae	Exotic	Casual	Tree	48631.123	27087.652	2.6	30
SN1186	Samanea saman	Fabaceae	Exotic	Casual	Tree	48626.833	27079.958	1.3	25
SN1187	Samanea saman	Fabaceae	Exotic	Casual	Tree	48624.579	27080.567	1.9	30
SN1188	Samanea saman	Fabaceae	Exotic	Casual	Tree	48624.049	27078.028	1.5	30
SN1189	Samanea saman	Fabaceae	Exotic	Casual	Tree	48615.263	27077.862	1.5	30
SN1190	Samanea saman	Fabaceae	Exotic	Casual	Tree	48615.368	27084.585	1.9	30
SN1191	Samanea saman	Fabaceae	Exotic	Casual	Tree	48607.939	27086.757	3	30
SN1192	Claoxylon indicum	Euphorbiaceae	Native	Common	Tree	48611.662	27103.254	1.2	12
SN1193	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48616.499	27110.267	1	10
SN1194	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48610.731	27124.832	3	40
SN1195	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48603.659	27129.575	2.8	40
SN1196	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48600.738	27130.443	2.8	40
SN1197	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48597.572	27126.525	1.4	30

SN1198	Cinnamomum iners	Lauraceae	Native	Common	Tree	48629.171	27114.186	1.8	14
SN1199	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48608.315	27065.32	1.8	14
SN1200	Samanea saman	Fabaceae	Exotic	Casual	Tree	48600.326	27067.048	1.8	50
SN1201	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48657.36004	27270.34809	1.3	18
SN1202	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48649.46001	27270.27017	1.2	18
SN1203	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48647.89004	27281.50983	1	18
SN1204	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48643.70997	27281.56546	1.8	20
SN1205	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48641.68001	27291.09134	2	20
SN1206	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48641.69004	27300.51708	1.6	18
SN1207	Acacia mangium	Fabaceae	Exotic	Naturalised	Tree	48649.21998	27299.11493	1.6	16
SN1208	Mallotus paniculatus	Euphorbiaceae	Native	Common	Tree	48633.70996	27297.31209	1.1	10
SN1209	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48619.86003	27287.08507	1.3	12
SN1210	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48607.33996	27287.14067	3.2	16
SN1211	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48609.25998	27286.89585	3	18
SN1212	Cinnamomum iners	Lauraceae	Native	Common	Tree	48593.57996	27265.01741	1	10
SN1213	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48599.46	27266.6533	1.4	10
SN1214	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48594.02003	27270.64838	1.2	11
SN1215	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48602.07995	27271.14918	1.8	15
SN1216	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48603.15994	27268.83448	2	9
SN1217	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48609.75998	27257.13857	1.3	11
SN1218	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48607.94997	27258.26253	1	8
SN1219	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48608.77997	27252.49803	1.3	14
SN1220	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48609.39996	27253.08784	1.4	13
SN1221	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48613.47002	27246.93386	1.1	15
SN1222	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48614.63004	27254.44551	1.6	14
SN1223	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48615.72995	27247.24546	1.2	9
SN1224	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48626.57995	27268.0333	1.3	9
SN1225	Cinnamomum iners	Lauraceae	Native	Common	Tree	48584.01004	27259.64238	1.3	9
SN1226	Cinnamomum iners	Lauraceae	Native	Common	Tree	48579.06005	27257.95085	1.6	8
SN1227	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48588.00004	27256.77127	1.3	16
SN1228	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48561.68003	27241.58095	1	13
SN1229	Terminalia catappa	Combretaceae	Native	Common	Tree	48558.89	27241.18032	2.2	15
SN1230	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48508.43996	27235.80516	3	16

SN1231	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48506.67	27230.48578	1.2	10
SN1232	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48499.72997	27234.58101	1.3	10
SN1233	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48490.99004	27224.43189	2.8	20
SN1234	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48492.76005	27213.74865	4.5	25
SN1235	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48494.37999	27206.19248	1.1	11
SN1236	Cinnamomum iners	Lauraceae	Native	Common	Tree	48478.54002	27204.05578	1	9
SN1237	Ficus microcarpa	Moraceae	Native	Common	Strangler	48492.77996	27211.34492	9	18
SN1237A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48495.03004	27212.99193	9	18
SN1237B	Ficus microcarpa	Moraceae	Native	Common	Strangler	48498.82995	27213.16999	9	18
SN1238	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48475.12004	27242.80481	3	15
SN1239	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48485.47	27232.90058	3.4	11
SN1240	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48559.76999	27265.38455	3	11
SN1241	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48544.13004	27266.71991	2.6	15
SN1242	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48547.10996	27257.56126	1.6	13
SN1243	Ficus benjamina	Moraceae	Cryptogenic	-	Strangler	48567.5332	27281.04221	6	15
SN1244	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48565.75997	27299.12582	2.2	13
SN1245	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48594.24997	27291.4807	4	12
SN1246	Ficus microcarpa	Moraceae	Native	Common	Strangler	48616.27995	27323.96451	10	13
SN1246A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48604.72998	27312.62466	10	13
SN1246B	Ficus microcarpa	Moraceae	Native	Common	Strangler	48616.38002	27324.07579	10	13
SN1247	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48621.11995	27317.44329	2.6	12
SN1248	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48624.03999	27327.51448	2.2	14
SN1249	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48671.21002	27302.27545	4.6	13
SN1249A	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48715.30003	27263.2261	1.2	18
SN1250	Pterocarpus indicus	Fabaceae	Exotic	Casual	Tree	48577.66988	27228.40499	1.2	15
SN1251	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48594.98042	27219.83619	1	9
SN1252	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48598.05992	27223.06343	1.1	10
SN1253	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48596.43005	27222.95214	1.1	10
SN1254	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48603.09992	27226.1794	1	10
SN1255	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48606.24024	27228.2938	1.8	12
SN1256	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48611.43948	27226.73584	1.1	12
SN1257	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48606.0202	27228.9615	1.6	12
SN1258	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48611.9802	27224.17631	1.4	13

SN1259	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48609.8704	27236.19496	1.2	11
SN1260	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48595.51996	27240.4237	1.6	16
SN1261	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48592.39956	27230.18558	1.7	12
SN1262	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48584.5699	27182.4448	1.8	10
SN1263	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48561.9805	27192.79412	1	10
SN1264	Elaeis guineensis	Arecaceae	Exotic	Casual	Tree	48515.79011	27160.85551	1	10
SN1265	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48516.24015	27162.19092	1.6	13
SN1266	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48589.17997	27124.68852	4	25
SN1267	Samanea saman	Fabaceae	Exotic	Casual	Tree	48626.43961	27043.78534	1.8	18
SN1268	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48443.613	27088.664	1.4	18
SN1269	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48523.625	27114.171	3.5	25
SN1270	Planchonella obovata	Sapotaceae	Native	Common	Tree	48483.498	27205.035	1	12
SN1271	Litsea umbellata	Lauraceae	Native	Vulnerable	Shrub	48490.245	27149.616	0.3	7
SN1272	Lindera lucida	Lauraceae	Native	Vulnerable	Tree	48480.514	27127.804	0.5	8
SN1301	Samanea saman	Fabaceae	Exotic	Casual	Tree	48609.624	27074.218	1.5	40
SN1302	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48591.437	27077.63	4	50
SN1303	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48557.651	27028.975	4	40
SN1304	Pterocarpus indicus	Fabaceae	Exotic	Casual	Tree	48538.831	27019.649	1.9	20
SN1305	Pterocarpus indicus	Fabaceae	Exotic	Casual	Tree	48534.786	27017.638	3	20
SN1306	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48529.732	27027.544	2.7	20
SN1307	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48515.973	27010.793	1.6	30
SN1308	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48517.073	27007.527	2.5	40
SN1309	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48516.217	27004.331	1.1	20
SN1310	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48528.382	26996.949	3	50
SN1311	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48500.744	26993.513	1.1	16
SN1312	Acacia auriculiformis	Fabaceae	Exotic	Naturalised	Tree	48493.978	27012.036	1.2	20
SN1313	Pittosporum ridleyi	Pittosporaceae	Native	Vulnerable	Tree	48515.865	26961.432	0.6	10
SN1314	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48512.996	26959.718	1.2	6
SN1315	Ficus microcarpa	Moraceae	Native	Common	Strangler	48455.214	27204.021	10	20
SN1315A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48456.389	27208.287	10	20
SN1315B	Ficus microcarpa	Moraceae	Native	Common	Strangler	48461.41	27201.818	10	20
SN1316	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48458.442	27197.091	2.1	40
SN1317	Senna siamea	Fabaceae	Exotic	Cultivated	Tree	48448.853	27196.405	1.5	14

SN1318	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48448.152	27194.291	1.1	16
SN1319	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48449.386	27189.635	1.7	40
SN1320	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48447.973	27188.12	1.7	14
SN1321	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48450.385	27184.124	1.7	40
SN1322	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48451.844	27180.32	3	50
SN1323	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48452.131	27171.441	1.8	50
SN1324	Ficus microcarpa	Moraceae	Native	Common	Strangler	48442.257	27174.753	12	20
SN1324A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48440.808	27174.581	12	20
SN1324B	Ficus microcarpa	Moraceae	Native	Common	Strangler	48437.701	27175.158	12	20
SN1325	Planchonella obovata	Sapotaceae	Native	Common	Tree	48432.279	27176.787	0.7	14
SN1326	Planchonella obovata	Sapotaceae	Native	Common	Tree	48428.234	27177.645	1.1	14
SN1327	Ficus microcarpa	Moraceae	Native	Common	Strangler	48425.803	27175.778	10	16
SN1327A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48425.34	27171.523	10	16
SN1327B	Ficus microcarpa	Moraceae	Native	Common	Strangler	48433.925	27174.238	10	16
SN1328	Adenanthera pavonina	Fabaceae	Exotic	Naturalised	Tree	48420.16	27161.34	1	8
SN1329	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48422.175	27158.566	1.3	14
SN1330	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48424.726	27156.47	1.3	14
SN1331	Cecropia pachystachya	Urticaceae	Exotic	Naturalised	Tree	48426.607	27151.41	1.2	8
SN1332	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48427.443	27149.26	1.4	12
SN1333	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48427.802	27149.653	1	12
SN1334	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48436.619	27149.15	2.5	50
SN1335	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48437.921	27145.549	1.7	50
SN1336	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48443.256	27146.558	1.3	14
SN1337	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48444.246	27146.449	1.3	14
SN1338	Spathodea campanulata	Bignoniaceae	Exotic	Naturalised	Tree	48448.214	27141.731	1.5	18
SN1339	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48429.338	27138.602	1	14
SN1340	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48411.172	27129.405	1.6	16
SN1341	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48408.424	27129.073	1	16
SN1342	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48403.48	27126.04	1.2	16
SN1343	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48400.876	27124.077	1.2	14
SN1344	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48395.58	27122.281	1	14
SN1345	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48392.56	27120.869	1.6	20
SN1346	Cinnamomum iners	Lauraceae	Native	Common	Tree	48385.827	27117.359	1	16

SN1347	Cinnamomum iners	Lauraceae	Native	Common	Tree	48380.886	27118.587	1	10
SN1348	Cinnamomum iners	Lauraceae	Native	Common	Tree	48380.295	27120.398	1	12
SN1348A	Syzygium polyanthum	Myrtaceae	Native	Common	Tree	48387.905	27126.082	1.5	20
SN1349	Horsfieldia crassifolia	Myristicaceae	Native	Critically endangered	Tree	48396.432	27111.038	0.3	6
SN1350	Sterculia parviflora	Malvaceae	Native	Critically endangered	Tree	48403.106	27107.313	0.8	12
SN1351	Sterculia parviflora	Malvaceae	Native	Critically endangered	Tree	48393.165	27103.506	0.3	6
SN1352	Peltophorum pterocarpum	Fabaceae	Native	Critically endangered	Tree	48415.355	27184.857	3.2	20
SN1353	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48438.758	27200.136	1.1	10
SN1354	Planchonella obovata	Sapotaceae	Native	Common	Tree	48485.275	27167.087	1.5	20
SN1355	Ficus microcarpa	Moraceae	Native	Common	Strangler	48491.113	27185.347	20	25
SN1355A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48487.083	27188.493	20	25
SN1355B	Ficus microcarpa	Moraceae	Native	Common	Strangler	48494.003	27191.848	20	25
SN1356	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48497.737	27189.615	2.6	50
SN1357	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48510.871	27195.295	2.6	50
SN1358	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48514.365	27203.29	3	50
SN1359	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48518.58	27189.36	2.6	50
SN1360	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48529.551	27177.6	1.2	16
SN1361	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48398.567	27034.184	2.3	20
SN1362	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48401.128	27026.46	2	20
SN1363	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48407.522	27025.829	1	22
SN1364	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48410.292	27025.319	1.9	22
SN1365	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48413.508	27011.122	2.5	22
SN1366	Falcataria falcata	Fabaceae	Exotic	Naturalised	Tree	48408.795	27004.068	1.2	20
SN1367	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48395.04	27001.305	1.2	12
SN1368	Alstonia angustiloba	Apocynaceae	Native	Common	Tree	48379.721	26994.669	1.1	15
SN1369	Macaranga heynei	Euphorbiaceae	Native	Common	Tree	48373.77	26998.428	1.1	16
SN1370	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48369.624	27000.832	1.2	15
SN1371	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48527.696	27176.629	1	16
SN1372	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48525.433	27175.083	1	14
SN1373	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48507.904	27181.518	1.2	16
SN1374	Cinnamomum iners	Lauraceae	Native	Common	Tree	48538.698	27197.346	1.2	10
SN1375	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48542.092	27200.157	1	18
SN1376	Macaranga gigantea	Euphorbiaceae	Native	Common	Tree	48542.603	27201.84	1	18

SN1377	Cyrtophyllum fragrans	Gentianaceae	Native	Common	Tree	48547.325	27203.349	2.4	20
SN1378	Nephelium lappaceum	Sapindaceae	Cryptogenic	-	Tree	48552.189	27204.963	1.1	16
SN1379	Ficus microcarpa	Moraceae	Native	Common	Strangler	48552.97	27204.684	8	25
SN1379A	Ficus microcarpa	Moraceae	Native	Common	Strangler	48555.927	27202.896	8	25
SN1379B	Ficus microcarpa	Moraceae	Native	Common	Strangler	48553.832	27200.133	8	25
SN1380	Syzygium grande	Myrtaceae	Native	Common	Tree	48539.245	27208.469	1	16

Appendix I
List of Recorded Faunal Species and Probable Species of Conservation Significance

Delivering a better world

Faunal group	Total no. of recorded species		No. of probable CS species
	All species	CS species	
Odonates	**21**	**0**	**1**
Dragonflies	18	0	0
Damselflies	3	0	1
Butterflies	**52**	**0**	**21**
Aculeata	**29**	**0**	**5**
Herpetofauna	**22**	**0**	**2**
Amphibians	8	0	0
Reptiles	14	0	2
Birds	**62**	**9**	**31**
Mammals	**17**	**5**	**7**
Non-volant Mammals	9	3	3
Bats	8	2	4
Fish	**4**	**0**	**1**
Mollusc	**3**	**0**	**0**
Decapod Crusatceans	**1**	**0**	**0**
Total	**211**	**14**	**68**

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (NParks, 2023)	Recorded Species
1	Dragonfly	Aeshnidae	*Gynacantha sp.*	Duskhawker sp.	NA	NA	NA	Yes
2	Damselfly	Coenagrionidae	*Nesoxenia lineata*	Ornate coraltail	Least Concern	Least Concern	Widespread and Common	Yes
3	Damselfly	Coenagrionidae	*Orthetrum testaceum*	Variable wisp	Least Concern	Least Concern	Widespread and Common	Yes
4	Damselfly	Coenagrionidae	*Rhyothemis obsolescens*	Violet sprite	Least Concern	Least Concern	Widespread and Common	Yes
5	Dragonfly	Libellulidae	*Agriocnemis femina*	Blue percher	Least Concern	Least Concern	Widespread and Common	Yes
6	Dragonfly	Libellulidae	*Agrionoptera insignis*	Bronze flutterer	Least Concern	Least Concern	Widespread but Uncommon	Yes
7	Dragonfly	Libellulidae	*Archibasis viola*	Common blue skimmer	Least Concern	Least Concern	Widespread and Common	Yes
8	Dragonfly	Libellulidae	*Ceriagrion cerinorubellum*	Common parasol	Least Concern	Least Concern	Widespread and Common	Yes
9	Dragonfly	Libellulidae	*Crocothemis servilia*	Common scarlet	Least Concern	Least Concern	Widespread and Common	Yes
10	Dragonfly	Libellulidae	*Diplacodes trivialis*	Crimson dropwing	Least Concern	Least Concern	Widespread and Common	Yes
11	Dragonfly	Libellulidae	*Hydrobasileus croceus*	Grenadier	Least Concern	Least Concern	Widespread and Common	Yes
12	Dragonfly	Libellulidae	*Lathrecista asiatica*	Indigo dropwing	Least Concern	Least Concern	Widespread and Common	Yes
13	Dragonfly	Libellulidae	*Neurothemis fluctuans*	Scarlet grenadier	Least Concern	Least Concern	Widespread and Common	Yes
14	Dragonfly	Libellulidae	*Orthetrum chrysis*	Scarlet skimmer	Least Concern	Least Concern	Widespread and Common	Yes
15	Dragonfly	Libellulidae	*Orthetrum glaucum*	Slender blue skimmer	Least Concern	Least Concern	Widespread and Common	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (NParks, 2023)	Recorded Species
16	Dragonfly	Libellulidae	*Orthetrum luzonicum*	Spine-tufted skimmer	Least Concern	Least Concern	Widespread and Common	Yes
17	Dragonfly	Libellulidae	*Orthetrum sabina*	Striped grenadier	Least Concern	Least Concern	Widespread but Uncommon	Yes
18	Dragonfly	Libellulidae	*Pantala flavescens*	Variegated green skimmer	Least Concern	Least Concern	Widespread and Common	Yes
19	Dragonfly	Libellulidae	*Rhyothemis phyllis*	Wandering glider	Least Concern	Least Concern	Widespread and Common	Yes
20	Dragonfly	Libellulidae	*Trithemis aurora*	Water monarch	Least Concern	Least Concern	Widespread and Common	Yes
21	Dragonfly	Libellulidae	*Trithemis festiva*	Yellow-barred flutterer	Least Concern	Least Concern	Widespread and Common	Yes
22	Damselfly	Platycnemididae	*Copera vittata*	Variable featherlegs	Least Concern	Vulnerable	Restricted and Rare	No

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks 2023)	Recorded Species
1	Bee	Apidae	*Amegilla andrewsi*	Andrew's blue-banded digger bee	Not Listed	Least Concern	Yes
2	Bee	Apidae	*Apis andreniformis*	NA	Not Listed	Least Concern	Yes
3	Bee	Apidae	*Apis cerana*	Eastern honey bee	Not Listed	Least Concern	Yes
4	Bee	Apidae	*Apis dorsata*	NA	Not Listed	Least Concern	Yes
5	Bee	Apidae	*Apis florea*	NA	Not Listed	Least Concern	Yes
6	Bee	Apidae	*Thyreus himalayensis*	NA	Not Listed	Least Concern	Yes
7	Bee	Apidae	*Thyreus lilacinus*	NA	Not Listed	Least Concern	Yes
8	Bee	Apidae	*Xylocopa flavonigrescens*	NA	Not Listed	Least Concern	Yes
9	Bee	Apidae	*Xylocopa latipes*	Broad-handed carpenter bee	Not Listed	Least Concern	Yes
10	Wasp	Crabronidae	*Dasyproctus agilis*	NA	Not Listed	Data deficient	Yes
11	Wasp	Crabronidae	*Liris subtessellatus*	NA	Not Listed	Least Concern	Yes
12	Wasp	Crabronidae	*Tachytes cf. modestus*	NA	Not Listed	Least Concern	Yes
13	Bee	Halictidae	*Lipotriches ceratina*	NA	Not Listed	Least Concern	Yes
14	Bee	Halictidae	*Lipotriches takauensis*		Not Listed	Vulnerable	No
15	Bee	Halictidae	*Nomia iridescens*	NA	Not Listed	Least Concern	Yes
16	Bee	Halictidae	*Nomia strigata*	Pearly-banded bee	Not Listed	Least Concern	Yes
17	Bee	Megachilidae	*Anthidiellum smithii*		Not Listed	Vulnerable	No
18	Bee	Megachilidae	*Megachile ornata*		Not Listed	Vulnerable	No
19	Bee	Megachilidae	*Megachile ramera*		Not Listed	Vulnerable	No
20	Wasp	Sphecidae	*Chalybion bengalense*	NA	Not Listed	Least Concern	Yes
21	Wasp	Vespidae	*Antepipona sp. nr. Bipustulata*	NA	Not Listed	Least Concern	Yes
22	Wasp	Vespidae	*Delta pyriforme*	NA	Not Listed	Least Concern	Yes
23	Wasp	Vespidae	*Liostenogaster nitidipennis*	NA	Not Listed	Near Threatened	Yes
24	Wasp	Vespidae	*Liostenogaster varipicta*	NA	Not Listed	Near Threatened	Yes
25	Wasp	Vespidae	*Parapolybia varia*	Lesser paper wasp	Not Listed	Near Threatened	Yes
26	Wasp	Vespidae	*Parischnogaster mellyi*	NA	Not Listed	Least Concern	Yes
27	Wasp	Vespidae	*Parischnogaster nigricans*	NA	Not Listed	Least Concern	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks 2023)	Recorded Species
28	Wasp	Vespidae	*Parischnogaster unicuspata*		Not Listed	Vulnerable	No
29	Wasp	Vespidae	*Ropalidia stigma*	NA	Not Listed	Least Concern	Yes
30	Wasp	Vespidae	*Ropalidia sumatrae*	NA	Not Listed	Least Concern	Yes
31	Wasp	Vespidae	*Stenodyneriellus guttulatus*	NA	Not Listed	Least Concern	Yes
32	Wasp	Vespidae	*Vespa affinis*	Lesser banded hornet	Not Listed	Least Concern	Yes
33	Wasp	Vespidae	*Vespa analis*	NA	Not Listed	Least Concern	Yes
34	Wasp	Vespidae	*Vespa tropica*	Greater banded hornet	Not Listed	Least Concern	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (Khew, 2015)	Recorded Species
1	Butterfly	Hesperiidae	*Ampittia dioscorides camertes*	Bush hopper	Not Listed	Least Concern	Moderately common	Yes
2	Butterfly	Hesperiidae	*Astictopterus jama jama*	Forest hopper	Not Listed	Endangered	Moderately rare	No
3	Butterfly	Hesperiidae	*Bibasis harisa consobrina*	Orange awlet	Not Listed	Least Concern	Moderately rare	Yes
4	Butterfly	Hesperiidae	*Caltoris cormasa*	Full stop swift	Not Listed	Least Concern	Moderately rare	Yes
5	Butterfly	Hesperiidae	*Caltoris philippina philippina*	Philippine swift	Not Listed	Vulnerable	Rare	No
6	Butterfly	Hesperiidae	*Cephrenes acalle niasicus*	Plain palm dart	Not Listed	Vulnerable	Moderately rare	No
7	Butterfly	Hesperiidae	*Cephrenes trichopepla*	Yellow palm dart	Not Listed	Least Concern	Common	Yes
8	Butterfly	Hesperiidae	*Eetion elia*	White spot palmer	Not Listed	Vulnerable	Moderately rare	No
9	Butterfly	Hesperiidae	*Erionota acroleuca apicalis*	White tipped banana skipper	Not Listed	Least Concern	Moderately rare	Yes
10	Butterfly	Hesperiidae	*Erionota thrax thrax*	Banana skipper	Not Listed	Least Concern	Moderately common	Yes
11	Butterfly	Hesperiidae	*Halpe ormenes vilasina*	Dark banded ace	Not Listed	Vulnerable	Rare	No
12	Butterfly	Hesperiidae	*Iambrix salsala salsala*	Chestnut bob	Not Listed	Least Concern	Common	Yes
13	Butterfly	Hesperiidae	*Matapa aria*	Common redeye	Not Listed	Least Concern	Moderately rare	Yes
14	Butterfly	Hesperiidae	*Pelopidas assamensis*	Great swift	Not Listed	Endangered	Moderately rare	No
15	Butterfly	Hesperiidae	*Pelopidas conjunctus conjunctus*	Conjoined swift	Not Listed	Endangered	Moderately rare	No
16	Butterfly	Hesperiidae	*Pelopidas mathias mathias*	Small branded swift	Not Listed	Least Concern	Common	Yes
17	Butterfly	Hesperiidae	*Pemara pugnans*	Pugnacious lancer	Not Listed	Vulnerable	Very rare	No
18	Butterfly	Hesperiidae	*Plastingia naga*	Chequered lancer	Not Listed	Least Concern	Moderately common	Yes
19	Butterfly	Hesperiidae	*Polytremis lubricans lubricans*	Contiguous swift	Not Listed	Least Concern	Common	Yes
20	Butterfly	Hesperiidae	*Potanthus omaha omaha*	Lesser dart	Not Listed	Least Concern	Common	Yes
21	Butterfly	Hesperiidae	*Pseudocoladenia dan dhyana*	Fulvous pied flat	Not Listed	Vulnerable	Moderately rare	No
22	Butterfly	Hesperiidae	*Tapena thwaitesi bornea*	Dark flat	Not Listed	Vulnerable	Moderately rare	No
23	Butterfly	Hesperiidae	*Telicota augias augias*	Pale palm dart	Not Listed	Vulnerable	Moderately common	No
24	Butterfly	Hesperiidae	*Telicota linna*	Linna palm dart	Not Listed	Vulnerable	Moderately rare	No
25	Butterfly	Lycaenidae	*Arhopala abseus abseus*	Aberrant oakblue	Not Listed	Least Concern	Moderately rare	Yes
26	Butterfly	Lycaenidae	*Arhopala aurea*	NA	Not Listed	Endangered	Very rare	No
27	Butterfly	Lycaenidae	*Arhopala centaurus nakula*	Centaur oakblue	Not Listed	Least Concern	Moderately common	Yes
28	Butterfly	Lycaenidae	*Arhopala myrzala lammas*	Malayan oakblue	Not Listed	Vulnerable	Very rare	No

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (Khew, 2015)	Recorded Species
29	Butterfly	Lycaenidae	*Catochrysops strabo strabo*	Forget-me-not	Not Listed	Vulnerable	Moderately rare	No
30	Butterfly	Lycaenidae	*Chilades pandava pandava*	Cycad blue	Not Listed	Least Concern	Common	Yes
31	Butterfly	Lycaenidae	*Everes lacturnus rileyi*	Indian cupid	Not Listed	Endangered	Rare	No
32	Butterfly	Lycaenidae	*Horaga syrinx maenala*	Ambon onyx	Not Listed	Vulnerable	Moderately common	No
33	Butterfly	Lycaenidae	*Hypolycaena thecloides thecloides*	Dark tit	Not Listed	Least Concern	Moderately rare	Yes
	Butterfly	Lycaenidae	*Miletus sp.*	NA	NA	NA	NA	Yes
34	Butterfly	Lycaenidae	*Prosotas dubiosa lumpura*	Tailless line blue	Not Listed	Least Concern	Common	Yes
35	Butterfly	Lycaenidae	*Rachana jalindra burbona*	Banded royal	Not Listed	Vulnerable	Very rare	No
36	Butterfly	Lycaenidae	*Virachola kessuma deliochus*	Pitcher blue	Not Listed	Endangered	Rare	No
37	Butterfly	Lycaenidae	*Zizeeria maha serica*	Pale grass blue	Not Listed	Least Concern	Common	Yes
38	Butterfly	Lycaenidae	*Zizina otis lampa*	Lesser grass blue	Not Listed	Least Concern	Common	Yes
39	Butterfly	Lycaenidae	*Zizula hylax pygmaea*	Pygmy grass blue	Not Listed	Least Concern	Common	Yes
40	Butterfly	Nymphalidae	*Acraea terpsicore*	Tawny coster	Not Listed	Least Concern	Common	Yes
41	Butterfly	Nymphalidae	*Danaus chrysippus chrysippus*	Plain tiger	Not Listed	Least Concern	Common	Yes
42	Butterfly	Nymphalidae	*Discophora sondaica despoliata*	Common duffer	Not Listed	Endangered	Rare	No
43	Butterfly	Nymphalidae	*Dryas iulia*	Julia heliconian	Not Listed	Not Evaluated	NA	Yes
44	Butterfly	Nymphalidae	*Elymnias hypermnestra agina*	Common palmfly	Not Listed	Least Concern	Common	Yes
45	Butterfly	Nymphalidae	*Elymnias panthera panthera*	Tawny palmfly	Not Listed	Near threatened	Moderately common	Yes
46	Butterfly	Nymphalidae	*Euthalia aconthea gurda*	Baron	Not Listed	Least Concern	Common	Yes
47	Butterfly	Nymphalidae	*Hypolimnas anomala anomala*	Malayan eggfly	Not Listed	Least Concern	Common	Yes
48	Butterfly	Nymphalidae	*Ideopsis vulgaris macrina*	Blue glassy tiger	Not Listed	Least Concern	Common	Yes
49	Butterfly	Nymphalidae	*Junonia almana javana*	Peacock pansy	Least Concern	Least Concern	Common	Yes
50	Butterfly	Nymphalidae	*Junonia atlites atlites*	Grey pansy	Not Listed	Least Concern	Moderately common	Yes
51	Butterfly	Nymphalidae	*Junonia hedonia ida*	Chocolate pansy	Not Listed	Least Concern	Common	Yes
52	Butterfly	Nymphalidae	*Junonia orithya wallacei*	Blue pansy	Not Listed	Least Concern	Common	Yes
53	Butterfly	Nymphalidae	*Moduza procris milonia*	Commander	Not Listed	Least Concern	Moderately common	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (Khew, 2015)	Recorded Species
54	Butterfly	Nymphalidae	*Mycalesis mineus macromalayana*	Dark brand bush brown	Not Listed	Least Concern	Common	Yes
55	Butterfly	Nymphalidae	*Mycalesis perseoides perseoides*	Burmese bush brown	Not Listed	Least Concern	Common	Yes
56	Butterfly	Nymphalidae	*Mycalesis visala phamis*	Long brand bush brown	Not Listed	Near threatened	Moderately common	Yes
57	Butterfly	Nymphalidae	*Neptis hylas papaja*	Common sailor	Not Listed	Least Concern	Moderately common	Yes
58	Butterfly	Nymphalidae	*Orsotriaena medus cinerea*	Dark grass brown	Not Listed	Least Concern	Common	Yes
59	Butterfly	Nymphalidae	*Phalanta phalantha phalantha*	Leopard	Not Listed	Least Concern	Common	Yes
60	Butterfly	Nymphalidae	*Polyura hebe plautus*	Plain nawab	Not Listed	Least Concern	Common	Yes
61	Butterfly	Papilionidae	*Chilasa clytia clytia*	Common mime	Not Listed	Least Concern	Common	Yes
62	Butterfly	Papilionidae	*Graphium agamemnon agamemnon*	Tailed jay	Not Listed	Least Concern	Common	Yes
63	Butterfly	Papilionidae	*Graphium sarpedon luctatius*	Common bluebottle	Not Listed	Least Concern	Common	Yes
64	Butterfly	Papilionidae	*Papilio demoleus malayanus*	Lime butterfly	Not Listed	Least Concern	Common	Yes
65	Butterfly	Papilionidae	*Papilio polytes romulus*	Common mormon	Not Listed	Least Concern	Common	Yes
66	Butterfly	Papilionidae	*Troides helena cerberus*	Common birdwing	Not Listed	Vulnerable	Moderately common	No
67	Butterfly	Pieridae	*Appias libythea olferna*	Striped albatross	Not Listed	Least Concern	Common	Yes
68	Butterfly	Pieridae	*Catopsilia pomona pomona*	Lemon emigrant	Not Listed	Least Concern	Common	Yes
69	Butterfly	Pieridae	*Catopsilia pyranthe pyranthe*	Mottled emigrant	Not Listed	Least Concern	Common	Yes
70	Butterfly	Pieridae	*Delias hyparete metarete*	Painted jezebel	Not Listed	Least Concern	Common	Yes
71	Butterfly	Pieridae	*Eurema blanda snelleni*	Three spot grass yellow	Not Listed	Least Concern	Common	Yes
72	Butterfly	Pieridae	*Eurema hecabe contubernalis*	Common grass yellow	Not Listed	Least Concern	Common	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Recorded Species
1	Freshwater fish	Cyprinidae	*Barbodes rhombeus*	Indochinese spotted barb	Least Concern	Not Evaluated	Yes
2	Freshwater fish	Gobiidae	*Rhinogobius similis*	Barcheek goby	Least Concern	Not Evaluated	Yes
3	Freshwater fish	Osphronemidae	*Trichopodus trichopterus*	Threespot gourami	Least Concern	Vulnerable	No
4	Freshwater fish	Poeciliidae	*Gambusia affinis*	Mosquitofish	Least Concern	Not Evaluated	Yes
5	Freshwater fish	Poeciliidae	*Poecilia reticulata*	Guppy	Least Concern	Not Evaluated	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (Davison et al. 2008)	Recorded Species
1	Freshwater gastropod	Lymnaeidae	*Radix rubiginosa*	NA	Not Listed	Not Evaluated	Yes
2	Freshwater gastropod	Physidae	*Physa acuta*	NA	Not Listed	Not Evaluated	Yes
3	Freshwater gastropod	Thiaridae	*Melanoides tuberculata*	NA	Least Concern	Not Evaluated	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (Davison et al. 2008)	Recorded Species
1	Freshwater shrimp	Palaemonidae	*Macrobrachium sp.*	NA	NA	NA	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (Figueroa et al. 2023)	Recorded Species
1	Frog	Bufonidae	*Duttaphrynus bengalensis*	Indian toad	Least Concern	NA	Widespread and Common	Yes
2	Frog	Dicroglossidae	*Limnonectes blythii*	Malayan giant frog	Near Threatened	Least Concern	Widespread and Common	Yes
3	Frog	Eleutherodactylidae	*Eleutherodactylus planirostris*	Greenhouse frog	Least Concern	Not Evaluated	Widespread and Common	Yes
4	Frog	Microhylidae	*Kaloula pulchra*	Banded bull frog	Least Concern	Not Evaluated	Widespread and Common	Yes
5	Frog	Microhylidae	*Microhyla butleri*	Painted chorus frog	Least Concern	Least Concern	Widespread and Common	Yes
6	Frog	Microhylidae	*Microhyla heymonsi*	Dark-sided chorus frog	Least Concern	Least Concern	Widespread and Common	Yes
7	Frog	Microhylidae	*Microhyla mukhlesuri*	East Asian ornate chorus frog	Least Concern	Not Evaluated	Restricted and Rare	Yes
8	Frog	Rhacophoridae	*Polypedates leucomystax*	Four-lined tree frog	Least Concern	Least Concern	Widespread and Common	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (Figueroa et al. 2023)	Recorded Species
1	Lizard	Agamidae	*Bronchocela cristatella*	*Green crested lizard*	Not Listed	Least Concern	Widespread but Uncommon	Yes
2	Lizard	Agamidae	*Calotes versicolor*	*Changeable lizard*	Not Listed	Not Evaluated	Widespread and Common	Yes
3	Lizard	Agamidae	*Draco sumatranus*	*Sumatran flying dragon*	Not Listed	Least Concern	Widespread and Common	Yes
4	Snake	Colubridae	*Chrysopelea paradisi*	*Paradise gliding snake*	Least Concern	Least Concern	Widespread and Common	Yes
5	Snake	Colubridae	*Dendrelaphis caudolineatus*	*Striped bronzeback*	Least Concern	Least Concern	Widespread and Common	Yes
6	Snake	Colubridae	*Dendrelaphis pictus*	*Painted bronzeback*	Least Concern	Least Concern	Widespread and Common	Yes
7	Snake	Colubridae	*Sibynophis melanocephalus*	*Black-headed collared snake*	Least Concern	Vulnerable	Wide-ranging but Uncommon	No
8	Snake	Elapidae	*Naja sumatrana*	*Equatorial spitting cobra*	Least Concern	Least Concern	Widespread and Common	Yes
9	Lizard	Gekkonidae	*Gekko monarchus*	*Spotted house gecko*	Not Listed	Least Concern	Widespread and Common	Yes
10	Lizard	Gekkonidae	*Hemidactylus brookii*	*Brooke's house gecko*	Not Listed	Not Evaluated	Restricted and Rare	Yes
11	Lizard	Gekkonidae	*Hemidactylus frenatus*	*Spiny-tailed house gecko*	Least Concern	Least Concern	Widespread and Common	Yes
12	Turtle	Geomydidae	*Cuora amboinensis*	*Malayan box terrapin*	Endangered	Near Threatened	Wide-ranging and Common	No
13	Snake	Pythonidae	*Malayopython reticulatus*	*Reticulated python*	Least Concern	Least Concern	Widespread and Common	Yes
14	Lizard	Scincidae	*Eutropis multifasciata*	*Many-lined sun skink*	Least Concern	Least Concern	Widespread and Common	Yes
15	Lizard	Varanidae	Varanus nebulosus	*Clouded monitor*	Not Listed	Least Concern	Restricted but Common	Yes
16	Lizard	Varanidae	*Varanus salvator*	*Malayan water monitor*	Least Concern	Least Concern	Widespread and Common	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (NSS, 2020; Singapore Birds Project, 2020)	Recorded Species
1	Bird	*Acanthizidae*	*Gerygone sulphurea*	Golden-bellied gerygone	Least Concern	Near Threatened	Common	Yes
3	Bird	*Accipitridae*	*Haliaeetus indus*	Brahminy kite	Least Concern	Least Concern	Common	Yes
4	Bird	*Accipitridae*	*Haliaeetus leucogaster*	White-bellied sea eagle	Least Concern	Least Concern	Common	Yes
5	Bird	*Accipitridae*	*NA*	Unidentified raptor	*NA*	*NA*	*NA*	Yes
6	Bird	*Accipitridae*	*Nisaetus cirrhatus*	Changeable hawk-eagle	Least Concern	Vulnerable	Common	Yes
9	Bird	*Aegithinidae*	*Aegithina tiphia*	Common iora	Least Concern	Least Concern	Common	Yes
10	Bird	*Alcedinidae*	*Halcyon smyrnensis*	White-throated kingfisher	Least Concern	Least Concern	Common	Yes
11	Bird	*Alcedinidae*	*Todiramphus chloris*	Collared kingfisher	Least Concern	Least Concern	Abundant	Yes
12	Bird	*Apodidae*	*Aerodramus sp.*	Swiftlet sp.	NA	NA	NA	Yes
14	Bird	*Apodidae*	*Collocalia affinis*	Plume-toed swiftlet	Least Concern	Vulnerable	Uncommon	Yes
16	Bird	*Ardeidae*	*Ardea intermedia*	Intermediate egret	Least Concern	Least Concern	Uncommon	Yes
20	Bird	*Ardeidae*	*Nycticorax nycticorax*	Black-crowned night heron	Least Concern	Endangered	Uncommon	Yes
21	Bird	*Caprimulgidae*	*Caprimulgus macrurus*	Large-tailed nightjar	Least Concern	Least Concern	Common	Yes
23	Bird	*Cisticolidae*	*Orthotomus atrogularis*	Dark-necked tailorbird	Least Concern	Least Concern	Common	Yes
24	Bird	*Cisticolidae*	*Orthotomus sericeus*	Rufous-tailed tailorbird	Least Concern	Near Threatened	Uncommon	Yes
25	Bird	*Cisticolidae*	*Orthotomus sutorius*	Common tailorbird	Least Concern	Least Concern	Common	Yes
26	Bird	*Cisticolidae*	*Prinia flaviventris*	Yellow-bellied prinia	Least Concern	Near Threatened	Common	Yes
27	Bird	*Columbidae*	*Columba livia*	Rock dove	Least Concern	NA	Abundant	Yes
29	Bird	*Columbidae*	*Ducula bicolor*	Pied imperial pigeon	Least Concern	Data Deficient	Uncommon	Yes
30	Bird	*Columbidae*	*Geopelia striata*	Zebra dove	Least Concern	Least Concern	Common	Yes
32	Bird	*Columbidae*	*Spilopelia chinensis*	Spotted dove	Least Concern	Least Concern	Abundant	Yes
33	Bird	*Columbidae*	*Streptopelia tranquebarica*	Red collared dove	Least Concern	NA	Uncommon	Yes
36	Bird	*Columbidae*	*Treron vernans*	Pink-necked green pigeon	Least Concern	Least Concern	Abundant	Yes
37	Bird	*Coraciidae*	*Eurystomus orientalis*	Oriental dollarbird	Least Concern	Least Concern	Common	Yes
38	Bird	*Corvidae*	*Corvus macrorhynchos*	Large-billed crow	Least Concern	Vulnerable	Uncommon	Yes
39	Bird	*Corvidae*	*Corvus splendens*	House crow	Least Concern	NA	Common	Yes
40	Bird	*Cuculidae*	*Chrysococcyx basalis*	Horsfield's bronze cuckoo	Least Concern	Least Concern	Rare	Yes
41	Bird	*Cuculidae*	*Chrysococcyx minutillus*	Little bronze-cuckoo	Least Concern	Least Concern	Common	Yes
43	Bird	*Cuculidae*	*Eudynamys scolopaceus*	Asian koel	Least Concern	Least Concern	Common	Yes
45	Bird	*Dicaeidae*	*Dicaeum cruentatum*	Scarlet-backed flowerpecker	Least Concern	Least Concern	Common	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (NSS, 2020; Singapore Birds Project, 2020)	Recorded Species
47	Bird	*Dicruridae*	*Dicrurus paradiseus*	Greater racket-tailed drongo	Least Concern	Least Concern	Common	Yes
49	Bird	*Estrildidae*	*Lonchura punctulata*	Scaly-breasted munia	Least Concern	Least Concern	Common	Yes
51	Bird	*Hirundinidae*	*Hirundo tahitica*	Pacific swallow	Least Concern	Least Concern	Common	Yes
53	Bird	*Laniidae*	*Lanius schach*	Long-tailed shrike	Least Concern	Least Concern	Uncommon	Yes
54	Bird	*Megalaimidae*	*Psilopogon haemacephalus*	Coppersmith barbet	Least Concern	Least Concern	Common	Yes
55	Bird	*Megalaimidae*	*Psilopogon lineatus*	Lineated barbet	Least Concern	NA	Common	Yes
56	Bird	*Meropidae*	*Merops viridis*	Blue-throated bee-eater	Least Concern	Least Concern	Common	Yes
57	Bird	*Motacillidae*	*Anthus rufulus*	Paddyfield pipit	Least Concern	Least Concern	Common	Yes
58	Bird	*Muscicapidae*	*Copsychus saularis*	Oriental magpie-robin	Least Concern	Vulnerable	Uncommon	Yes
59	Bird	*NA*	*NA*	Unidentified sunbird	*NA*	*NA*	*NA*	Yes
60	Bird	*Nectariniidae*	*Anthreptes malacensis*	Brown-throated sunbird	Least Concern	Least Concern	Common	Yes
61	Bird	*Nectariniidae*	*Cinnyris jugularis*	Olive-backed sunbird	Least Concern	Least Concern	Common	Yes
62	Bird	*Oriolidae*	*Oriolus chinensis*	Black-naped oriole	Least Concern	Least Concern	Abundant	Yes
63	Bird	*Picidae*	*Dinopium javanense*	Common flameback	Least Concern	Least Concern	Common	Yes
64	Bird	*Picidae*	*Micropternus brachyurus*	Rufous woodpecker	Least Concern	Least Concern	Uncommon	Yes
65	Bird	*Picidae*	*Picus vittatus*	Laced woodpecker	Least Concern	Least Concern	Common	Yes
66	Bird	*Pittidae*	*Pitta moluccensis*	Blue-winged pitta	Least Concern	Least Concern	Uncommon	Yes
67	Bird	*Ploceidae*	*Ploceus philippinus*	Baya weaver	Least Concern	Vulnerable	Uncommon	Yes
68	Bird	*Psittaculidae*	*Loriculus galgulus*	Blue-crowned hanging-parrot	Least Concern	Least Concern	Common	Yes
69	Bird	*Psittaculidae*	*Psittacula alexandri*	Red-breasted parakeet	Near Threatened	NA	Common	Yes
70	Bird	*Psittaculidae*	*Psittacula longicauda*	Long-tailed parakeet	Vulnerable	Near Threatened	Common	Yes
72	Bird	*Pycnonotidae*	*Pycnonotus goiavier*	Yellow-vented bulbul	Least Concern	Least Concern	Abundant	Yes
73	Bird	*Pycnonotidae*	*Pycnonotus plumosus*	Olive-winged bulbul	Least Concern	Least Concern	Common	Yes
74	Bird	*Pycnonotidae*	*Pycnonotus zeylanicus*	Straw-headed bulbul	Critically Endangered	Endangered	Uncommon	Yes
75	Bird	*Rallidae*	*Amaurornis phoenicurus*	White-breasted waterhen	Least Concern	Least Concern	Common	Yes
78	Bird	Rallidae	*Rallina fasciata*	Red-legged crake	Least Concern	Near Threatened	Uncommon	Yes
80	Bird	*Rhipiduridae*	*Rhipidura javanica*	Malaysian pied fantail	Least Concern	Least Concern	Common	Yes
87	Bird	*Strigidae*	*Otus lempiji*	Sunda scops owl	Least Concern	Least Concern	Common	Yes
89	Bird	*Sturnidae*	*Acridotheres javanicus*	Javan myna	Vulnerable	NA	Abundant	Yes
90	Bird	*Sturnidae*	*Aplonis panayensis*	Asian glossy starling	Least Concern	Least Concern	Abundant	Yes
91	Bird	*Timaliidae*	*Mixornis gularis*	Pin-striped tit-babbler	Least Concern	Least Concern	Common	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (NSS, 2020; Singapore Birds Project, 2020)	Recorded Species
92	Bird	*Zosteropidae*	*Zosterops simplex*	Swinhoe's white-eye	Least Concern	Vulnerable	Common	Yes

No.	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (Baker & Lim, 2012)	Recorded Species
1	Canidae	*Canis lupus familiaris*	Feral dog	Not Listed	Not Evaluated	NA	Yes
2	Cercopithecidae	*Macaca fascicularis*	Long-tailed macaque	Endangered	Least Concern	Widespread and Common	Yes
3	Felidae	*Felis catus*	Feral cat	Not Listed	Not Evaluated	NA	Yes
4	Manidae	*Manis javanica*	Sunda pangolin	Critically Endangered	Critically Endangered	Widespread but Rare	Yes
5	Muridae	*Rattus tanezumi*	Asian house rat	Least Concern	Least Concern	Widespread and Common	Yes
6	Muridae	*Rattus tiomanicus*	Malaysian wood rat	Least Concern	Least Concern	Widespread and Common	Yes
7	Mustelidae	*Lutrogale perspicillata*	Smooth otter	Vulnerable	Endangered	Widespread but Rare	Yes
8	Sciuridae	*Callosciurus notatus*	Plantain squirrel	Least Concern	Least Concern	Widespread and Common	Yes
9	Tupaiidae	*Tupaia glis*	Common treeshrew	Least Concern	Least Concern	Widespread and Common	Yes

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2023)	Distribution/Rarity (Baker & Lim, 2012)	Recorded Species
1	Bat	Emballonuridae	*Saccolaimus saccolaimus*	Pouch tomb bat	Least Concern	Least Concern	Widespread and Common	Yes
2	Bat	Emballonuridae	*Taphozous melanopogon*	Black-bearded tomb bat	Least Concern	Least Concern	Widespread but Rare	Yes
3	Bat	Molossidae	*Cheiromeles torquatus*	Naked bulldog bat	Least Concern	Critically Endangered	Restricted and Rare	No
4	Bat	Pteropodidae	*Cynopterus brachyotis*	Lesser short-nosed fruit bat	Least Concern	Least Concern	Widespread and Common	Yes
5	Bat	Pteropodidae	*Eonycteris spelaea*	Cave nectar bat	Least Concern	Vulnerable	Widespread but Uncommon	No
6	Bat	Vespertilionidae	*Myotis horsfieldii*	Horsfield's myotis	Least Concern	Least Concern	NA	Yes
7	Bat	Vespertilionidae	*Myotis muricola*	Asian whiskered myotis	Least Concern	Least Concern	Widespread and Common	Yes
8	Bat	Vespertilionidae	*Pipistrellus javanicus*	Javan pipistrelle	Least Concern	Least Concern	Widespread but Uncommon	Yes
9	Bat	Vespertilionidae	*Scotophilus kuhlii*	Lesser Asian house bat	Least Concern	Least Concern	Widespread and Common	Yes
10	Bat	Vespertilionidae	*Tylonycteris fulvida*	Lesser bamboo bat	Not Listed	Vulnerable	Restricted and Rare	Yes
11	Bat	Vespertilionidae	*Tylonycteris malayana*	Greater bamboo bat	Least Concern	Vulnerable	Widespread and Common	Yes

Appendix J
Camera Trap Data for the Whole Biodiversity Study Area

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Station	Latitude	Longitude	SamplingDate	FileModifyDate	Date
E1	1.45674	103.82119	20230731	28/6/23 23:50	28/6/23
E1	1.45674	103.82119	20230731	30/6/23 2:00	30/6/23
E1	1.45674	103.82119	20230731	30/6/23 16:19	30/6/23
E1	1.45674	103.82119	20230731	1/7/23 0:51	1/7/23
E1	1.45674	103.82119	20230731	1/7/23 7:23	1/7/23
E1	1.45674	103.82119	20230731	3/7/23 2:48	3/7/23
E1	1.45674	103.82119	20230731	3/7/23 2:49	3/7/23
E1	1.45674	103.82119	20230731	3/7/23 11:22	3/7/23
E1	1.45674	103.82119	20230731	3/7/23 12:31	3/7/23
E1	1.45674	103.82119	20230731	4/7/23 1:40	4/7/23
E1	1.45674	103.82119	20230731	4/7/23 9:56	4/7/23
E1	1.45674	103.82119	20230731	4/7/23 11:44	4/7/23
E1	1.45674	103.82119	20230731	6/7/23 3:16	6/7/23
E1	1.45674	103.82119	20230731	10/7/23 16:24	10/7/23
E1	1.45674	103.82119	20230731	11/7/23 8:21	11/7/23
E1	1.45674	103.82119	20230731	13/7/23 4:01	13/7/23
E1	1.45674	103.82119	20230731	13/7/23 21:37	13/7/23
E1	1.45674	103.82119	20230731	13/7/23 21:40	13/7/23
E1	1.45674	103.82119	20230731	14/7/23 4:32	14/7/23
E1	1.45674	103.82119	20230731	14/7/23 6:39	14/7/23
E1	1.45674	103.82119	20230731	14/7/23 7:48	14/7/23
E1	1.45674	103.82119	20230731	15/7/23 8:22	15/7/23
E1	1.45674	103.82119	20230731	15/7/23 8:34	15/7/23
E1	1.45674	103.82119	20230731	16/7/23 9:44	16/7/23
E1	1.45674	103.82119	20230731	17/7/23 23:50	17/7/23
E1	1.45674	103.82119	20230731	18/7/23 16:32	18/7/23
E1	1.45674	103.82119	20230731	18/7/23 16:33	18/7/23
E1	1.45674	103.82119	20230731	20/7/23 2:18	20/7/23
E1	1.45674	103.82119	20230731	20/7/23 7:34	20/7/23
E1	1.45674	103.82119	20230731	20/7/23 13:25	20/7/23
E1	1.45674	103.82119	20230731	20/7/23 17:03	20/7/23
E1	1.45674	103.82119	20230731	21/7/23 0:05	21/7/23
E1	1.45674	103.82119	20230731	22/7/23 21:15	22/7/23
E1	1.45674	103.82119	20230731	26/7/23 2:32	26/7/23
E1	1.45674	103.82119	20230731	27/7/23 4:16	27/7/23
E1	1.45674	103.82119	20230731	28/7/23 8:47	28/7/23
E1	1.45674	103.82119	20230731	30/7/23 22:09	30/7/23
E1	1.45674	103.82119	20230731	31/7/23 1:18	31/7/23
E2	1.45703	103.8215	20230731	1/7/23 7:23	1/7/23
E2	1.45703	103.8215	20230731	3/7/23 2:48	3/7/23
E2	1.45703	103.8215	20230731	3/7/23 6:43	3/7/23
E2	1.45703	103.8215	20230731	3/7/23 11:21	3/7/23
E2	1.45703	103.8215	20230731	3/7/23 13:14	3/7/23
E2	1.45703	103.8215	20230731	4/7/23 1:40	4/7/23
E2	1.45703	103.8215	20230731	5/7/23 0:53	5/7/23
E2	1.45703	103.8215	20230731	5/7/23 4:26	5/7/23
E2	1.45703	103.8215	20230731	6/7/23 3:13	6/7/23
E2	1.45703	103.8215	20230731	6/7/23 3:17	6/7/23
E2	1.45703	103.8215	20230731	6/7/23 3:19	6/7/23
E2	1.45703	103.8215	20230731	7/7/23 3:30	7/7/23
E2	1.45703	103.8215	20230731	7/7/23 3:51	7/7/23
E2	1.45703	103.8215	20230731	7/7/23 3:56	7/7/23
E2	1.45703	103.8215	20230731	7/7/23 4:24	7/7/23
E2	1.45703	103.8215	20230731	8/7/23 5:29	8/7/23
E2	1.45703	103.8215	20230731	8/7/23 23:50	8/7/23
E2	1.45703	103.8215	20230731	9/7/23 3:40	9/7/23
E2	1.45703	103.8215	20230731	10/7/23 16:24	10/7/23
E2	1.45703	103.8215	20230731	11/7/23 2:46	11/7/23

E2	1.45703	103.8215	20230731	11/7/23 23:41	11/7/23
E2	1.45703	103.8215	20230731	11/7/23 23:52	11/7/23
E2	1.45703	103.8215	20230731	12/7/23 0:27	12/7/23
E2	1.45703	103.8215	20230731	12/7/23 0:28	12/7/23
E2	1.45703	103.8215	20230731	12/7/23 19:50	12/7/23
E2	1.45703	103.8215	20230731	13/7/23 4:23	13/7/23
E2	1.45703	103.8215	20230731	13/7/23 21:37	13/7/23
E2	1.45703	103.8215	20230731	13/7/23 21:39	13/7/23
E2	1.45703	103.8215	20230731	14/7/23 4:31	14/7/23
E2	1.45703	103.8215	20230731	14/7/23 6:37	14/7/23
E2	1.45703	103.8215	20230731	15/7/23 22:09	15/7/23
E2	1.45703	103.8215	20230731	16/7/23 9:43	16/7/23
E2	1.45703	103.8215	20230731	17/7/23 23:49	17/7/23
E2	1.45703	103.8215	20230731	19/7/23 7:28	19/7/23
E2	1.45703	103.8215	20230731	19/7/23 7:28	19/7/23
E2	1.45703	103.8215	20230731	20/7/23 2:20	20/7/23
E2	1.45703	103.8215	20230731	20/7/23 7:57	20/7/23
E2	1.45703	103.8215	20230731	20/7/23 8:00	20/7/23
E2	1.45703	103.8215	20230731	20/7/23 8:05	20/7/23
E2	1.45703	103.8215	20230731	20/7/23 13:51	20/7/23
E2	1.45703	103.8215	20230731	20/7/23 17:15	20/7/23
E2	1.45703	103.8215	20230731	22/7/23 21:14	22/7/23
E2	1.45703	103.8215	20230731	26/7/23 2:31	26/7/23
E2	1.45703	103.8215	20230731	26/7/23 14:41	26/7/23
E2	1.45703	103.8215	20230731	26/7/23 22:58	26/7/23
E2	1.45703	103.8215	20230731	27/7/23 4:15	27/7/23
E2	1.45703	103.8215	20230731	27/7/23 4:15	27/7/23
E2	1.45703	103.8215	20230731	30/7/23 22:08	30/7/23
N4.10	1.457344	103.8212	20230731	21/6/23 16:05	21/6/23
N4.10	1.457344	103.8212	20230731	23/6/23 9:01	23/6/23
N4.10	1.457344	103.8212	20230731	23/6/23 10:38	23/6/23
N4.10	1.457344	103.8212	20230731	23/6/23 12:32	23/6/23
N4.10	1.457344	103.8212	20230731	24/6/23 2:01	24/6/23
N4.10	1.457344	103.8212	20230731	24/6/23 13:27	24/6/23
N4.10	1.457344	103.8212	20230731	24/6/23 14:07	24/6/23
N4.10	1.457344	103.8212	20230731	25/6/23 0:01	25/6/23
N4.10	1.457344	103.8212	20230731	25/6/23 10:50	25/6/23
N4.10	1.457344	103.8212	20230731	27/6/23 18:53	27/6/23
N4.10	1.457344	103.8212	20230731	29/6/23 9:33	29/6/23
N4.10	1.457344	103.8212	20230731	1/7/23 7:53	1/7/23
N4.10	1.457344	103.8212	20230731	1/7/23 9:36	1/7/23
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N4.10	1.457344	103.8212	20230731	3/7/23 7:59	3/7/23
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N4.10	1.457344	103.8212	20230731	5/7/23 17:40	5/7/23
N4.10	1.457344	103.8212	20230731	6/7/23 13:56	6/7/23
N4.10	1.457344	103.8212	20230731	6/7/23 15:51	6/7/23
N4.10	1.457344	103.8212	20230731	8/7/23 10:26	8/7/23
N4.10	1.457344	103.8212	20230731	8/7/23 11:08	8/7/23
N4.10	1.457344	103.8212	20230731	8/7/23 13:06	8/7/23
N4.10	1.457344	103.8212	20230731	9/7/23 10:59	9/7/23

N4.10	1.457344	103.8212	20230731	13/7/23 16:30	13/7/23
N4.10	1.457344	103.8212	20230731	21/7/23 14:46	21/7/23
N4.10	1.457344	103.8212	20230731	22/7/23 10:15	22/7/23
N4.10	1.457344	103.8212	20230731	22/7/23 19:43	22/7/23
N4.10	1.457344	103.8212	20230731	23/7/23 7:28	23/7/23
N4.10	1.457344	103.8212	20230731	25/7/23 14:12	25/7/23
N4.10	1.457344	103.8212	20230731	26/7/23 9:36	26/7/23
N4.10	1.457344	103.8212	20230731	27/7/23 7:22	27/7/23
N4.10	1.457344	103.8212	20230731	29/7/23 13:50	29/7/23
N4.10	1.457344	103.8212	20230731	30/7/23 15:46	30/7/23
N4.3	1.459712	103.8183	20230731	22/6/23 7:06	22/6/23
N4.3	1.459712	103.8183	20230731	23/6/23 18:05	23/6/23
N4.3	1.459712	103.8183	20230731	25/6/23 8:46	25/6/23
N4.3	1.459712	103.8183	20230731	25/6/23 9:10	25/6/23
N4.3	1.459712	103.8183	20230731	26/6/23 9:43	26/6/23
N4.3	1.459712	103.8183	20230731	27/6/23 21:17	27/6/23
N4.3	1.459712	103.8183	20230731	27/6/23 21:17	27/6/23
N4.3	1.459712	103.8183	20230731	27/6/23 21:18	27/6/23
N4.3	1.459712	103.8183	20230731	27/6/23 21:18	27/6/23
N4.3	1.459712	103.8183	20230731	30/6/23 18:46	30/6/23
N4.3	1.459712	103.8183	20230731	1/7/23 18:52	1/7/23
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N4.3	1.459712	103.8183	20230731	2/7/23 11:37	2/7/23
N4.3	1.459712	103.8183	20230731	2/7/23 12:45	2/7/23
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N4.3	1.459712	103.8183	20230731	6/7/23 12:13	6/7/23
N4.3	1.459712	103.8183	20230731	8/7/23 10:59	8/7/23
N4.3	1.459712	103.8183	20230731	8/7/23 19:11	8/7/23
N4.3	1.459712	103.8183	20230731	12/7/23 9:10	12/7/23
N4.3	1.459712	103.8183	20230731	12/7/23 9:51	12/7/23
N4.3	1.459712	103.8183	20230731	12/7/23 9:51	12/7/23
N4.3	1.459712	103.8183	20230731	14/7/23 11:03	14/7/23
N4.3	1.459712	103.8183	20230731	14/7/23 16:05	14/7/23
N4.3	1.459712	103.8183	20230731	14/7/23 16:06	14/7/23
N4.3	1.459712	103.8183	20230731	16/7/23 18:42	16/7/23
N4.3	1.459712	103.8183	20230731	17/7/23 8:16	17/7/23
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N4.4	1.4596	103.8188	20230731	23/6/23 7:23	23/6/23
N4.4	1.4596	103.8188	20230731	23/6/23 10:25	23/6/23
N4.4	1.4596	103.8188	20230731	23/6/23 12:01	23/6/23
N4.4	1.4596	103.8188	20230731	24/6/23 7:26	24/6/23
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N4.4	1.4596	103.8188	20230731	24/6/23 15:21	24/6/23
N4.4	1.4596	103.8188	20230731	24/6/23 15:25	24/6/23
N4.4	1.4596	103.8188	20230731	24/6/23 18:10	24/6/23
N4.4	1.4596	103.8188	20230731	24/6/23 19:08	24/6/23
N4.4	1.4596	103.8188	20230731	25/6/23 8:07	25/6/23

N4.4	1.4596	103.8188	20230731	25/6/23 8:58	25/6/23
N4.4	1.4596	103.8188	20230731	25/6/23 11:09	25/6/23
N4.4	1.4596	103.8188	20230731	25/6/23 12:31	25/6/23
N4.4	1.4596	103.8188	20230731	25/6/23 12:33	25/6/23
N4.4	1.4596	103.8188	20230731	25/6/23 13:38	25/6/23
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N4.4	1.4596	103.8188	20230731	26/6/23 12:25	26/6/23
N4.4	1.4596	103.8188	20230731	27/6/23 17:03	27/6/23
N4.4	1.4596	103.8188	20230731	27/6/23 17:40	27/6/23
N4.4	1.4596	103.8188	20230731	28/6/23 8:31	28/6/23
N4.4	1.4596	103.8188	20230731	28/6/23 8:38	28/6/23
N4.4	1.4596	103.8188	20230731	28/6/23 8:48	28/6/23
N4.4	1.4596	103.8188	20230731	28/6/23 12:58	28/6/23
N4.4	1.4596	103.8188	20230731	29/6/23 9:48	29/6/23
N4.4	1.4596	103.8188	20230731	29/6/23 9:49	29/6/23
N4.4	1.4596	103.8188	20230731	29/6/23 10:16	29/6/23
N4.4	1.4596	103.8188	20230731	29/6/23 18:36	29/6/23
N4.4	1.4596	103.8188	20230731	30/6/23 8:31	30/6/23
N4.4	1.4596	103.8188	20230731	30/6/23 8:45	30/6/23
N4.4	1.4596	103.8188	20230731	30/6/23 8:52	30/6/23
N4.4	1.4596	103.8188	20230731	1/7/23 0:35	1/7/23
N4.4	1.4596	103.8188	20230731	1/7/23 11:03	1/7/23
N4.4	1.4596	103.8188	20230731	1/7/23 11:17	1/7/23
N4.4	1.4596	103.8188	20230731	2/7/23 10:21	2/7/23
N4.4	1.4596	103.8188	20230731	2/7/23 11:09	2/7/23
N4.4	1.4596	103.8188	20230731	2/7/23 13:07	2/7/23
N4.4	1.4596	103.8188	20230731	2/7/23 13:24	2/7/23
N4.4	1.4596	103.8188	20230731	2/7/23 13:58	2/7/23
N4.4	1.4596	103.8188	20230731	3/7/23 14:15	3/7/23
N4.4	1.4596	103.8188	20230731	3/7/23 15:13	3/7/23
N4.4	1.4596	103.8188	20230731	3/7/23 15:38	3/7/23
N4.4	1.4596	103.8188	20230731	4/7/23 7:59	4/7/23
N4.4	1.4596	103.8188	20230731	4/7/23 8:08	4/7/23
N4.4	1.4596	103.8188	20230731	4/7/23 10:24	4/7/23
N4.4	1.4596	103.8188	20230731	4/7/23 10:31	4/7/23
N4.4	1.4596	103.8188	20230731	4/7/23 11:40	4/7/23
N4.4	1.4596	103.8188	20230731	4/7/23 12:28	4/7/23
N4.4	1.4596	103.8188	20230731	4/7/23 12:39	4/7/23
N4.4	1.4596	103.8188	20230731	5/7/23 7:55	5/7/23
N4.4	1.4596	103.8188	20230731	5/7/23 8:01	5/7/23
N4.4	1.4596	103.8188	20230731	5/7/23 8:52	5/7/23
N4.4	1.4596	103.8188	20230731	5/7/23 13:56	5/7/23
N4.4	1.4596	103.8188	20230731	5/7/23 18:14	5/7/23
N4.4	1.4596	103.8188	20230731	8/7/23 7:40	8/7/23
N4.4	1.4596	103.8188	20230731	9/7/23 8:11	9/7/23
N4.4	1.4596	103.8188	20230731	10/7/23 7:55	10/7/23
N4.4	1.4596	103.8188	20230731	10/7/23 9:03	10/7/23
N4.4	1.4596	103.8188	20230731	12/7/23 8:14	12/7/23
N4.4	1.4596	103.8188	20230731	16/7/23 8:55	16/7/23

N4.4	1.4596	103.8188	20230731	16/7/23 10:06	16/7/23
N4.4	1.4596	103.8188	20230731	16/7/23 10:38	16/7/23
N4.4	1.4596	103.8188	20230731	18/7/23 12:44	18/7/23
N4.4	1.4596	103.8188	20230731	19/7/23 10:27	19/7/23
N4.4	1.4596	103.8188	20230731	20/7/23 7:33	20/7/23
N4.4	1.4596	103.8188	20230731	24/7/23 7:15	24/7/23
N4.4	1.4596	103.8188	20230731	24/7/23 13:24	24/7/23
N4.4	1.4596	103.8188	20230731	24/7/23 14:15	24/7/23
N4.4	1.4596	103.8188	20230731	25/7/23 12:37	25/7/23
N4.4	1.4596	103.8188	20230731	25/7/23 12:42	25/7/23
N4.4	1.4596	103.8188	20230731	27/7/23 7:40	27/7/23
N4.4	1.4596	103.8188	20230731	28/7/23 18:15	28/7/23
N4.5	1.458843	103.8195	20230731	28/6/23 13:46	28/6/23
N4.5	1.458843	103.8195	20230731	1/7/23 8:21	1/7/23
N4.5	1.458843	103.8195	20230731	1/7/23 10:42	1/7/23
N4.5	1.458843	103.8195	20230731	2/7/23 7:26	2/7/23
N4.5	1.458843	103.8195	20230731	2/7/23 11:15	2/7/23
N4.5	1.458843	103.8195	20230731	4/7/23 13:16	4/7/23
N4.5	1.458843	103.8195	20230731	4/7/23 13:20	4/7/23
N4.5	1.458843	103.8195	20230731	8/7/23 18:15	8/7/23
N4.5	1.458843	103.8195	20230731	13/7/23 9:23	13/7/23
N4.5	1.458843	103.8195	20230731	18/7/23 13:31	18/7/23
N4.5	1.458843	103.8195	20230731	18/7/23 13:32	18/7/23
N4.5	1.458843	103.8195	20230731	20/7/23 12:23	20/7/23
N4.5	1.458843	103.8195	20230731	20/7/23 12:45	20/7/23
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N4.5	1.458843	103.8195	20230731	25/7/23 7:33	25/7/23
N4.5	1.458843	103.8195	20230731	31/7/23 7:29	31/7/23
N4.7	1.459518	103.821	20230731	22/6/23 2:18	22/6/23
N4.7	1.459518	103.821	20230731	22/6/23 2:22	22/6/23
N4.7	1.459518	103.821	20230731	22/6/23 8:13	22/6/23
N4.7	1.459518	103.821	20230731	25/6/23 10:11	25/6/23
N4.7	1.459518	103.821	20230731	25/6/23 16:51	25/6/23
N4.7	1.459518	103.821	20230731	26/6/23 17:46	26/6/23
N4.7	1.459518	103.821	20230731	28/6/23 13:06	28/6/23
N4.7	1.459518	103.821	20230731	29/6/23 8:27	29/6/23
N4.7	1.459518	103.821	20230731	5/7/23 21:49	5/7/23
N4.7	1.459518	103.821	20230731	8/7/23 12:37	8/7/23
N4.7	1.459518	103.821	20230731	9/7/23 15:38	9/7/23
N4.7	1.459518	103.821	20230731	10/7/23 10:46	10/7/23
N4.7	1.459518	103.821	20230731	12/7/23 9:36	12/7/23
N4.7	1.459518	103.821	20230731	13/7/23 7:13	13/7/23
N4.7	1.459518	103.821	20230731	13/7/23 7:42	13/7/23
N4.7	1.459518	103.821	20230731	13/7/23 8:46	13/7/23
N4.7	1.459518	103.821	20230731	13/7/23 13:02	13/7/23
N4.7	1.459518	103.821	20230731	14/7/23 5:26	14/7/23
N4.7	1.459518	103.821	20230731	14/7/23 5:27	14/7/23
N4.7	1.459518	103.821	20230731	14/7/23 5:29	14/7/23

N4.7	1.459518	103.821	20230731	14/7/23 5:59	14/7/23
N4.7	1.459518	103.821	20230731	14/7/23 6:00	14/7/23
N4.7	1.459518	103.821	20230731	14/7/23 6:01	14/7/23
N4.7	1.459518	103.821	20230731	14/7/23 6:07	14/7/23
N4.7	1.459518	103.821	20230731	14/7/23 6:08	14/7/23
N4.7	1.459518	103.821	20230731	14/7/23 6:09	14/7/23
N4.7	1.459518	103.821	20230731	14/7/23 6:11	14/7/23
N4.7	1.459518	103.821	20230731	14/7/23 6:35	14/7/23
N4.7	1.459518	103.821	20230731	14/7/23 7:14	14/7/23
N4.7	1.459518	103.821	20230731	16/7/23 9:51	16/7/23
N4.7	1.459518	103.821	20230731	16/7/23 9:51	16/7/23
N4.7	1.459518	103.821	20230731	18/7/23 7:18	18/7/23
N4.7	1.459518	103.821	20230731	21/7/23 14:16	21/7/23
N4.7	1.459518	103.821	20230731	24/7/23 10:13	24/7/23
N4.7	1.459518	103.821	20230731	26/7/23 15:26	26/7/23
N4.7	1.459518	103.821	20230731	26/7/23 15:27	26/7/23
N4.8	1.458756	103.821	20230731	21/6/23 14:19	21/6/23
N4.8	1.458756	103.821	20230731	22/6/23 8:59	22/6/23
N4.8	1.458756	103.821	20230731	22/6/23 13:03	22/6/23
N4.8	1.458756	103.821	20230731	24/6/23 4:41	24/6/23
N4.8	1.458756	103.821	20230731	25/6/23 10:32	25/6/23
N4.8	1.458756	103.821	20230731	26/6/23 23:38	26/6/23
N4.8	1.458756	103.821	20230731	26/6/23 23:39	26/6/23
N4.8	1.458756	103.821	20230731	28/6/23 13:32	28/6/23
N4.8	1.458756	103.821	20230731	30/6/23 6:56	30/6/23
N4.8	1.458756	103.821	20230731	2/7/23 9:52	2/7/23
N4.8	1.458756	103.821	20230731	2/7/23 10:43	2/7/23
N4.8	1.458756	103.821	20230731	2/7/23 13:18	2/7/23
N4.8	1.458756	103.821	20230731	2/7/23 15:04	2/7/23
N4.8	1.458756	103.821	20230731	2/7/23 15:24	2/7/23
N4.8	1.458756	103.821	20230731	3/7/23 7:23	3/7/23
N4.8	1.458756	103.821	20230731	3/7/23 14:07	3/7/23
N4.8	1.458756	103.821	20230731	4/7/23 11:09	4/7/23
N4.8	1.458756	103.821	20230731	4/7/23 11:10	4/7/23
N4.8	1.458756	103.821	20230731	4/7/23 18:55	4/7/23
N4.8	1.458756	103.821	20230731	4/7/23 19:06	4/7/23
N4.8	1.458756	103.821	20230731	6/7/23 10:22	6/7/23
N4.8	1.458756	103.821	20230731	6/7/23 12:05	6/7/23
N4.8	1.458756	103.821	20230731	7/7/23 7:10	7/7/23
N4.8	1.458756	103.821	20230731	7/7/23 8:38	7/7/23
N4.8	1.458756	103.821	20230731	7/7/23 11:57	7/7/23
N4.8	1.458756	103.821	20230731	8/7/23 12:45	8/7/23
N4.8	1.458756	103.821	20230731	9/7/23 9:41	9/7/23
N4.8	1.458756	103.821	20230731	10/7/23 12:50	10/7/23
N4.8	1.458756	103.821	20230731	10/7/23 13:32	10/7/23
N4.8	1.458756	103.821	20230731	11/7/23 9:42	11/7/23
N4.8	1.458756	103.821	20230731	15/7/23 15:58	15/7/23
N4.8	1.458756	103.821	20230731	15/7/23 16:00	15/7/23
N4.8	1.458756	103.821	20230731	17/7/23 8:15	17/7/23
N4.8	1.458756	103.821	20230731	17/7/23 10:11	17/7/23

N4.8	1.458756	103.821	20230731	18/7/23 15:48	18/7/23
N4.8	1.458756	103.821	20230731	19/7/23 15:15	19/7/23
N4.8	1.458756	103.821	20230731	19/7/23 16:58	19/7/23
N4.8	1.458756	103.821	20230731	21/7/23 18:42	21/7/23
N4.8	1.458756	103.821	20230731	22/7/23 9:48	22/7/23
N4.8	1.458756	103.821	20230731	22/7/23 13:04	22/7/23
N4.8	1.458756	103.821	20230731	22/7/23 18:27	22/7/23
N4.8	1.458756	103.821	20230731	25/7/23 14:39	25/7/23
N4.8	1.458756	103.821	20230731	25/7/23 15:40	25/7/23
N4.8	1.458756	103.821	20230731	25/7/23 18:50	25/7/23
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N4.9	1.458028	103.821	20230731	25/6/23 7:04	25/6/23
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N4.9	1.458028	103.821	20230731	29/6/23 18:26	29/6/23
N4.9	1.458028	103.821	20230731	5/7/23 10:16	5/7/23
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N4.9	1.458028	103.821	20230731	13/7/23 7:20	13/7/23
N4.9	1.458028	103.821	20230731	15/7/23 18:47	15/7/23
N4.9	1.458028	103.821	20230731	17/7/23 15:22	17/7/23
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N5.11	1.454994	103.8214	20230731	2/7/23 15:36	2/7/23
N5.11	1.454994	103.8214	20230731	4/7/23 12:50	4/7/23
N5.11	1.454994	103.8214	20230731	10/7/23 16:27	10/7/23
N5.11	1.454994	103.8214	20230731	15/7/23 14:49	15/7/23
N5.11	1.454994	103.8214	20230731	16/7/23 12:37	16/7/23
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N5.11	1.454994	103.8214	20230731	25/7/23 0:23	25/7/23
N5.11	1.454994	103.8214	20230731	25/7/23 0:24	25/7/23
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N5.11	1.454994	103.8214	20230731	25/7/23 10:09	25/7/23
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N5.11	1.454994	103.8214	20230731	30/7/23 20:15	30/7/23
N5.11	1.454994	103.8214	20230731	30/7/23 20:16	30/7/23
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N5.13	1.456087	103.8217	20230731	2/7/23 15:46	2/7/23
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N5.13	1.456087	103.8217	20230731	15/7/23 8:46	15/7/23

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N5.14	1.455184	103.8224	20230731	16/7/23 8:08	16/7/23
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N5.14	1.455184	103.8224	20230731	22/7/23 11:01	22/7/23
N5.14	1.455184	103.8224	20230731	22/7/23 11:03	22/7/23
N5.14	1.455184	103.8224	20230731	23/7/23 7:14	23/7/23
N5.14	1.455184	103.8224	20230731	23/7/23 8:43	23/7/23
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N5.14	1.455184	103.8224	20230731	24/7/23 10:23	24/7/23
N5.14	1.455184	103.8224	20230731	24/7/23 19:39	24/7/23
N5.14	1.455184	103.8224	20230731	26/7/23 14:33	26/7/23
N5.14	1.455184	103.8224	20230731	26/7/23 14:56	26/7/23
N5.15	1.45665	103.8225	20230731	1/7/23 9:06	1/7/23
N5.15	1.45665	103.8225	20230731	18/7/23 13:06	18/7/23
N5.15	1.45665	103.8225	20230731	28/7/23 15:12	28/7/23
N5.16	1.455774	103.823	20230731	21/6/23 17:31	21/6/23
N5.16	1.455774	103.823	20230731	24/6/23 7:44	24/6/23
N5.16	1.455774	103.823	20230731	24/6/23 8:16	24/6/23
N5.16	1.455774	103.823	20230731	24/6/23 16:31	24/6/23
N5.16	1.455774	103.823	20230731	27/6/23 7:03	27/6/23
N5.16	1.455774	103.823	20230731	27/6/23 7:05	27/6/23
N5.16	1.455774	103.823	20230731	28/6/23 6:55	28/6/23
N5.16	1.455774	103.823	20230731	28/6/23 8:34	28/6/23
N5.16	1.455774	103.823	20230731	28/6/23 13:02	28/6/23
N5.16	1.455774	103.823	20230731	28/6/23 14:03	28/6/23
N5.16	1.455774	103.823	20230731	28/6/23 14:04	28/6/23
N5.16	1.455774	103.823	20230731	29/6/23 7:38	29/6/23
N5.16	1.455774	103.823	20230731	30/6/23 22:57	30/6/23
N5.16	1.455774	103.823	20230731	2/7/23 7:03	2/7/23
N5.16	1.455774	103.823	20230731	2/7/23 11:09	2/7/23
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N5.16	1.455774	103.823	20230731	4/7/23 21:51	4/7/23
N5.16	1.455774	103.823	20230731	4/7/23 21:52	4/7/23

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N5.16	1.455774	103.823	20230731	6/7/23 22:12	6/7/23
N5.16	1.455774	103.823	20230731	7/7/23 7:13	7/7/23
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N5.16	1.455774	103.823	20230731	7/7/23 12:33	7/7/23
N5.16	1.455774	103.823	20230731	7/7/23 12:40	7/7/23
N5.16	1.455774	103.823	20230731	7/7/23 17:38	7/7/23
N5.16	1.455774	103.823	20230731	8/7/23 23:05	8/7/23
N5.16	1.455774	103.823	20230731	9/7/23 13:35	9/7/23
N5.16	1.455774	103.823	20230731	10/7/23 22:39	10/7/23
N5.16	1.455774	103.823	20230731	11/7/23 1:50	11/7/23
N5.16	1.455774	103.823	20230731	11/7/23 9:04	11/7/23
N5.16	1.455774	103.823	20230731	12/7/23 11:55	12/7/23
N5.16	1.455774	103.823	20230731	13/7/23 13:53	13/7/23
N5.16	1.455774	103.823	20230731	13/7/23 13:56	13/7/23
N5.16	1.455774	103.823	20230731	13/7/23 14:57	13/7/23
N5.16	1.455774	103.823	20230731	14/7/23 0:15	14/7/23
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N5.16	1.455774	103.823	20230731	18/7/23 17:42	18/7/23
N5.16	1.455774	103.823	20230731	18/7/23 17:58	18/7/23
N5.16	1.455774	103.823	20230731	21/7/23 15:47	21/7/23
N5.16	1.455774	103.823	20230731	23/7/23 7:21	23/7/23
N5.16	1.455774	103.823	20230731	24/7/23 9:58	24/7/23
N5.16	1.455774	103.823	20230731	24/7/23 12:36	24/7/23
N5.16	1.455774	103.823	20230731	27/7/23 17:13	27/7/23
N5.16	1.455774	103.823	20230731	28/7/23 12:18	28/7/23
N5.16	1.455774	103.823	20230731	28/7/23 16:57	28/7/23
N5.16	1.455774	103.823	20230731	29/7/23 22:58	29/7/23
N5.16	1.455774	103.823	20230731	30/7/23 13:23	30/7/23
N5.16	1.455774	103.823	20230731	30/7/23 16:27	30/7/23
N5.17	1.456693	103.8238	20230731	22/6/23 14:13	22/6/23
N5.17	1.456693	103.8238	20230731	25/6/23 11:40	25/6/23
N5.17	1.456693	103.8238	20230731	28/6/23 16:37	28/6/23
N5.17	1.456693	103.8238	20230731	16/7/23 16:29	16/7/23
N5.17	1.456693	103.8238	20230731	22/7/23 11:21	22/7/23
N5.17	1.456693	103.8238	20230731	26/7/23 11:58	26/7/23
N5.17	1.456693	103.8238	20230731	30/7/23 18:50	30/7/23
N5.17	1.456693	103.8238	20230731	30/7/23 18:52	30/7/23
N5.17	1.456693	103.8238	20230731	30/7/23 19:05	30/7/23
N5.18	1.454789	103.8233	20230731	22/6/23 6:44	22/6/23
N5.18	1.454789	103.8233	20230731	24/6/23 7:56	24/6/23
N5.18	1.454789	103.8233	20230731	24/6/23 8:09	24/6/23
N5.18	1.454789	103.8233	20230731	27/6/23 18:07	27/6/23
N5.18	1.454789	103.8233	20230731	28/6/23 11:49	28/6/23
N5.18	1.454789	103.8233	20230731	28/6/23 13:51	28/6/23
N5.18	1.454789	103.8233	20230731	29/6/23 14:04	29/6/23
N5.18	1.454789	103.8233	20230731	6/7/23 3:46	6/7/23

N5.18	1.454789	103.8233	20230731	8/7/23 9:04	8/7/23
N5.18	1.454789	103.8233	20230731	8/7/23 9:47	8/7/23
N5.18	1.454789	103.8233	20230731	9/7/23 6:14	9/7/23
N5.18	1.454789	103.8233	20230731	12/7/23 14:59	12/7/23
N5.18	1.454789	103.8233	20230731	15/7/23 8:52	15/7/23
N5.18	1.454789	103.8233	20230731	16/7/23 7:19	16/7/23
N5.18	1.454789	103.8233	20230731	16/7/23 12:37	16/7/23
N5.18	1.454789	103.8233	20230731	17/7/23 5:49	17/7/23
N5.18	1.454789	103.8233	20230731	18/7/23 23:26	18/7/23
N5.18	1.454789	103.8233	20230731	23/7/23 8:07	23/7/23
N5.18	1.454789	103.8233	20230731	23/7/23 8:19	23/7/23
N5.18	1.454789	103.8233	20230731	23/7/23 8:22	23/7/23
N5.18	1.454789	103.8233	20230731	23/7/23 8:23	23/7/23
N5.18	1.454789	103.8233	20230731	23/7/23 8:34	23/7/23
N5.18	1.454789	103.8233	20230731	23/7/23 8:35	23/7/23
N5.18	1.454789	103.8233	20230731	23/7/23 10:55	23/7/23
N5.18	1.454789	103.8233	20230731	30/7/23 12:42	30/7/23
N5.18	1.454789	103.8233	20230731	30/7/23 12:47	30/7/23
N5.18	1.454789	103.8233	20230731	30/7/23 12:56	30/7/23
N5.19	1.456959	103.8249	20230731	13/7/23 10:23	13/7/23
N5.20	1.456158	103.8247	20230731	25/6/23 14:05	25/6/23
N5.20	1.456158	103.8247	20230731	25/6/23 14:06	25/6/23
N5.20	1.456158	103.8247	20230731	1/7/23 8:52	1/7/23
N5.20	1.456158	103.8247	20230731	3/7/23 16:34	3/7/23
N5.20	1.456158	103.8247	20230731	4/7/23 15:13	4/7/23
N5.20	1.456158	103.8247	20230731	10/7/23 8:19	10/7/23
N5.20	1.456158	103.8247	20230731	13/7/23 3:16	13/7/23
N5.20	1.456158	103.8247	20230731	15/7/23 11:57	15/7/23
N5.20	1.456158	103.8247	20230731	20/7/23 7:19	20/7/23
N5.20	1.456158	103.8247	20230731	21/7/23 17:20	21/7/23
N5.20	1.456158	103.8247	20230731	23/7/23 18:25	23/7/23
N5.20	1.456158	103.8247	20230731	26/7/23 11:52	26/7/23
N5.20	1.456158	103.8247	20230731	26/7/23 11:53	26/7/23
N5.20	1.456158	103.8247	20230731	26/7/23 16:20	26/7/23
N5.21	1.455057	103.8245	20230731	21/6/23 11:37	21/6/23
N5.21	1.455057	103.8245	20230731	21/6/23 13:19	21/6/23
N5.21	1.455057	103.8245	20230731	25/6/23 7:08	25/6/23
N5.21	1.455057	103.8245	20230731	26/6/23 8:25	26/6/23
N5.21	1.455057	103.8245	20230731	28/6/23 9:38	28/6/23
N5.21	1.455057	103.8245	20230731	28/6/23 9:44	28/6/23
N5.21	1.455057	103.8245	20230731	28/6/23 9:49	28/6/23
N5.21	1.455057	103.8245	20230731	6/7/23 9:19	6/7/23
N5.21	1.455057	103.8245	20230731	7/7/23 11:20	7/7/23
N5.21	1.455057	103.8245	20230731	10/7/23 18:56	10/7/23
N5.21	1.455057	103.8245	20230731	10/7/23 19:01	10/7/23
N5.21	1.455057	103.8245	20230731	11/7/23 6:39	11/7/23
N5.21	1.455057	103.8245	20230731	12/7/23 10:41	12/7/23
N5.21	1.455057	103.8245	20230731	12/7/23 13:29	12/7/23
N5.21	1.455057	103.8245	20230731	12/7/23 13:34	12/7/23
N5.21	1.455057	103.8245	20230731	13/7/23 8:42	13/7/23

N5.21	1.455057	103.8245	20230731	13/7/23 13:05	13/7/23
N5.21	1.455057	103.8245	20230731	13/7/23 18:44	13/7/23
N5.21	1.455057	103.8245	20230731	15/7/23 9:46	15/7/23
N5.21	1.455057	103.8245	20230731	15/7/23 11:49	15/7/23
N5.21	1.455057	103.8245	20230731	17/7/23 17:21	17/7/23
N5.21	1.455057	103.8245	20230731	21/7/23 12:13	21/7/23
N5.21	1.455057	103.8245	20230731	21/7/23 18:15	21/7/23
N5.21	1.455057	103.8245	20230731	22/7/23 11:44	22/7/23
N5.21	1.455057	103.8245	20230731	23/7/23 7:53	23/7/23
N5.21	1.455057	103.8245	20230731	23/7/23 12:27	23/7/23
N5.21	1.455057	103.8245	20230731	25/7/23 9:15	25/7/23
N5.21	1.455057	103.8245	20230731	26/7/23 13:36	26/7/23
N5.21	1.455057	103.8245	20230731	28/7/23 7:35	28/7/23
N5.21	1.455057	103.8245	20230731	28/7/23 7:36	28/7/23
N5.21	1.455057	103.8245	20230731	29/7/23 18:43	29/7/23
N5.23	1.453689	103.8243	20230731	22/6/23 9:15	22/6/23
N5.23	1.453689	103.8243	20230731	22/6/23 16:33	22/6/23
N5.23	1.453689	103.8243	20230731	22/6/23 17:44	22/6/23
N5.23	1.453689	103.8243	20230731	23/6/23 15:04	23/6/23
N5.23	1.453689	103.8243	20230731	24/6/23 11:34	24/6/23
N5.23	1.453689	103.8243	20230731	26/6/23 17:43	26/6/23
N5.23	1.453689	103.8243	20230731	27/6/23 7:44	27/6/23
N5.23	1.453689	103.8243	20230731	29/6/23 0:08	29/6/23
N5.23	1.453689	103.8243	20230731	29/6/23 18:32	29/6/23
N5.23	1.453689	103.8243	20230731	29/6/23 22:15	29/6/23
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N5.23	1.453689	103.8243	20230731	29/6/23 22:23	29/6/23
N5.23	1.453689	103.8243	20230731	29/6/23 23:39	29/6/23
N5.23	1.453689	103.8243	20230731	30/6/23 8:09	30/6/23
N5.23	1.453689	103.8243	20230731	30/6/23 18:23	30/6/23
N5.23	1.453689	103.8243	20230731	1/7/23 20:37	1/7/23
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N5.23	1.453689	103.8243	20230731	6/7/23 12:05	6/7/23
N5.23	1.453689	103.8243	20230731	6/7/23 13:47	6/7/23
N5.23	1.453689	103.8243	20230731	6/7/23 14:02	6/7/23
N5.23	1.453689	103.8243	20230731	6/7/23 18:13	6/7/23
N5.23	1.453689	103.8243	20230731	7/7/23 13:18	7/7/23

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N5.23	1.453689	103.8243	20230731	24/7/23 10:45	24/7/23
N5.23	1.453689	103.8243	20230731	24/7/23 11:28	24/7/23
N5.23	1.453689	103.8243	20230731	24/7/23 11:59	24/7/23
N5.23	1.453689	103.8243	20230731	24/7/23 12:05	24/7/23
N5.23	1.453689	103.8243	20230731	24/7/23 12:13	24/7/23
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N5.23	1.453689	103.8243	20230731	25/7/23 21:30	25/7/23
N5.23	1.453689	103.8243	20230731	26/7/23 20:15	26/7/23
N5.23	1.453689	103.8243	20230731	28/7/23 3:07	28/7/23
N5.23	1.453689	103.8243	20230731	28/7/23 17:04	28/7/23
N5.23	1.453689	103.8243	20230731	30/7/23 7:37	30/7/23
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N5.24	1.456105	103.8256	20230731	11/7/23 8:21	11/7/23
N5.24	1.456105	103.8256	20230731	11/7/23 18:26	11/7/23
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N5.24	1.456105	103.8256	20230731	11/7/23 22:37	11/7/23
N5.24	1.456105	103.8256	20230731	11/7/23 22:38	11/7/23
N5.24	1.456105	103.8256	20230731	12/7/23 0:58	12/7/23
N5.24	1.456105	103.8256	20230731	12/7/23 2:25	12/7/23
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N5.24	1.456105	103.8256	20230731	12/7/23 12:40	12/7/23
N5.24	1.456105	103.8256	20230731	13/7/23 9:57	13/7/23
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N5.24	1.456105	103.8256	20230731	14/7/23 12:55	14/7/23
N5.24	1.456105	103.8256	20230731	14/7/23 13:42	14/7/23
N5.24	1.456105	103.8256	20230731	15/7/23 8:18	15/7/23
N5.24	1.456105	103.8256	20230731	15/7/23 8:45	15/7/23
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N5.24	1.456105	103.8256	20230731	17/7/23 8:00	17/7/23
N5.24	1.456105	103.8256	20230731	17/7/23 8:03	17/7/23
N5.24	1.456105	103.8256	20230731	22/7/23 15:33	22/7/23
N5.24	1.456105	103.8256	20230731	24/7/23 18:04	24/7/23
N5.24	1.456105	103.8256	20230731	25/7/23 16:34	25/7/23
N5.24	1.456105	103.8256	20230731	27/7/23 18:26	27/7/23
N5.24	1.456105	103.8256	20230731	30/7/23 14:25	30/7/23
N5.25	1.455273	103.826	20230731	21/6/23 15:57	21/6/23
N5.25	1.455273	103.826	20230731	21/6/23 18:55	21/6/23
N5.25	1.455273	103.826	20230731	25/6/23 9:51	25/6/23
N5.25	1.455273	103.826	20230731	25/6/23 14:26	25/6/23
N5.25	1.455273	103.826	20230731	26/6/23 16:16	26/6/23
N5.25	1.455273	103.826	20230731	27/6/23 7:31	27/6/23
N5.25	1.455273	103.826	20230731	29/6/23 8:47	29/6/23
N5.25	1.455273	103.826	20230731	1/7/23 9:20	1/7/23
N5.25	1.455273	103.826	20230731	4/7/23 12:44	4/7/23
N5.25	1.455273	103.826	20230731	4/7/23 13:55	4/7/23
N5.25	1.455273	103.826	20230731	4/7/23 15:13	4/7/23
N5.25	1.455273	103.826	20230731	8/7/23 10:45	8/7/23
N5.25	1.455273	103.826	20230731	8/7/23 13:34	8/7/23
N5.25	1.455273	103.826	20230731	9/7/23 7:54	9/7/23
N5.25	1.455273	103.826	20230731	9/7/23 9:02	9/7/23
N5.25	1.455273	103.826	20230731	9/7/23 9:10	9/7/23
N5.25	1.455273	103.826	20230731	9/7/23 9:33	9/7/23
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N5.25	1.455273	103.826	20230731	9/7/23 9:46	9/7/23
N5.25	1.455273	103.826	20230731	9/7/23 9:55	9/7/23
N5.25	1.455273	103.826	20230731	9/7/23 10:15	9/7/23
N5.25	1.455273	103.826	20230731	10/7/23 15:21	10/7/23

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N5.25	1.455273	103.826	20230731	12/7/23 17:39	12/7/23
N5.25	1.455273	103.826	20230731	13/7/23 16:34	13/7/23
N5.25	1.455273	103.826	20230731	16/7/23 18:37	16/7/23
N5.25	1.455273	103.826	20230731	17/7/23 14:47	17/7/23
N5.25	1.455273	103.826	20230731	18/7/23 11:40	18/7/23
N5.25	1.455273	103.826	20230731	19/7/23 16:22	19/7/23
N5.25	1.455273	103.826	20230731	21/7/23 14:54	21/7/23
N5.25	1.455273	103.826	20230731	21/7/23 16:10	21/7/23
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N5.25	1.455273	103.826	20230731	24/7/23 14:33	24/7/23
N5.25	1.455273	103.826	20230731	24/7/23 14:34	24/7/23
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N5.26	1.454686	103.8255	20230731	21/6/23 15:43	21/6/23
N5.26	1.454686	103.8255	20230731	21/6/23 15:44	21/6/23
N5.26	1.454686	103.8255	20230731	24/6/23 7:57	24/6/23
N5.26	1.454686	103.8255	20230731	25/6/23 9:43	25/6/23
N5.26	1.454686	103.8255	20230731	27/6/23 16:18	27/6/23
N5.26	1.454686	103.8255	20230731	29/6/23 8:07	29/6/23
N5.26	1.454686	103.8255	20230731	29/6/23 15:12	29/6/23
N5.26	1.454686	103.8255	20230731	29/6/23 15:17	29/6/23
N5.26	1.454686	103.8255	20230731	2/7/23 11:23	2/7/23
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N5.26	1.454686	103.8255	20230731	4/7/23 13:04	4/7/23
N5.26	1.454686	103.8255	20230731	4/7/23 16:21	4/7/23
N5.26	1.454686	103.8255	20230731	4/7/23 18:43	4/7/23
N5.26	1.454686	103.8255	20230731	4/7/23 18:56	4/7/23
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N5.26	1.454686	103.8255	20230731	18/7/23 9:27	18/7/23
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N5.26	1.454686	103.8255	20230731	18/7/23 9:29	18/7/23

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N5.26	1.454686	103.8255	20230731	21/7/23 13:51	21/7/23
N5.26	1.454686	103.8255	20230731	21/7/23 15:31	21/7/23
N5.26	1.454686	103.8255	20230731	21/7/23 17:07	21/7/23
N5.26	1.454686	103.8255	20230731	21/7/23 17:33	21/7/23
N5.26	1.454686	103.8255	20230731	24/7/23 11:43	24/7/23
N5.26	1.454686	103.8255	20230731	24/7/23 14:27	24/7/23
N5.26	1.454686	103.8255	20230731	24/7/23 14:42	24/7/23
N5.26	1.454686	103.8255	20230731	24/7/23 15:45	24/7/23
N5.26	1.454686	103.8255	20230731	26/7/23 9:38	26/7/23
N5.26	1.454686	103.8255	20230731	26/7/23 9:45	26/7/23
N5.26	1.454686	103.8255	20230731	29/7/23 15:27	29/7/23
N5.26	1.454686	103.8255	20230731	30/7/23 13:47	30/7/23
N5.26	1.454686	103.8255	20230731	30/7/23 14:19	30/7/23
N5.27	1.455273	103.826	20230731	23/6/23 12:28	23/6/23
N5.27	1.455273	103.826	20230731	26/6/23 16:00	26/6/23
N5.27	1.455273	103.826	20230731	26/6/23 20:03	26/6/23
N5.27	1.455273	103.826	20230731	27/6/23 12:55	27/6/23
N5.27	1.455273	103.826	20230731	28/6/23 18:34	28/6/23
N5.27	1.455273	103.826	20230731	28/6/23 21:32	28/6/23
N5.27	1.455273	103.826	20230731	5/7/23 8:26	5/7/23
N5.27	1.455273	103.826	20230731	5/7/23 8:47	5/7/23
N5.27	1.455273	103.826	20230731	5/7/23 8:48	5/7/23
N5.27	1.455273	103.826	20230731	5/7/23 20:37	5/7/23
N5.27	1.455273	103.826	20230731	6/7/23 14:00	6/7/23
N5.27	1.455273	103.826	20230731	8/7/23 19:47	8/7/23
N5.27	1.455273	103.826	20230731	15/7/23 7:35	15/7/23
N5.27	1.455273	103.826	20230731	15/7/23 7:38	15/7/23
N5.27	1.455273	103.826	20230731	15/7/23 9:48	15/7/23
N5.27	1.455273	103.826	20230731	25/7/23 19:51	25/7/23
N5.28	1.454519	103.8261	20230731	22/6/23 8:01	22/6/23
N5.28	1.454519	103.8261	20230731	23/6/23 9:10	23/6/23
N5.28	1.454519	103.8261	20230731	25/6/23 8:03	25/6/23
N5.28	1.454519	103.8261	20230731	25/6/23 10:52	25/6/23
N5.28	1.454519	103.8261	20230731	25/6/23 15:53	25/6/23
N5.28	1.454519	103.8261	20230731	27/6/23 13:40	27/6/23
N5.28	1.454519	103.8261	20230731	27/6/23 17:45	27/6/23
N5.28	1.454519	103.8261	20230731	28/6/23 8:57	28/6/23
N5.28	1.454519	103.8261	20230731	28/6/23 9:56	28/6/23
N5.28	1.454519	103.8261	20230731	28/6/23 13:17	28/6/23
N5.28	1.454519	103.8261	20230731	29/6/23 14:44	29/6/23
N5.28	1.454519	103.8261	20230731	30/6/23 7:43	30/6/23
N5.28	1.454519	103.8261	20230731	2/7/23 14:24	2/7/23
N5.28	1.454519	103.8261	20230731	2/7/23 16:01	2/7/23
N5.28	1.454519	103.8261	20230731	3/7/23 7:58	3/7/23
N5.28	1.454519	103.8261	20230731	3/7/23 9:22	3/7/23
N5.28	1.454519	103.8261	20230731	3/7/23 9:23	3/7/23
N5.28	1.454519	103.8261	20230731	3/7/23 11:51	3/7/23
N5.28	1.454519	103.8261	20230731	4/7/23 8:35	4/7/23

N5.28	1.454519	103.8261	20230731	4/7/23 8:46	4/7/23
N5.28	1.454519	103.8261	20230731	5/7/23 8:54	5/7/23
N5.28	1.454519	103.8261	20230731	6/7/23 17:27	6/7/23
N5.28	1.454519	103.8261	20230731	7/7/23 8:36	7/7/23
N5.28	1.454519	103.8261	20230731	7/7/23 10:12	7/7/23
N5.28	1.454519	103.8261	20230731	7/7/23 10:25	7/7/23
N5.28	1.454519	103.8261	20230731	8/7/23 8:42	8/7/23
N5.28	1.454519	103.8261	20230731	8/7/23 12:38	8/7/23
N5.28	1.454519	103.8261	20230731	9/7/23 7:53	9/7/23
N5.28	1.454519	103.8261	20230731	9/7/23 8:42	9/7/23
N5.28	1.454519	103.8261	20230731	9/7/23 11:31	9/7/23
N5.28	1.454519	103.8261	20230731	9/7/23 16:09	9/7/23
N5.28	1.454519	103.8261	20230731	10/7/23 12:34	10/7/23
N5.28	1.454519	103.8261	20230731	10/7/23 13:25	10/7/23
N5.28	1.454519	103.8261	20230731	10/7/23 13:26	10/7/23
N5.28	1.454519	103.8261	20230731	10/7/23 15:41	10/7/23
N5.28	1.454519	103.8261	20230731	10/7/23 16:35	10/7/23
N5.28	1.454519	103.8261	20230731	11/7/23 9:32	11/7/23
N5.28	1.454519	103.8261	20230731	11/7/23 10:38	11/7/23
N5.28	1.454519	103.8261	20230731	11/7/23 10:59	11/7/23
N5.28	1.454519	103.8261	20230731	11/7/23 11:41	11/7/23
N5.28	1.454519	103.8261	20230731	11/7/23 11:41	11/7/23
N5.28	1.454519	103.8261	20230731	12/7/23 9:32	12/7/23
N5.28	1.454519	103.8261	20230731	12/7/23 10:23	12/7/23
N5.28	1.454519	103.8261	20230731	12/7/23 17:15	12/7/23
N5.28	1.454519	103.8261	20230731	15/7/23 16:46	15/7/23
N5.28	1.454519	103.8261	20230731	16/7/23 8:03	16/7/23
N5.28	1.454519	103.8261	20230731	22/7/23 8:17	22/7/23
N5.28	1.454519	103.8261	20230731	22/7/23 8:18	22/7/23
N5.28	1.454519	103.8261	20230731	22/7/23 15:49	22/7/23
N5.28	1.454519	103.8261	20230731	22/7/23 15:52	22/7/23
N5.28	1.454519	103.8261	20230731	22/7/23 15:56	22/7/23
N5.28	1.454519	103.8261	20230731	23/7/23 3:13	23/7/23
N5.28	1.454519	103.8261	20230731	23/7/23 8:10	23/7/23
N5.28	1.454519	103.8261	20230731	23/7/23 15:56	23/7/23
N5.28	1.454519	103.8261	20230731	23/7/23 17:42	23/7/23
N5.28	1.454519	103.8261	20230731	26/7/23 6:58	26/7/23
N5.28	1.454519	103.8261	20230731	26/7/23 9:44	26/7/23
N5.28	1.454519	103.8261	20230731	27/7/23 4:58	27/7/23
N5.28	1.454519	103.8261	20230731	27/7/23 8:00	27/7/23
N5.28	1.454519	103.8261	20230731	27/7/23 8:17	27/7/23
N5.28	1.454519	103.8261	20230731	27/7/23 15:49	27/7/23
N5.28	1.454519	103.8261	20230731	28/7/23 8:33	28/7/23
N5.28	1.454519	103.8261	20230731	30/7/23 20:36	30/7/23

Time	FileName	ScientificName	Quantity
23:50:24	RCNX0006.AVI	Canis lupus familiaris	2
2:00:46	RCNX0008.AVI	Canis lupus familiaris	2
16:19:20	RCNX0009.AVI	Canis lupus familiaris	1
0:51:32	RCNX0010.AVI	Canis lupus familiaris	1
7:23:48	RCNX0011.AVI	Canis lupus familiaris	1
2:48:50	RCNX0012.AVI	Canis lupus familiaris	3
2:49:24	RCNX0013.AVI	Canis lupus familiaris	1
11:22:26	RCNX0014.AVI	Canis lupus familiaris	1
12:31:10	RCNX0015.AVI	Canis lupus familiaris	1
1:40:32	RCNX0016.AVI	Canis lupus familiaris	3
9:56:26	RCNX0017.AVI	Canis lupus familiaris	1
11:44:56	RCNX0018.AVI	Acridotheres javanicus	1
3:16:22	RCNX0019.AVI	Canis lupus familiaris	1
16:24:54	RCNX0034.AVI	Canis lupus familiaris	1
8:21:12	RCNX0035.AVI	Canis lupus familiaris	1
4:01:28	RCNX0036.AVI	Canis lupus familiaris	1
21:37:58	RCNX0039.AVI	Canis lupus familiaris	1
21:40:26	RCNX0040.AVI	Canis lupus familiaris	1
4:32:22	RCNX0041.AVI	Canis lupus familiaris	1
6:39:02	RCNX0042.AVI	Canis lupus familiaris	1
7:48:04	RCNX0043.AVI	Canis lupus familiaris	1
8:22:52	RCNX0044.AVI	Canis lupus familiaris	1
8:34:00	RCNX0045.AVI	Canis lupus familiaris	1
9:44:04	RCNX0054.AVI	Canis lupus familiaris	1
23:50:46	RCNX0056.AVI	Canis lupus familiaris	2
16:32:40	RCNX0058.AVI	Acridotheres javanicus	1
16:33:46	RCNX0059.AVI	Acridotheres javanicus	1
2:18:24	RCNX0061.AVI	Canis lupus familiaris	1
7:34:54	RCNX0062.AVI	Canis lupus familiaris	1
13:25:26	RCNX0063.AVI	Canis lupus familiaris	1
17:03:40	RCNX0064.AVI	Canis lupus familiaris	1
0:05:48	RCNX0065.AVI	Canis lupus familiaris	2
21:15:18	RCNX0066.AVI	Canis lupus familiaris	1
2:32:10	RCNX0070.AVI	Canis lupus familiaris	1
4:16:18	RCNX0071.AVI	Canis lupus familiaris	1
8:47:26	RCNX0074.AVI	Acridotheres javanicus	5
22:09:08	RCNX0075.AVI	Canis lupus familiaris	1
1:18:08	RCNX0076.AVI	Canis lupus familiaris	1
7:23:02	RCNX0008.AVI	Canis lupus familiaris	3
2:48:28	RCNX0010.AVI	Canis lupus familiaris	3
6:43:26	RCNX0011.AVI	Canis lupus familiaris	1
11:21:38	RCNX0012.AVI	Canis lupus familiaris	1
13:14:48	RCNX0013.AVI	Canis lupus familiaris	1
1:40:06	RCNX0014.AVI	Canis lupus familiaris	4
0:53:00	RCNX0016.AVI	Canis lupus familiaris	1
4:26:52	RCNX0017.AVI	Canis lupus familiaris	1
3:13:54	RCNX0022.AVI	Canis lupus familiaris	1
3:17:08	RCNX0023.AVI	Canis lupus familiaris	2
3:19:16	RCNX0024.AVI	Canis lupus familiaris	1
3:30:54	RCNX0025.AVI	Canis lupus familiaris	1
3:51:02	RCNX0026.AVI	Canis lupus familiaris	1
3:56:48	RCNX0027.AVI	Canis lupus familiaris	1
4:24:54	RCNX0028.AVI	Canis lupus familiaris	1
5:29:06	RCNX0029.AVI	Canis lupus familiaris	1
23:50:06	RCNX0030.AVI	Canis lupus familiaris	1
3:40:52	RCNX0031.AVI	Canis lupus familiaris	1
16:24:06	RCNX0038.AVI	Canis lupus familiaris	1
2:46:26	RCNX0040.AVI	Canis lupus familiaris	1

23:41:22	RCNX0041.AVI	Canis lupus familiaris	1
23:52:10	RCNX0042.AVI	Canis lupus familiaris	1
0:27:48	RCNX0043.AVI	Canis lupus familiaris	1
0:28:24	RCNX0044.AVI	Canis lupus familiaris	1
19:50:24	RCNX0045.AVI	Canis lupus familiaris	1
4:23:40	RCNX0046.AVI	Canis lupus familiaris	1
21:37:30	RCNX0051.AVI	Canis lupus familiaris	2
21:39:56	RCNX0053.AVI	Canis lupus familiaris	1
4:31:56	RCNX0054.AVI	Canis lupus familiaris	1
6:37:58	RCNX0055.AVI	Canis lupus familiaris	1
22:09:46	RCNX0062.AVI	Canis lupus familiaris	1
9:43:16	RCNX0063.AVI	Canis lupus familiaris	1
23:49:54	RCNX0064.AVI	Canis lupus familiaris	1
7:28:02	RCNX0066.AVI	Canis lupus familiaris	1
7:28:32	RCNX0067.AVI	Canis lupus familiaris	1
2:20:06	RCNX0069.AVI	Canis lupus familiaris	1
7:57:36	RCNX0070.AVI	Canis lupus familiaris	1
8:00:26	RCNX0071.AVI	Canis lupus familiaris	1
8:05:14	RCNX0072.AVI	Canis lupus familiaris	1
13:51:08	RCNX0074.AVI	Canis lupus familiaris	1
17:15:52	RCNX0075.AVI	Canis lupus familiaris	1
21:14:36	RCNX0076.AVI	Canis lupus familiaris	1
2:31:06	RCNX0079.AVI	Canis lupus familiaris	1
14:41:46	RCNX0081.AVI	Canis lupus familiaris	1
22:58:10	RCNX0082.AVI	Canis lupus familiaris	1
4:15:16	RCNX0083.AVI	Canis lupus familiaris	1
4:15:54	RCNX0084.AVI	Canis lupus familiaris	1
22:08:26	RCNX0090.AVI	Canis lupus familiaris	1
16:05:38	RCNX0017.AVI	Amaurornis phoenicurus	1
9:01:22	RCNX0018.AVI	Amaurornis phoenicurus	1
10:38:12	RCNX0019.AVI	Amaurornis phoenicurus	1
12:32:08	RCNX0020.AVI	Amaurornis phoenicurus	1
2:01:08	RCNX0021.AVI	Canis lupus familiaris	1
13:27:54	RCNX0022.AVI	Amaurornis phoenicurus	1
14:07:40	RCNX0023.AVI	Amaurornis phoenicurus	1
0:01:02	RCNX0024.AVI	Rattus tanezumi	1
10:50:00	RCNX0025.AVI	Amaurornis phoenicurus	1
18:53:20	RCNX0027.AVI	Rallina fasciata	2
9:33:20	RCNX0028.AVI	Amaurornis phoenicurus	1
7:53:34	RCNX0029.AVI	Rallina fasciata	1
9:36:28	RCNX0031.AVI	Rallina fasciata	1
7:51:32	RCNX0032.AVI	Rallina fasciata	1
7:59:28	RCNX0033.AVI	Amaurornis phoenicurus	1
9:52:08	RCNX0034.AVI	Rallina fasciata	1
9:52:58	RCNX0035.AVI	Rallina fasciata	1
12:05:30	RCNX0036.AVI	Amaurornis phoenicurus	1
15:28:04	RCNX0037.AVI	Chalcophaps indica	1
17:40:14	RCNX0038.AVI	Rallina fasciata	1
13:56:48	RCNX0039.AVI	Amaurornis phoenicurus	1
15:51:50	RCNX0040.AVI	Amaurornis phoenicurus	1
10:26:58	RCNX0041.AVI	Amaurornis phoenicurus	1
11:08:28	RCNX0042.AVI	Rallina fasciata	1
13:06:46	RCNX0043.AVI	Amaurornis phoenicurus	1
10:59:20	RCNX0044.AVI	Amaurornis phoenicurus	1

16:30:04	RCNX0049.AVI	Amaurornis phoenicurus	1
14:46:24	RCNX0051.AVI	Callosciurus notatus	1
10:15:04	RCNX0052.AVI	Amaurornis phoenicurus	1
19:43:36	RCNX0053.AVI	Rattus tanezumi	1
7:28:44	RCNX0056.AVI	Rallina fasciata	1
14:12:54	RCNX0057.AVI	Amaurornis phoenicurus	1
9:36:06	RCNX0058.AVI	Amaurornis phoenicurus	1
7:22:44	RCNX0060.AVI	Rallina fasciata	1
13:50:54	RCNX0061.AVI	Amaurornis phoenicurus	1
15:46:52	RCNX0062.AVI	Callosciurus notatus	1
7:06:58	RCNX0006.AVI	Amaurornis phoenicurus	4
18:05:10	RCNX0007.AVI	Lewinia striata	1
8:46:38	RCNX0008.AVI	Lewinia striata	1
9:10:48	RCNX0009.AVI	Lewinia striata	2
9:43:16	RCNX0010.AVI	Lewinia striata	1
21:17:04	RCNX0011.AVI	Canis lupus familiaris	3
21:17:30	RCNX0012.AVI	Canis lupus familiaris	2
21:18:16	RCNX0013.AVI	Canis lupus familiaris	2
21:18:42	RCNX0014.AVI	Canis lupus familiaris	2
18:46:10	RCNX0015.AVI	Amaurornis phoenicurus	2
18:52:10	RCNX0016.AVI	Lewinia striata	1
9:50:08	RCNX0018.AVI	Lewinia striata	1
11:17:40	RCNX0020.AVI	Lewinia striata	1
11:37:16	RCNX0021.AVI	Lewinia striata	1
12:45:20	RCNX0022.AVI	Amaurornis phoenicurus	1
17:58:20	RCNX0023.AVI	Lewinia striata	1
11:00:58	RCNX0025.AVI	Lewinia striata	1
12:13:08	RCNX0027.AVI	Lewinia striata	1
10:59:32	RCNX0029.AVI	Amaurornis phoenicurus	1
19:11:40	RCNX0030.AVI	Lewinia striata	1
9:10:26	RCNX0032.AVI	Lewinia striata	2
9:51:10	RCNX0033.AVI	Lewinia striata	1
9:51:40	RCNX0034.AVI	Lewinia striata	1
11:03:18	RCNX0035.AVI	Lewinia striata	1
16:05:46	RCNX0036.AVI	Canis lupus familiaris	3
16:06:14	RCNX0037.AVI	Canis lupus familiaris	1
18:42:34	RCNX0038.AVI	Amaurornis phoenicurus	1
8:16:52	RCNX0039.AVI	Lewinia striata	1
8:20:54	RCNX0041.AVI	Lewinia striata	1
7:23:44	RCNX0006.AVI	Amaurornis phoenicurus	1
10:25:26	RCNX0007.AVI	Lewinia striata	1
12:01:24	RCNX0008.AVI	Amaurornis phoenicurus	1
7:26:28	RCNX0009.AVI	Amaurornis phoenicurus	1
11:41:08	RCNX0010.AVI	Amaurornis phoenicurus	1
12:29:16	RCNX0011.AVI	Chalcophaps indica	1
15:21:04	RCNX0012.AVI	Amaurornis phoenicurus	1
15:25:24	RCNX0013.AVI	Amaurornis phoenicurus	1
18:10:18	RCNX0015.AVI	Amaurornis phoenicurus	1
19:08:06	RCNX0016.AVI	Rallina fasciata	2
8:07:36	RCNX0017.AVI	Lewinia striata	1

8:58:38	RCNX0018.AVI	Amaurornis phoenicurus	1
11:09:30	RCNX0019.AVI	Amaurornis phoenicurus	1
12:31:12	RCNX0020.AVI	Amaurornis phoenicurus	1
12:33:08	RCNX0021.AVI	Amaurornis phoenicurus	1
13:38:32	RCNX0022.AVI	Amaurornis phoenicurus	1
11:49:28	RCNX0025.AVI	Amaurornis phoenicurus	1
11:54:50	RCNX0027.AVI	Amaurornis phoenicurus	1
12:25:56	RCNX0028.AVI	Chalcophaps indica	1
17:03:30	RCNX0029.AVI	Amaurornis phoenicurus	1
17:40:12	RCNX0031.AVI	Amaurornis phoenicurus	1
8:31:52	RCNX0033.AVI	Amaurornis phoenicurus	1
8:38:02	RCNX0034.AVI	Amaurornis phoenicurus	1
8:48:54	RCNX0035.AVI	Amaurornis phoenicurus	1
12:58:54	RCNX0038.AVI	Amaurornis phoenicurus	1
9:48:02	RCNX0039.AVI	Amaurornis phoenicurus	1
9:49:28	RCNX0040.AVI	Amaurornis phoenicurus	1
10:16:30	RCNX0041.AVI	Amaurornis phoenicurus	1
18:36:18	RCNX0042.AVI	Amaurornis phoenicurus	1
8:31:00	RCNX0044.AVI	Amaurornis phoenicurus	1
8:45:08	RCNX0045.AVI	Amaurornis phoenicurus	1
8:52:04	RCNX0046.AVI	Amaurornis phoenicurus	1
0:35:36	RCNX0050.AVI	Canis lupus familiaris	1
11:03:30	RCNX0051.AVI	Amaurornis phoenicurus	1
11:17:38	RCNX0052.AVI	Amaurornis phoenicurus	1
10:21:32	RCNX0054.AVI	Amaurornis phoenicurus	1
11:09:38	RCNX0055.AVI	Amaurornis phoenicurus	1
13:07:30	RCNX0056.AVI	Lewinia striata	1
13:24:22	RCNX0057.AVI	Lewinia striata	1
13:58:28	RCNX0058.AVI	Amaurornis phoenicurus	1
14:15:52	RCNX0059.AVI	Amaurornis phoenicurus	1
15:13:12	RCNX0060.AVI	Amaurornis phoenicurus	1
15:38:18	RCNX0061.AVI	Amaurornis phoenicurus	1
7:59:12	RCNX0063.AVI	Amaurornis phoenicurus	1
8:08:48	RCNX0064.AVI	Amaurornis phoenicurus	1
10:24:12	RCNX0066.AVI	Amaurornis phoenicurus	1
10:31:46	RCNX0067.AVI	Amaurornis phoenicurus	1
11:40:52	RCNX0068.AVI	Amaurornis phoenicurus	1
12:28:44	RCNX0069.AVI	Amaurornis phoenicurus	1
12:39:06	RCNX0071.AVI	Amaurornis phoenicurus	1
7:55:34	RCNX0072.AVI	Amaurornis phoenicurus	1
8:01:50	RCNX0073.AVI	Amaurornis phoenicurus	1
8:52:40	RCNX0075.AVI	Amaurornis phoenicurus	1
13:56:08	RCNX0077.AVI	Amaurornis phoenicurus	1
18:14:32	RCNX0078.AVI	Lewinia striata	1
7:40:54	RCNX0079.AVI	Amaurornis phoenicurus	1
8:11:06	RCNX0081.AVI	Amaurornis phoenicurus	1
7:55:56	RCNX0082.AVI	Amaurornis phoenicurus	1
9:03:34	RCNX0083.AVI	Lewinia striata	1
8:14:52	RCNX0086.AVI	Amaurornis phoenicurus	1
8:55:50	RCNX0087.AVI	Amaurornis phoenicurus	1

10:06:48	RCNX0088.AVI	Amaurornis phoenicurus	1
10:38:08	RCNX0089.AVI	Amaurornis phoenicurus	1
12:44:34	RCNX0091.AVI	Amaurornis phoenicurus	1
10:27:38	RCNX0092.AVI	Amaurornis phoenicurus	1
7:33:56	RCNX0093.AVI	Amaurornis phoenicurus	1
7:15:42	RCNX0094.AVI	Rallina fasciata	1
13:24:52	RCNX0095.AVI	Picus vittatus	1
14:15:24	RCNX0096.AVI	Callosciurus notatus	1
12:37:30	RCNX0097.AVI	Canis lupus familiaris	2
12:42:22	RCNX0098.AVI	Canis lupus familiaris	1
7:40:42	RCNX0099.AVI	Amaurornis phoenicurus	1
18:15:24	RCNX0100.AVI	Callosciurus notatus	1
13:46:54	RCNX0009.AVI	Callosciurus notatus	1
8:21:54	RCNX0010.AVI	Amaurornis phoenicurus	1
10:42:04	RCNX0011.AVI	Rallina fasciata	1
7:26:58	RCNX0012.AVI	Rallina fasciata	1
11:15:06	RCNX0013.AVI	Callosciurus notatus	1
13:16:18	RCNX0014.AVI	Callosciurus notatus	1
13:20:48	RCNX0016.AVI	Callosciurus notatus	1
18:15:28	RCNX0017.AVI	Amaurornis phoenicurus	1
9:23:22	RCNX0018.AVI	Amaurornis phoenicurus	1
13:31:34	RCNX0019.AVI	Amaurornis phoenicurus	1
13:32:36	RCNX0020.AVI	Amaurornis phoenicurus	1
12:23:00	RCNX0021.AVI	Canis lupus familiaris	1
12:45:34	RCNX0022.AVI	Canis lupus familiaris	1
20:12:36	RCNX0023.AVI	Canis lupus familiaris	1
17:42:24	RCNX0024.AVI	Amaurornis phoenicurus	1
17:42:24	RCNX0024.AVI	Callosciurus notatus	1
7:33:24	RCNX0026.AVI	Amaurornis phoenicurus	1
7:29:32	RCNX0027.AVI	Callosciurus notatus	1
2:18:32	RCNX0009.AVI	Canis lupus familiaris	1
2:22:52	RCNX0010.AVI	Canis lupus familiaris	1
8:13:14	RCNX0011.AVI	Canis lupus familiaris	1
10:11:30	RCNX0013.AVI	Amaurornis phoenicurus	1
16:51:28	RCNX0014.AVI	Callosciurus notatus	1
17:46:48	RCNX0015.AVI	Amaurornis phoenicurus	1
13:06:56	RCNX0016.AVI	Callosciurus notatus	1
8:27:46	RCNX0017.AVI	Amaurornis phoenicurus	1
21:49:14	RCNX0018.AVI	Canis lupus familiaris	1
12:37:32	RCNX0019.AVI	Lewinia striata	1
15:38:24	RCNX0021.AVI	Amaurornis phoenicurus	1
10:46:30	RCNX0022.AVI	Amaurornis phoenicurus	1
9:36:56	RCNX0023.AVI	Amaurornis phoenicurus	1
7:13:10	RCNX0024.AVI	Tupaia glis	1
7:42:52	RCNX0025.AVI	Amaurornis phoenicurus	1
8:46:54	RCNX0026.AVI	Amaurornis phoenicurus	1
13:02:40	RCNX0027.AVI	Callosciurus notatus	1
5:26:44	RCNX0028.AVI	Canis lupus familiaris	2
5:27:10	RCNX0029.AVI	Canis lupus familiaris	2
5:29:54	RCNX0030.AVI	Canis lupus familiaris	1

5:59:14	RCNX0031.AVI	Canis lupus familiaris	3
6:00:36	RCNX0032.AVI	Canis lupus familiaris	2
6:01:14	RCNX0033.AVI	Canis lupus familiaris	1
6:07:58	RCNX0035.AVI	Canis lupus familiaris	2
6:08:54	RCNX0036.AVI	Canis lupus familiaris	1
6:09:58	RCNX0037.AVI	Canis lupus familiaris	1
6:11:24	RCNX0038.AVI	Canis lupus familiaris	1
6:35:32	RCNX0039.AVI	Canis lupus familiaris	1
7:14:20	RCNX0040.AVI	Canis lupus familiaris	1
9:51:14	RCNX0042.AVI	Felis catus	1
9:51:48	RCNX0043.AVI	Felis catus	1
7:18:06	RCNX0047.AVI	Rallina fasciata	1
14:16:54	RCNX0048.AVI	Callosciurus notatus	1
10:13:56	RCNX0050.AVI	Callosciurus notatus	1
15:26:42	RCNX0051.AVI	Canis lupus familiaris	1
15:27:12	RCNX0052.AVI	Canis lupus familiaris	1
14:19:42	RCNX0011.AVI	Callosciurus notatus	1
8:59:18	RCNX0012.AVI	Rallina fasciata	1
13:03:54	RCNX0013.AVI	Canis lupus familiaris	1
4:41:34	RCNX0014.AVI	Canis lupus familiaris	1
10:32:14	RCNX0015.AVI	Amaurornis phoenicurus	1
23:38:34	RCNX0018.AVI	Canis lupus familiaris	2
23:39:02	RCNX0019.AVI	Canis lupus familiaris	3
13:32:36	RCNX0022.AVI	Chalcophaps indica	1
6:56:16	RCNX0024.AVI	Canis lupus familiaris	1
9:52:04	RCNX0025.AVI	Amaurornis phoenicurus	1
10:43:18	RCNX0026.AVI	Amaurornis phoenicurus	1
13:18:36	RCNX0028.AVI	Amaurornis phoenicurus	1
15:04:00	RCNX0029.AVI	Callosciurus notatus	1
15:24:06	RCNX0030.AVI	Amaurornis phoenicurus	1
7:23:58	RCNX0031.AVI	Rallina fasciata	1
14:07:08	RCNX0033.AVI	Rallina fasciata	1
11:09:14	RCNX0034.AVI	Amaurornis phoenicurus	1
11:10:28	RCNX0035.AVI	Callosciurus notatus	1
18:55:40	RCNX0036.AVI	Canis lupus familiaris	2
19:06:00	RCNX0037.AVI	Canis lupus familiaris	1
10:22:32	RCNX0043.AVI	Amaurornis phoenicurus	1
12:05:50	RCNX0045.AVI	Amaurornis phoenicurus	1
7:10:00	RCNX0047.AVI	Rallina fasciata	2
8:38:12	RCNX0048.AVI	Amaurornis phoenicurus	1
11:57:22	RCNX0049.AVI	Amaurornis phoenicurus	1
12:45:50	RCNX0052.AVI	Amaurornis phoenicurus	1
9:41:56	RCNX0054.AVI	Rallina fasciata	1
12:50:00	RCNX0055.AVI	Amaurornis phoenicurus	1
13:32:04	RCNX0056.AVI	Tupaia glis	1
9:42:54	RCNX0062.AVI	Amaurornis phoenicurus	1
15:58:52	RCNX0067.AVI	Canis lupus familiaris	1
16:00:36	RCNX0068.AVI	Canis lupus familiaris	2
8:15:02	RCNX0069.AVI	Amaurornis phoenicurus	1
10:11:08	RCNX0070.AVI	Rallina fasciata	1

15:48:34	RCNX0072.AVI	Amaurornis phoenicurus	1
15:15:26	RCNX0073.AVI	Amaurornis phoenicurus	1
16:58:52	RCNX0074.AVI	Amaurornis phoenicurus	1
18:42:46	RCNX0076.AVI	Rallina fasciata	1
9:48:38	RCNX0077.AVI	Amaurornis phoenicurus	1
13:04:06	RCNX0078.AVI	Dinopium javanese	1
18:27:10	RCNX0079.AVI	Rallina fasciata	1
14:39:48	RCNX0081.AVI	Rallina fasciata	1
15:40:16	RCNX0082.AVI	Callosciurus notatus	1
18:50:38	RCNX0083.AVI	Rallina fasciata	1
16:54:30	RCNX0084.AVI	Tupaia glis	1
8:26:24	RCNX0085.AVI	Rallina fasciata	2
12:39:12	RCNX0086.AVI	Callosciurus notatus	1
7:04:28	RCNX0015.AVI	Rallina fasciata	2
7:55:18	RCNX0016.AVI	Rallina fasciata	1
18:26:42	RCNX0017.AVI	Rallina fasciata	2
10:16:24	RCNX0018.AVI	Canis lupus familiaris	1
13:18:34	RCNX0019.AVI	Rallina fasciata	1
7:20:20	RCNX0020.AVI	Amaurornis phoenicurus	1
18:47:00	RCNX0021.AVI	Rallina fasciata	1
15:22:54	RCNX0023.AVI	Rallina fasciata	1
15:38:06	RCNX0024.AVI	Rallina fasciata	1
15:32:46	RCNX0026.AVI	Varanus salvator	1
15:36:32	RCNX0010.AVI	Callosciurus notatus	1
12:50:26	RCNX0011.AVI	Callosciurus notatus	1
16:27:10	RCNX0012.AVI	Varanus nebulosus	1
14:49:58	RCNX0013.AVI	Canis lupus familiaris	1
12:37:48	RCNX0014.AVI	Canis lupus familiaris	1
0:22:46	RCNX0018.AVI	Canis lupus familiaris	1
0:23:10	RCNX0019.AVI	Canis lupus familiaris	1
0:23:34	RCNX0020.AVI	Canis lupus familiaris	1
0:24:00	RCNX0021.AVI	Canis lupus familiaris	1
0:24:24	RCNX0022.AVI	Canis lupus familiaris	1
4:02:00	RCNX0024.AVI	Canis lupus familiaris	1
9:12:54	RCNX0025.AVI	Canis lupus familiaris	1
10:09:16	RCNX0027.AVI	Canis lupus familiaris	1
20:15:00	RCNX0028.AVI	Canis lupus familiaris	1
20:15:38	RCNX0029.AVI	Canis lupus familiaris	1
20:16:16	RCNX0030.AVI	Canis lupus familiaris	1
13:47:48	RCNX0005.AVI	Amaurornis phoenicurus	1
6:30:32	RCNX0007.AVI	Canis lupus familiaris	1
9:32:00	RCNX0012.AVI	Canis lupus familiaris	1
11:09:36	RCNX0013.AVI	Chalcophaps indica	1
15:46:12	RCNX0014.AVI	Amaurornis phoenicurus	1
9:06:48	RCNX0015.AVI	Canis lupus familiaris	1
14:09:46	RCNX0016.AVI	Amaurornis phoenicurus	1
16:38:50	RCNX0019.AVI	Rallina fasciata	1
8:13:48	RCNX0020.AVI	Tupaia glis	1
8:45:52	RCNX0022.AVI	Canis lupus familiaris	1
8:46:32	RCNX0023.AVI	Canis lupus familiaris	2

8:58:46	RCNX0024.AVI	Canis lupus familiaris	1
9:34:24	RCNX0025.AVI	Amaurornis phoenicurus	1
9:27:20	RCNX0028.AVI	Canis lupus familiaris	1
7:49:22	RCNX0029.AVI	Amaurornis phoenicurus	1
20:04:16	RCNX0030.AVI	Canis lupus familiaris	1
20:05:24	RCNX0031.AVI	Canis lupus familiaris	1
15:20:04	RCNX0032.AVI	Canis lupus familiaris	1
10:44:54	RCNX0033.AVI	Chalcophaps indica	1
15:09:28	RCNX0040.AVI	Callosciurus notatus	1
8:21:54	RCNX0042.AVI	Tupaia glis	1
10:38:06	RCNX0006.AVI	Canis lupus familiaris	1
10:38:36	RCNX0007.AVI	Canis lupus familiaris	2
8:20:42	RCNX0008.AVI	Canis lupus familiaris	1
2:09:34	RCNX0009.AVI	Canis lupus familiaris	1
17:36:26	RCNX0010.AVI	Canis lupus familiaris	1
7:41:46	RCNX0011.AVI	Canis lupus familiaris	2
8:08:58	RCNX0012.AVI	Canis lupus familiaris	1
18:16:10	RCNX0029.AVI	Chalcophaps indica	1
8:59:50	RCNX0037.AVI	Canis lupus familiaris	1
10:57:38	RCNX0038.AVI	Canis lupus familiaris	1
11:01:10	RCNX0040.AVI	Canis lupus familiaris	1
11:03:12	RCNX0041.AVI	Canis lupus familiaris	1
7:14:02	RCNX0043.AVI	Canis lupus familiaris	1
8:43:18	RCNX0044.AVI	Canis lupus familiaris	2
9:47:44	RCNX0048.AVI	Canis lupus familiaris	1
10:23:16	RCNX0049.AVI	Canis lupus familiaris	1
19:39:48	RCNX0050.AVI	Canis lupus familiaris	1
14:33:14	RCNX0051.AVI	Canis lupus familiaris	1
14:56:12	RCNX0052.AVI	Canis lupus familiaris	2
9:06:32	RCNX0010.AVI	Canis lupus familiaris	1
13:06:52	RCNX0012.AVI	Canis lupus familiaris	1
15:12:54	RCNX0015.AVI	Rallina fasciata	2
17:31:50	RCNX0005.AVI	Chalcophaps indica	1
7:44:00	RCNX0007.AVI	Canis lupus familiaris	1
8:16:58	RCNX0008.AVI	Canis lupus familiaris	1
16:31:48	RCNX0009.AVI	Canis lupus familiaris	1
7:03:42	RCNX0013.AVI	Canis lupus familiaris	1
7:05:10	RCNX0014.AVI	Canis lupus familiaris	1
6:55:22	RCNX0016.AVI	Canis lupus familiaris	1
8:34:26	RCNX0017.AVI	Canis lupus familiaris	2
13:02:26	RCNX0018.AVI	Picus vittatus	1
14:03:18	RCNX0019.AVI	Canis lupus familiaris	1
14:04:12	RCNX0020.AVI	Canis lupus familiaris	1
7:38:16	RCNX0021.AVI	Canis lupus familiaris	5
22:57:54	RCNX0022.AVI	Canis lupus familiaris	1
7:03:38	RCNX0023.AVI	Canis lupus familiaris	3
11:09:30	RCNX0024.AVI	Callosciurus notatus	1
14:40:44	RCNX0025.AVI	Callosciurus notatus	1
21:51:40	RCNX0026.AVI	Canis lupus familiaris	1
21:52:24	RCNX0027.AVI	Canis lupus familiaris	1

9:13:42	RCNX0028.AVI	Picus vittatus	1
3:45:00	RCNX0029.AVI	Canis lupus familiaris	1
22:12:12	RCNX0030.AVI	Canis lupus familiaris	1
7:13:58	RCNX0031.AVI	Canis lupus familiaris	1
8:06:10	RCNX0032.AVI	Canis lupus familiaris	2
12:29:46	RCNX0033.AVI	Canis lupus familiaris	1
12:33:16	RCNX0034.AVI	Canis lupus familiaris	1
12:40:00	RCNX0035.AVI	Canis lupus familiaris	1
17:38:52	RCNX0036.AVI	Canis lupus familiaris	2
23:05:20	RCNX0037.AVI	Canis lupus familiaris	1
13:35:16	RCNX0038.AVI	Canis lupus familiaris	1
22:39:54	RCNX0039.AVI	Canis lupus familiaris	1
1:50:32	RCNX0040.AVI	Canis lupus familiaris	2
9:04:36	RCNX0041.AVI	Callosciurus notatus	1
11:55:16	RCNX0042.AVI	Canis lupus familiaris	1
13:53:54	RCNX0043.AVI	Callosciurus notatus	1
13:56:36	RCNX0044.AVI	Callosciurus notatus	1
14:57:52	RCNX0046.AVI	Callosciurus notatus	1
0:15:26	RCNX0047.AVI	Canis lupus familiaris	1
6:54:02	RCNX0048.AVI	Canis lupus familiaris	1
17:53:32	RCNX0049.AVI	Canis lupus familiaris	1
17:42:56	RCNX0050.AVI	Callosciurus notatus	1
17:58:04	RCNX0051.AVI	Callosciurus notatus	1
15:47:14	RCNX0054.AVI	Callosciurus notatus	1
7:21:30	RCNX0055.AVI	Tupaia glis	1
9:58:28	RCNX0056.AVI	Callosciurus notatus	1
12:36:40	RCNX0057.AVI	Callosciurus notatus	1
17:13:52	RCNX0060.AVI	Canis lupus familiaris	1
12:18:00	RCNX0061.AVI	Canis lupus familiaris	1
16:57:04	RCNX0062.AVI	Callosciurus notatus	1
22:58:00	RCNX0063.AVI	Canis lupus familiaris	1
13:23:10	RCNX0064.AVI	Canis lupus familiaris	1
16:27:28	RCNX0065.AVI	Canis lupus familiaris	1
14:13:02	RCNX0011.AVI	Canis lupus familiaris	1
11:40:00	RCNX0013.AVI	Callosciurus notatus	1
16:37:48	RCNX0014.AVI	Callosciurus notatus	1
16:29:10	RCNX0018.AVI	Chalcophaps indica	1
11:21:38	RCNX0021.AVI	Canis lupus familiaris	1
11:58:26	RCNX0023.AVI	Canis lupus familiaris	1
18:50:42	RCNX0024.AVI	Canis lupus familiaris	1
18:52:26	RCNX0025.AVI	Canis lupus familiaris	1
19:05:10	RCNX0026.AVI	Canis lupus familiaris	2
6:44:14	RCNX0004.AVI	Canis lupus familiaris	1
7:56:56	RCNX0005.AVI	Canis lupus familiaris	1
8:09:30	RCNX0006.AVI	Amaurornis phoenicurus	1
18:07:04	RCNX0008.AVI	Pitta moluccensis	1
11:49:28	RCNX0009.AVI	Pitta moluccensis	1
13:51:58	RCNX0010.AVI	Canis lupus familiaris	1
14:04:58	RCNX0011.AVI	Canis lupus familiaris	1
3:46:34	RCNX0012.AVI	Canis lupus familiaris	1

9:04:32	RCNX0013.AVI	Amaurornis phoenicurus	1
9:47:22	RCNX0014.AVI	Canis lupus familiaris	2
6:14:52	RCNX0015.AVI	Canis lupus familiaris	1
14:59:18	RCNX0016.AVI	Amaurornis phoenicurus	1
8:52:00	RCNX0017.AVI	Canis lupus familiaris	1
7:19:30	RCNX0018.AVI	Canis lupus familiaris	2
12:37:34	RCNX0019.AVI	Canis lupus familiaris	1
5:49:38	RCNX0021.AVI	Rattus tanezumi	1
23:26:56	RCNX0023.AVI	Canis lupus familiaris	1
8:07:12	RCNX0024.AVI	Canis lupus familiaris	2
8:19:30	RCNX0025.AVI	Canis lupus familiaris	1
8:22:44	RCNX0026.AVI	Canis lupus familiaris	1
8:23:16	RCNX0027.AVI	Canis lupus familiaris	1
8:34:50	RCNX0028.AVI	Canis lupus familiaris	1
8:35:26	RCNX0029.AVI	Canis lupus familiaris	1
10:55:38	RCNX0030.AVI	Canis lupus familiaris	1
12:42:38	RCNX0032.AVI	Canis lupus familiaris	1
12:47:08	RCNX0033.AVI	Canis lupus familiaris	1
12:56:42	RCNX0034.AVI	Canis lupus familiaris	1
10:23:58	RCNX0013.AVI	Amaurornis phoenicurus	1
14:05:58	RCNX0006.AVI	Callosciurus notatus	1
14:06:40	RCNX0007.AVI	Callosciurus notatus	1
8:52:28	RCNX0008.AVI	Tupaia glis	1
16:34:44	RCNX0009.AVI	Amaurornis phoenicurus	1
15:13:24	RCNX0010.AVI	Callosciurus notatus	1
8:19:16	RCNX0014.AVI	Tupaia glis	1
3:16:08	RCNX0015.AVI	Canis lupus familiaris	1
11:57:02	RCNX0016.AVI	Tupaia glis	1
7:19:32	RCNX0017.AVI	Tupaia glis	1
17:20:46	RCNX0019.AVI	Picus vittatus	1
18:25:42	RCNX0021.AVI	Rallina fasciata	1
11:52:22	RCNX0022.AVI	Callosciurus notatus	1
11:53:24	RCNX0023.AVI	Callosciurus notatus	1
16:20:08	RCNX0024.AVI	Callosciurus notatus	1
11:37:40	RCNX0006.AVI	Rallina fasciata	1
13:19:46	RCNX0007.AVI	Acridotheres javanicus	1
7:08:36	RCNX0010.AVI	Rallina fasciata	1
8:25:26	RCNX0011.AVI	Rallina fasciata	1
9:38:14	RCNX0013.AVI	Amaurornis phoenicurus	1
9:44:54	RCNX0014.AVI	Amaurornis phoenicurus	1
9:49:24	RCNX0015.AVI	Amaurornis phoenicurus	1
9:19:22	RCNX0017.AVI	Amaurornis phoenicurus	1
11:20:44	RCNX0019.AVI	Rallina fasciata	1
18:56:48	RCNX0020.AVI	Callosciurus notatus	1
19:01:16	RCNX0021.AVI	Callosciurus notatus	1
6:39:36	RCNX0022.AVI	Rattus tanezumi	1
10:41:14	RCNX0024.AVI	Canis lupus familiaris	1
13:29:50	RCNX0025.AVI	Tupaia glis	1
13:34:42	RCNX0026.AVI	Tupaia glis	1
8:42:12	RCNX0027.AVI	Amaurornis phoenicurus	1

13:05:38	RCNX0028.AVI	Canis lupus familiaris	1
18:44:18	RCNX0029.AVI	Rallina fasciata	1
9:46:46	RCNX0030.AVI	Callosciurus notatus	1
11:49:38	RCNX0032.AVI	Tupaia glis	1
17:21:32	RCNX0034.AVI	Tupaia glis	1
12:13:34	RCNX0037.AVI	Chalcophaps indica	1
18:15:06	RCNX0038.AVI	Amaurornis phoenicurus	1
11:44:10	RCNX0040.AVI	Callosciurus notatus	1
7:53:56	RCNX0041.AVI	Callosciurus notatus	1
12:27:44	RCNX0042.AVI	Amaurornis phoenicurus	1
9:15:58	RCNX0045.AVI	Tupaia glis	1
13:36:24	RCNX0048.AVI	Varanus nebulosus	1
7:35:08	RCNX0049.AVI	Amaurornis phoenicurus	1
7:36:52	RCNX0050.AVI	Amaurornis phoenicurus	1
18:43:02	RCNX0052.AVI	Rallina fasciata	1
9:15:06	RCNX0007.AVI	Amaurornis phoenicurus	1
16:33:38	RCNX0008.AVI	Callosciurus notatus	1
17:44:30	RCNX0009.AVI	Amaurornis phoenicurus	1
15:04:08	RCNX0011.AVI	Canis lupus familiaris	1
11:34:18	RCNX0012.AVI	Canis lupus familiaris	1
17:43:44	RCNX0017.AVI	Amaurornis phoenicurus	1
7:44:00	RCNX0018.AVI	Amaurornis phoenicurus	1
0:08:50	RCNX0023.AVI	Rattus tanezumi	1
18:32:40	RCNX0026.AVI	Amaurornis phoenicurus	1
22:15:22	RCNX0027.AVI	Canis lupus familiaris	1
22:22:20	RCNX0029.AVI	Canis lupus familiaris	1
22:23:16	RCNX0030.AVI	Canis lupus familiaris	1
23:39:20	RCNX0031.AVI	Rattus tanezumi	1
8:09:24	RCNX0032.AVI	Amaurornis phoenicurus	1
18:23:00	RCNX0033.AVI	Amaurornis phoenicurus	1
20:37:22	RCNX0034.AVI	Rattus tanezumi	1
23:14:04	RCNX0035.AVI	Canis lupus familiaris	2
7:42:04	RCNX0036.AVI	Amaurornis phoenicurus	1
16:00:52	RCNX0037.AVI	Chalcophaps indica	1
17:48:18	RCNX0038.AVI	Amaurornis phoenicurus	1
18:10:54	RCNX0039.AVI	Amaurornis phoenicurus	1
7:44:44	RCNX0041.AVI	Amaurornis phoenicurus	1
7:51:36	RCNX0042.AVI	Canis lupus familiaris	1
15:54:58	RCNX0045.AVI	Amaurornis phoenicurus	1
23:20:40	RCNX0046.AVI	Canis lupus familiaris	1
7:35:28	RCNX0047.AVI	Amaurornis phoenicurus	1
11:18:28	RCNX0048.AVI	Canis lupus familiaris	2
5:14:46	RCNX0049.AVI	Canis lupus familiaris	1
5:15:18	RCNX0050.AVI	Canis lupus familiaris	1
10:43:06	RCNX0051.AVI	Chalcophaps indica	1
12:05:12	RCNX0052.AVI	Rallina fasciata	1
13:47:52	RCNX0053.AVI	Amaurornis phoenicurus	2
14:02:18	RCNX0054.AVI	Amaurornis phoenicurus	1
18:13:10	RCNX0055.AVI	Amaurornis phoenicurus	1
13:18:10	RCNX0056.AVI	Canis lupus familiaris	1

13:18:56	RCNX0057.AVI	Canis lupus familiaris	1
17:48:02	RCNX0058.AVI	Amaurornis phoenicurus	1
19:36:06	RCNX0059.AVI	Rattus tanezumi	1
11:50:20	RCNX0060.AVI	Amaurornis phoenicurus	1
12:43:46	RCNX0061.AVI	Canis lupus familiaris	1
14:05:36	RCNX0062.AVI	Callosciurus notatus	1
18:07:16	RCNX0063.AVI	Amaurornis phoenicurus	1
18:26:28	RCNX0064.AVI	Amaurornis phoenicurus	1
1:58:24	RCNX0065.AVI	Canis lupus familiaris	1
7:16:38	RCNX0066.AVI	Amaurornis phoenicurus	1
16:43:52	RCNX0067.AVI	Callosciurus notatus	1
18:42:50	RCNX0068.AVI	Tupaia glis	1
19:12:44	RCNX0069.AVI	Rallina fasciata	1
19:14:56	RCNX0070.AVI	Rallina fasciata	1
23:13:18	RCNX0071.AVI	Canis lupus familiaris	1
8:13:22	RCNX0072.AVI	Canis lupus familiaris	1
9:56:06	RCNX0073.AVI	Amaurornis phoenicurus	1
12:09:36	RCNX0074.AVI	Canis lupus familiaris	1
12:36:44	RCNX0075.AVI	Amaurornis phoenicurus	1
2:13:00	RCNX0079.AVI	Canis lupus familiaris	1
3:59:38	RCNX0080.AVI	Canis lupus familiaris	1
9:25:12	RCNX0081.AVI	Amaurornis phoenicurus	1
9:34:16	RCNX0082.AVI	Rallina fasciata	1
1:58:16	RCNX0084.AVI	Canis lupus familiaris	1
8:40:44	RCNX0085.AVI	Canis lupus familiaris	2
9:36:10	RCNX0088.AVI	Dinopium javanese	1
9:56:24	RCNX0089.AVI	Rallina fasciata	1
13:08:56	RCNX0090.AVI	Canis lupus familiaris	1
14:03:26	RCNX0091.AVI	Canis lupus familiaris	1
8:23:38	RCNX0093.AVI	Canis lupus familiaris	1
8:35:24	RCNX0094.AVI	Canis lupus familiaris	2
9:13:22	RCNX0095.AVI	Amaurornis phoenicurus	1
11:45:30	RCNX0098.AVI	Amaurornis phoenicurus	1
23:41:10	RCNX0099.AVI	Canis lupus familiaris	1
23:48:38	RCNX0100.AVI	Canis lupus familiaris	1
16:56:56	RCNX0101.AVI	Amaurornis phoenicurus	1
18:27:24	RCNX0102.AVI	Canis lupus familiaris	1
18:35:56	RCNX0103.AVI	Canis lupus familiaris	1
7:29:26	RCNX0106.AVI	Amaurornis phoenicurus	1
9:19:14	RCNX0107.AVI	Amaurornis phoenicurus	1
3:38:40	RCNX0108.AVI	Canis lupus familiaris	1
18:23:56	RCNX0109.AVI	Amaurornis phoenicurus	1
19:01:42	RCNX0110.AVI	Amaurornis phoenicurus	1
18:35:44	RCNX0111.AVI	Amaurornis phoenicurus	1
11:28:22	RCNX0112.AVI	Canis lupus familiaris	1
13:59:54	RCNX0113.AVI	Canis lupus familiaris	1
14:02:30	RCNX0114.AVI	Canis lupus familiaris	1
9:52:24	RCNX0115.AVI	Canis lupus familiaris	1
18:47:02	RCNX0116.AVI	Canis lupus familiaris	1
18:47:30	RCNX0117.AVI	Canis lupus familiaris	1

18:50:20	RCNX0118.AVI	Canis lupus familiaris	1
0:08:36	RCNX0119.AVI	Canis lupus familiaris	1
2:04:00	RCNX0122.AVI	Canis lupus familiaris	1
4:39:08	RCNX0123.AVI	Canis lupus familiaris	1
4:40:58	RCNX0124.AVI	Canis lupus familiaris	1
7:00:34	RCNX0125.AVI	Canis lupus familiaris	1
9:25:56	RCNX0126.AVI	Canis lupus familiaris	1
18:10:48	RCNX0127.AVI	Amaurornis phoenicurus	1
19:02:02	RCNX0128.AVI	Canis lupus familiaris	1
19:02:28	RCNX0129.AVI	Canis lupus familiaris	1
3:32:28	RCNX0130.AVI	Canis lupus familiaris	1
10:45:22	RCNX0131.AVI	Canis lupus familiaris	1
11:28:30	RCNX0132.AVI	Canis lupus familiaris	1
11:59:28	RCNX0133.AVI	Canis lupus familiaris	1
12:05:18	RCNX0134.AVI	Canis lupus familiaris	1
12:13:02	RCNX0135.AVI	Canis lupus familiaris	1
13:30:14	RCNX0136.AVI	Canis lupus familiaris	1
22:11:26	RCNX0137.AVI	Canis lupus familiaris	1
22:29:04	RCNX0138.AVI	Canis lupus familiaris	1
10:45:12	RCNX0139.AVI	Canis lupus familiaris	1
21:30:14	RCNX0141.AVI	Canis lupus familiaris	1
20:15:30	RCNX0144.AVI	Canis lupus familiaris	2
3:07:04	RCNX0147.AVI	Canis lupus familiaris	1
17:04:48	RCNX0148.AVI	Amaurornis phoenicurus	1
7:37:18	RCNX0150.AVI	Canis lupus familiaris	1
9:22:16	RCNX0151.AVI	Chalcophaps indica	1
19:10:06	RCNX0153.AVI	Tupaia glis	1
20:39:46	RCNX0154.AVI	Canis lupus familiaris	1
9:00:34	RCNX0155.AVI	Canis lupus familiaris	1
9:22:08	RCNX0156.AVI	Canis lupus familiaris	1
16:14:16	RCNX00016.AVI	Tupaia glis	1
13:59:38	RCNX00017.AVI	Tupaia glis	1
2:02:32	RCNX0006.AVI	Canis lupus familiaris	1
2:06:36	RCNX0008.AVI	Canis lupus familiaris	1
12:58:46	RCNX0010.AVI	Amaurornis phoenicurus	1
9:34:22	RCNX0011.AVI	Amaurornis phoenicurus	1
10:56:28	RCNX0012.AVI	Canis lupus familiaris	1
10:08:04	RCNX0013.AVI	Amaurornis phoenicurus	1
12:22:36	RCNX0014.AVI	Callosciurus notatus	1
15:55:18	RCNX0015.AVI	Tupaia glis	1
13:21:44	RCNX0018.AVI	Canis lupus familiaris	2
13:38:24	RCNX0019.AVI	Tupaia glis	1
13:45:10	RCNX0020.AVI	Tupaia glis	1
21:37:16	RCNX0021.AVI	Canis lupus familiaris	3
16:05:16	RCNX0022.AVI	Tupaia glis	1
9:48:08	RCNX0023.AVI	Amaurornis phoenicurus	0
9:54:16	RCNX0024.AVI	Amaurornis phoenicurus	1
10:33:18	RCNX0025.AVI	Amaurornis phoenicurus	1
14:46:28	RCNX0026.AVI	Tupaia glis	1
16:36:46	RCNX0027.AVI	Amaurornis phoenicurus	1

8:51:08	RCNX0028.AVI	Tupaia glis	1
8:19:30	RCNX0029.AVI	Canis lupus familiaris	1
8:21:22	RCNX0030.AVI	Canis lupus familiaris	1
18:26:14	RCNX0031.AVI	Rallina fasciata	1
22:34:18	RCNX0032.AVI	Canis lupus familiaris	1
22:37:08	RCNX0033.AVI	Canis lupus familiaris	1
22:38:18	RCNX0034.AVI	Canis lupus familiaris	2
0:58:10	RCNX0035.AVI	Canis lupus familiaris	1
2:25:20	RCNX0036.AVI	Canis lupus familiaris	1
3:01:00	RCNX0037.AVI	Canis lupus familiaris	1
12:39:16	RCNX0038.AVI	Canis lupus familiaris	1
12:40:30	RCNX0039.AVI	Canis lupus familiaris	1
9:57:16	RCNX0040.AVI	Varanus salvator	1
15:16:58	RCNX0041.AVI	Canis lupus familiaris	2
23:33:30	RCNX0042.AVI	Canis lupus familiaris	1
12:55:46	RCNX0043.AVI	Canis lupus familiaris	1
13:42:26	RCNX0044.AVI	Canis lupus familiaris	1
8:18:00	RCNX0045.AVI	Amaurornis phoenicurus	1
8:45:20	RCNX0046.AVI	Chalcophaps indica	1
9:03:40	RCNX0047.AVI	Amaurornis phoenicurus	1
7:53:08	RCNX0048.AVI	Canis lupus familiaris	2
8:00:18	RCNX0049.AVI	Canis lupus familiaris	1
8:03:30	RCNX0051.AVI	Canis lupus familiaris	1
15:33:24	RCNX0052.AVI	Chalcophaps indica	1
18:04:24	RCNX0053.AVI	Tupaia glis	1
16:34:50	RCNX0054.AVI	Callosciurus notatus	1
18:26:50	RCNX0057.AVI	Varanus salvator	1
14:25:26	RCNX0059.AVI	Chalcophaps indica	1
15:57:02	RCNX0006.AVI	Rallina fasciata	1
18:55:40	RCNX0007.AVI	Tupaia glis	1
9:51:18	RCNX0008.AVI	Rallina fasciata	1
14:26:46	RCNX0009.AVI	Amaurornis phoenicurus	1
16:16:14	RCNX0010.AVI	Amaurornis phoenicurus	1
7:31:56	RCNX0011.AVI	Amaurornis phoenicurus	1
8:47:48	RCNX0012.AVI	Amaurornis phoenicurus	1
9:20:42	RCNX0014.AVI	Amaurornis phoenicurus	1
12:44:54	RCNX0016.AVI	Callosciurus notatus	1
13:55:12	RCNX0017.AVI	Callosciurus notatus	1
15:13:02	RCNX0018.AVI	Callosciurus notatus	1
10:45:50	RCNX0019.AVI	Amaurornis phoenicurus	1
13:34:28	RCNX0020.AVI	Canis lupus familiaris	1
7:54:42	RCNX0021.AVI	Rallina fasciata	1
9:02:40	RCNX0022.AVI	Rallina fasciata	1
9:10:48	RCNX0023.AVI	Rallina fasciata	1
9:33:06	RCNX0025.AVI	Rallina fasciata	1
9:35:58	RCNX0026.AVI	Rallina fasciata	1
9:46:18	RCNX0027.AVI	Rallina fasciata	1
9:55:44	RCNX0028.AVI	Rallina fasciata	1
10:15:22	RCNX0030.AVI	Rallina fasciata	1
15:21:58	RCNX0033.AVI	Callosciurus notatus	1

17:07:46	RCNX0036.AVI	Callosciurus notatus	1
17:39:04	RCNX0037.AVI	Tupaia glis	1
16:34:26	RCNX0039.AVI	Amaurornis phoenicurus	1
18:37:26	RCNX0042.AVI	Amaurornis phoenicurus	1
14:47:38	RCNX0043.AVI	Amaurornis phoenicurus	1
11:40:18	RCNX0044.AVI	Amaurornis phoenicurus	1
16:22:52	RCNX0046.AVI	Amaurornis phoenicurus	1
14:54:28	RCNX0047.AVI	Amaurornis phoenicurus	1
16:10:08	RCNX0048.AVI	Amaurornis phoenicurus	1
9:52:02	RCNX0050.AVI	Amaurornis phoenicurus	1
1:33:20	RCNX0052.AVI	Rattus tanezumi	1
14:33:22	RCNX0053.AVI	Callosciurus notatus	1
14:34:00	RCNX0054.AVI	Callosciurus notatus	1
15:42:00	RCNX0009.AVI	Callosciurus notatus	1
15:43:22	RCNX0010.AVI	Callosciurus notatus	1
15:44:04	RCNX0011.AVI	Callosciurus notatus	1
7:57:40	RCNX0012.AVI	Amaurornis phoenicurus	2
9:43:08	RCNX0013.AVI	Amaurornis phoenicurus	1
16:18:48	RCNX0017.AVI	Tupaia glis	1
8:07:22	RCNX0018.AVI	Tupaia glis	1
15:12:58	RCNX0019.AVI	Tupaia glis	2
15:17:50	RCNX0020.AVI	Picus vittatus	1
11:23:52	RCNX0021.AVI	Amaurornis phoenicurus	1
13:10:26	RCNX0022.AVI	Callosciurus notatus	1
13:11:10	RCNX0023.AVI	Callosciurus notatus	1
16:39:42	RCNX0024.AVI	Callosciurus notatus	1
16:40:28	RCNX0025.AVI	Callosciurus notatus	1
9:52:08	RCNX0028.AVI	Tupaia glis	1
13:04:38	RCNX0029.AVI	Callosciurus notatus	1
16:21:36	RCNX0031.AVI	Callosciurus notatus	1
18:43:26	RCNX0035.AVI	Picus vittatus	1
18:56:54	RCNX0036.AVI	Picus vittatus	1
18:57:22	RCNX0037.AVI	Picus vittatus	1
11:58:10	RCNX0038.AVI	Oriolus chinensis	1
11:59:56	RCNX0041.AVI	Amaurornis phoenicurus	1
18:32:22	RCNX0042.AVI	Canis lupus familiaris	2
10:19:38	RCNX0043.AVI	Canis lupus familiaris	1
8:27:52	RCNX0044.AVI	Canis lupus familiaris	1
14:18:08	RCNX0045.AVI	Amaurornis phoenicurus	1
17:31:00	RCNX0046.AVI	Amaurornis phoenicurus	2
17:47:20	RCNX0047.AVI	Tupaia glis	1
18:39:06	RCNX0048.AVI	Rallina fasciata	1
16:51:34	RCNX0049.AVI	Tupaia glis	1
7:38:54	RCNX0051.AVI	Canis lupus familiaris	1
9:56:26	RCNX0052.AVI	Tupaia glis	1
17:46:48	RCNX0053.AVI	Tupaia glis	1
7:19:30	RCNX0054.AVI	Tupaia glis	1
9:27:40	RCNX0055.AVI	Tupaia glis	2
9:28:38	RCNX0056.AVI	Tupaia glis	1
9:29:26	RCNX0057.AVI	Tupaia glis	1

14:18:14	RCNX0058.AVI	Tupaia glis	1
13:50:28	RCNX0059.AVI	Callosciurus notatus	1
13:51:42	RCNX0060.AVI	Callosciurus notatus	1
15:31:56	RCNX0062.AVI	Tupaia glis	1
17:07:02	RCNX0063.AVI	Tupaia glis	1
17:33:32	RCNX0064.AVI	Amaurornis phoenicurus	1
11:43:30	RCNX0066.AVI	Tupaia glis	1
14:27:22	RCNX0067.AVI	Callosciurus notatus	1
14:42:06	RCNX0068.AVI	Callosciurus notatus	1
15:45:24	RCNX0069.AVI	Tupaia glis	1
9:38:04	RCNX0070.AVI	Callosciurus notatus	1
9:45:34	RCNX0071.AVI	Callosciurus notatus	1
15:27:18	RCNX0082.AVI	Callosciurus notatus	1
13:47:32	RCNX0084.AVI	Mixornis gularis	0
14:19:06	RCNX0085.AVI	Callosciurus notatus	1
12:28:06	RCNX0010.AVI	Canis lupus familiaris	2
16:00:48	RCNX0012.AVI	Canis lupus familiaris	1
20:03:32	RCNX0013.AVI	Canis lupus familiaris	1
12:55:50	RCNX0014.AVI	Amaurornis phoenicurus	1
18:34:12	RCNX0015.AVI	Amaurornis phoenicurus	1
21:32:58	RCNX0016.AVI	Canis lupus familiaris	1
8:26:38	RCNX0019.AVI	Amaurornis phoenicurus	1
8:47:28	RCNX0020.AVI	Canis lupus familiaris	1
8:48:08	RCNX0021.AVI	Canis lupus familiaris	1
20:37:28	RCNX0022.AVI	Canis lupus familiaris	1
14:00:02	RCNX0023.AVI	Callosciurus notatus	1
19:47:36	RCNX0025.AVI	Canis lupus familiaris	1
7:35:26	RCNX0026.AVI	Canis lupus familiaris	1
7:38:12	RCNX0027.AVI	Canis lupus familiaris	1
9:48:44	RCNX0028.AVI	Canis lupus familiaris	2
19:51:08	RCNX0033.AVI	Canis lupus familiaris	2
8:01:20	RCNX0005.AVI	Amaurornis phoenicurus	1
9:10:04	RCNX0006.AVI	Canis lupus familiaris	1
8:03:00	RCNX0007.AVI	Amaurornis phoenicurus	1
10:52:00	RCNX0008.AVI	Callosciurus notatus	1
15:53:28	RCNX0009.AVI	Callosciurus notatus	1
13:40:28	RCNX0010.AVI	Tupaia glis	1
17:45:56	RCNX0011.AVI	Tupaia glis	1
8:57:30	RCNX0012.AVI	Amaurornis phoenicurus	1
9:56:42	RCNX0013.AVI	Amaurornis phoenicurus	1
13:17:02	RCNX0015.AVI	Amaurornis phoenicurus	1
14:44:46	RCNX0016.AVI	Amaurornis phoenicurus	1
7:43:22	RCNX0017.AVI	Amaurornis phoenicurus	1
14:24:38	RCNX0020.AVI	Callosciurus notatus	1
16:01:56	RCNX0021.AVI	Tupaia glis	1
7:58:12	RCNX0022.AVI	Amaurornis phoenicurus	1
9:22:52	RCNX0023.AVI	Amaurornis phoenicurus	1
9:23:24	RCNX0024.AVI	Amaurornis phoenicurus	1
11:51:58	RCNX0025.AVI	Amaurornis phoenicurus	1
8:35:54	RCNX0027.AVI	Amaurornis phoenicurus	1

8:46:14	RCNX0028.AVI	Amaurornis phoenicurus	1
8:54:58	RCNX0031.AVI	Amaurornis phoenicurus	1
17:27:46	RCNX0032.AVI	Amaurornis phoenicurus	1
8:36:50	RCNX0033.AVI	Tupaia glis	1
10:12:48	RCNX0034.AVI	Amaurornis phoenicurus	1
10:25:14	RCNX0035.AVI	Tupaia glis	1
8:42:38	RCNX0036.AVI	Amaurornis phoenicurus	1
12:38:32	RCNX0037.AVI	Amaurornis phoenicurus	1
7:53:40	RCNX0038.AVI	Amaurornis phoenicurus	1
8:42:52	RCNX0039.AVI	Amaurornis phoenicurus	1
11:31:38	RCNX0040.AVI	Amaurornis phoenicurus	1
16:09:30	RCNX0041.AVI	Amaurornis phoenicurus	1
12:34:50	RCNX0042.AVI	Amaurornis phoenicurus	1
13:25:10	RCNX0043.AVI	Copsychus saularis	1
13:26:46	RCNX0044.AVI	Copsychus saularis	1
15:41:52	RCNX0045.AVI	Amaurornis phoenicurus	1
16:35:34	RCNX0046.AVI	Amaurornis phoenicurus	1
9:32:30	RCNX0047.AVI	Amaurornis phoenicurus	1
10:38:46	RCNX0048.AVI	Amaurornis phoenicurus	1
10:59:48	RCNX0049.AVI	Callosciurus notatus	1
11:41:06	RCNX0050.AVI	Amaurornis phoenicurus	1
11:41:52	RCNX0051.AVI	Amaurornis phoenicurus	1
9:32:12	RCNX0052.AVI	Amaurornis phoenicurus	1
10:23:18	RCNX0053.AVI	Amaurornis phoenicurus	1
17:15:10	RCNX0054.AVI	Amaurornis phoenicurus	1
16:46:30	RCNX0057.AVI	Amaurornis phoenicurus	1
8:03:14	RCNX0059.AVI	Amaurornis phoenicurus	1
8:17:38	RCNX0062.AVI	Amaurornis phoenicurus	1
8:18:18	RCNX0063.AVI	Tupaia glis	1
15:49:12	RCNX0064.AVI	Callosciurus notatus	1
15:52:52	RCNX0065.AVI	Callosciurus notatus	1
15:56:12	RCNX0066.AVI	Callosciurus notatus	1
3:13:42	RCNX0067.AVI	Rattus tanezumi	1
8:10:08	RCNX0069.AVI	Amaurornis phoenicurus	1
15:56:26	RCNX0070.AVI	Callosciurus notatus	1
17:42:40	RCNX0071.AVI	Amaurornis phoenicurus	1
6:58:52	RCNX0072.AVI	Tupaia glis	1
9:44:22	RCNX0073.AVI	Amaurornis phoenicurus	1
4:58:48	RCNX0074.AVI	Rattus tanezumi	1
8:00:22	RCNX0075.AVI	Amaurornis phoenicurus	1
8:17:06	RCNX0076.AVI	Tupaia glis	2
15:49:42	RCNX0077.AVI	Tupaia glis	1
8:33:36	RCNX0081.AVI	Amaurornis phoenicurus	2
20:36:10	RCNX0084.AVI	Rattus tiomanicus	2

Appendix K
Independent Detections and Maximum Quantity of Species at Each Camera Trap Station

Delivering a better world

Station	ScientificName	IndpDet	MaxQty
E1	Canis lupus familiaris	31	3
E2	Canis lupus familiaris	36	4
N4.3	Canis lupus familiaris	2	3
N4.4	Callosciurus notatus	2	1
N4.4	Canis lupus familiaris	2	2
N4.5	Callosciurus notatus	5	1
N4.5	Canis lupus familiaris	2	1
N4.7	Callosciurus notatus	5	1
N4.7	Canis lupus familiaris	5	3
N4.7	Felis catus	1	1
N4.7	Tupaia glis	1	1
N4.8	Callosciurus notatus	5	1
N4.8	Canis lupus familiaris	6	3
N4.8	Tupaia glis	2	1
N4.9	Canis lupus familiaris	1	1
N4.10	Callosciurus notatus	2	1
N4.10	Canis lupus familiaris	1	1
N4.10	Rattus tanezumi	2	1
N5.11	Callosciurus notatus	2	1
N5.11	Canis lupus familiaris	6	1
N5.13	Callosciurus notatus	1	1
N5.13	Canis lupus familiaris	7	2
N5.13	Tupaia glis	2	1
N5.14	Canis lupus familiaris	12	2
N5.15	Canis lupus familiaris	2	1
N5.16	Callosciurus notatus	10	1
N5.16	Canis lupus familiaris	28	5
N5.16	Tupaia glis	1	1
N5.17	Callosciurus notatus	2	1
N5.17	Canis lupus familiaris	4	2
N5.18	Canis lupus familiaris	14	2
N5.18	Rattus tanezumi	1	1
N5.20	Callosciurus notatus	4	1
N5.20	Canis lupus familiaris	1	1
N5.20	Tupaia glis	4	1
N5.21	Callosciurus notatus	4	1
N5.21	Canis lupus familiaris	2	1
N5.21	Rattus tanezumi	1	1
N5.21	Tupaia glis	4	1
N5.23	Callosciurus notatus	3	1
N5.23	Canis lupus familiaris	44	2
N5.23	Rattus tanezumi	4	1
N5.23	Tupaia glis	2	1
N5.24	Callosciurus notatus	2	1
N5.24	Canis lupus familiaris	13	3
N5.24	Tupaia glis	7	1
N5.25	Callosciurus notatus	6	1
N5.25	Canis lupus familiaris	1	1
N5.25	Rattus tanezumi	1	1
N5.25	Tupaia glis	2	1
N5.26	Callosciurus notatus	10	1

Station	ScientificName	IndpDet	MaxQty
N5.26	Canis lupus familiaris	4	2
N5.26	Tupaia glis	15	2
N5.27	Callosciurus notatus	1	1
N5.27	Canis lupus familiaris	10	2
N5.28	Callosciurus notatus	6	1
N5.28	Canis lupus familiaris	1	1
N5.28	Rattus tanezumi	2	1
N5.28	Rattus tiomanicus	1	2
N5.28	Tupaia glis	9	2

Appendix L
Impact Assessment of Habitat and Plant Receptors

Delivering a better world

Receptor Type	Type	Habitat	Phase	Impact type	Impact category	Sensitivity (S)	Key minimum controls	Impact intensity (I)	Reason	Consequence (C = S × I)	Likelihood (L)	Reason	Impact significance (C × L)	Key mitigation measures	Residual impact intensity	Residual consequence	Residual likelihood	Residual impact significance
Habitat	Terrestrial	Abandoned-land forest	Construction	Loss of habitat	Direct	Priority 2	Hoarding installation, TPZ installation, daily checks by EM	Negligible	No overlap	Imperceptible	Unlikely	No development	Negligible	Avoid areas of high conservation value, erect hoardings to delineate worksites involving heavy machinery, ensure no works and disturbances to areas outside of worksite involving manual work only	Negligible	Imperceptible	Unlikely	Negligible
Habitat	Terrestrial	Exotic-dominated secondary forest	Construction	Loss of habitat	Direct	Priority 2		High	> 40% of the habitat overlaps with the worksites [44.6%]	Medium	Certain	Overlaps with worksite	Major		Medium	Low	Certain	Moderate
Habitat	Terrestrial	Grassland	Construction	Loss of habitat	Direct	Priority 2		High	> 40% of the habitat overlaps with the worksites [47.9%]	Medium	Certain	Overlaps with worksite	Major		Medium	Low	Certain	Moderate
Habitat	Terrestrial	Scrubland	Construction	Loss of habitat	Direct	Priority 3		Medium	10–40% of the habitat overlaps with the worksites [21%]	Very Low	Certain	Overlaps with worksite	Minor		Medium	Very Low	Certain	Minor
Habitat	Terrestrial	Urban vegetation	Construction	Loss of habitat	Direct	Priority 3		Negligible	No overlap	Imperceptible	Unlikely	No development	Negligible		Negligible	Imperceptible	Unlikely	Negligible
Habitat	Aquatic	Naturalised stream	Construction	Loss of habitat	Direct	Priority 3		High	> 40% of the habitat overlaps with the worksites	Low	Certain	Overlaps with worksite	Moderate		Medium	Very Low	Certain	Minor
Habitat	Terrestrial	Abandoned-land forest	Construction	Habitat degradation	Indirect	Priority 2	ECM implementation, proper stockpiling, DCM implementation, ensure noise levels within approved limits, daily checks by EM, avoid fogging	Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Less likely	Minimum controls	Negligible	Implement proper ECM plan prior to site clearance, implement DCM, conduct regular site inspection for compliance and monitoring	Low	Very Low	Less likely	Negligible
Habitat	Terrestrial	Exotic-dominated secondary forest	Construction	Habitat degradation	Indirect	Priority 2		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Less likely	Minimum controls	Negligible		Low	Very Low	Less likely	Negligible

Habitat	Terrestrial	Grassland	Construction	Habitat degradation	Indirect	Priority 2		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Less likely	Minimum controls	Negligible		Low	Very Low	Less likely	Negligible
Habitat	Terrestrial	Scrubland	Construction	Habitat degradation	Indirect	Priority 3		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Less likely	Minimum controls	Negligible		Low	Very Low	Less likely	Negligible
Habitat	Terrestrial	Urban vegetation	Construction	Habitat degradation	Indirect	Priority 3		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Less likely	Minimum controls	Negligible		Low	Very Low	Less likely	Negligible
Habitat	Aquatic	Naturalised stream	Construction	Habitat degradation	Indirect	Priority 3		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Less likely	Minimum controls	Negligible		Low	Very Low	Less likely	Negligible
Habitat	Terrestrial	Abandoned-land forest	Operational	Habitat degradation	Indirect	Priority 2	Avoid fogging	Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Unlikely	Remaining habitats are not accessible to public	Negligible	NA	Low	Very Low	Less likely	Negligible
Habitat	Terrestrial	Exotic-dominated secondary forest	Operational	Habitat degradation	Indirect	Priority 2		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Unlikely	Remaining habitats are not accessible to public	Negligible		Low	Very Low	Less likely	Negligible
Habitat	Terrestrial	Grassland	Operational	Habitat degradation	Indirect	Priority 2		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Unlikely	Remaining habitats are not accessible to public	Negligible		Low	Very Low	Less likely	Negligible
Habitat	Terrestrial	Scrubland	Operational	Habitat degradation	Indirect	Priority 3		Low	≤ 10% of the habitat type overlaps with	Very Low	Unlikely	Remaining habitats are not accessible to public	Negligible		Low	Very Low	Less likely	Negligible

									the impact zone								
Habitat	Terrestrial	Urban vegetation	Operational	Habitat degradation	Indirect	Priority 3		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Unlikely	Remaining habitats are not accessible to public	Negligible		Low	Very Low	Less likely	Negligible
Habitat	Terrestrial	Abandoned-land forest	Operational	Changes in microclimatic conditions	Indirect	Priority 2	Ensure noise levels within approved limits, ensure dust levels within approved limits	Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Unlikely	Presence of road	Negligible	NA	Medium	Low	Unlikely	Negligible
Habitat	Terrestrial	Exotic-dominated secondary forest	Operational	Changes in microclimatic conditions	Indirect	Priority 2		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Unlikely	Presence of road	Negligible		Low	Very Low	Unlikely	Negligible
Habitat	Terrestrial	Grassland	Operational	Changes in microclimatic conditions	Indirect	Priority 2		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Unlikely	Presence of road	Negligible		Low	Very Low	Unlikely	Negligible
Habitat	Terrestrial	Scrubland	Operational	Changes in microclimatic conditions	Indirect	Priority 3		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Unlikely	Presence of road	Negligible		Negligible	Imperceptible	Unlikely	Negligible
Habitat	Terrestrial	Urban vegetation	Operational	Changes in microclimatic conditions	Indirect	Priority 3		Low	≤ 10% of the habitat type overlaps with the impact zone	Very Low	Unlikely	Presence of road	Negligible		Negligible	Imperceptible	Unlikely	Negligible

Receptor Type	Type	Site	Receptor	Phase	Impact type	Sensitivity (S)	Impact intensity (I)	Rationale for impact intensity	Consequence (C = S × I)	Likelihood (L)	Rationale for likelihood	Impact significance (C × L)	Key mitigation measures	Residual impact intensity	Residual consequence	Residual likelihood	Residual impact significance
Plant	Direct	Biodiversity Study Area	*Adenia cordifolia*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Bambusa heterostachya*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Bambusa vulgaris*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Callicarpa longifolia*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Calophyllum inophyllum*	Construction	Mortality	High	Medium	50% or more of all plant specimens of this species are within the worksites [1 out of 2 specimens within BSA]	Medium	Certain	Plant specimens of this species are within the worksites	Major	Tree to be retained within the worksites via Tree Protection Zones (TPZs)	Negligible	Very Low	Certain	Minor
Plant	Direct	Biodiversity Study Area	*Cissus repens*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Cnestis palala*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Cyperus compressus*	Construction	Mortality	High	High	All plant specimens of this species are within the worksites [1 out 1 specimens within BSA]	High	Certain	Plant specimens of this species are within the worksites	Major	Transplant or salvage saplings of conservation significance	Negligible	Very Low	Certain	Minor
Plant	Direct	Biodiversity Study Area	*Ficus benjamina*	Construction	Mortality	High	Low	Less than 50% of all plant specimens of this species are within the worksites [1 out 4 specimens within BSA]	Low	Certain	Plant specimens of this species are within the worksites	Moderate	Tree to be retained within the worksites via Tree Protection Zones (TPZs)	Negligible	Very Low	Certain	Minor
Plant	Direct	Biodiversity Study Area	*Ficus microcarpa*	Construction	Mortality	High	Low	Less than 50% of all plant specimens of this species are within the worksites [7 out 19 specimens within BSA]	Low	Certain	Plant specimens of this species are within the worksites	Moderate	Tree to be retained within the worksites via Tree Protection Zones (TPZs)	Negligible	Very Low	Certain	Minor
Plant	Direct	Biodiversity Study Area	*Goniophlebium percussum*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible

Plant	Direct	Biodiversity Study Area	*Horsfieldia crassifolia*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Horsfieldia polyspherula var. polyspherula*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Lindera lucida*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Litsea umbellata*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Macaranga griffithiana*	Construction	Mortality	High	Low	Less than 50% of all plant specimens of this species are within the worksites [2 out 17 specimens within BSA]	Low	Certain	Plant specimens of this species are within the worksites	Moderate	Transplant or salvage all saplings of conservation significance	Negligible	Very Low	Certain	Minor
Plant	Direct	Biodiversity Study Area	*Melicope lunu-ankenda*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Microlepia speluncae*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Neoscortechinia sumatrensis*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Pittosporum ridleyi*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Santiria laevigata*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Direct	Biodiversity Study Area	*Tectaria* cf. *semipinnata*	Construction	Mortality	High	High	All plant specimens of this species are within the worksites [1 out 1 specimens within BSA]	High	Certain	Plant specimens of this species are within the worksites	Major	Transplant or salvage saplings of conservation significance	Negligible	Very Low	Certain	Minor
Plant	Direct	Biodiversity Study Area	*Trema tomentosum*	Construction	Mortality	High	High	All plant specimens of this species are within the worksites [2 out 2 specimens within BSA]	High	Certain	Plant specimens of this species are within the worksites	Major	Transplant or salvage saplings of conservation significance	Negligible	Very Low	Certain	Minor
Plant	Direct	Biodiversity Study Area	*Uncaria cordata*	Construction	Mortality	High	Negligible	No plant specimens of this species are within the worksites	Very Low	Unlikely	No plant specimens of this species are within the worksites	Negligible	-	Negligible	Very Low	Unlikely	Negligible

Plant	Indirect	Biodiversity Study Area	*Adenia cordifolia*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Bambusa heterostachya*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Bambusa vulgaris*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Callicarpa longifolia*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Calophyllum inophyllum*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Cissus repens*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Cnestis palala*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Ficus benjamina*	Construction	Decline in plant health and	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested	Negligible	-	Negligible	Very Low	Unlikely	Negligible

					survival						Area); plant specimens remain in their original forested habitats						
Plant	Indirect	Biodiversity Study Area	*Ficus microcarpa*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Goniophlebium percussum*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Horsfieldia crassifolia*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Horsfieldia polyspherula var. polyspherula*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Lindera lucida*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Litsea umbellata*	Construction	Decline in plant health and survival	High	Low	Less than 50% of all plant specimens of this species are within the impact zone of the worksites [1 out of 11 specimens within BSA]	Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Low	Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Macaranga griffithiana*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity	*Melicope lunu-ankenda*	Construction	Decline in plant	High	Negligible	No plant specimens of this species are within the	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4	Negligible	-	Negligible	Very Low	Unlikely	Negligible

		Study Area			health and survival			impact zone of the worksites			Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats						
Plant	Indirect	Biodiversity Study Area	*Microlepia speluncae*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Neoscortechinia sumatrensis*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Pittosporum ridleyi*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Santiria laevigata*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible
Plant	Indirect	Biodiversity Study Area	*Uncaria cordata*	Construction	Decline in plant health and survival	High	Negligible	No plant specimens of this species are within the impact zone of the worksites	Very Low	Unlikely	No formation of forest edges (i.e., construction activities are within N4 Forested Area beyond existing Canberra road outside N5 Forested Area); plant specimens remain in their original forested habitats	Negligible	-	Negligible	Very Low	Unlikely	Negligible

Appendix M
Impact Assessment on Fauna

Receptors

Delivering a better world

Type	Family	Receptor (scientific name)	Receptor (common name)	Global status (IUCN/COSTES)	National status	Species of Conservation Significance	Recorded species	Project Phase	Impact type	Sensitivity (S)	Impact intensity (I)	Rationale for impact intensity	Consequence (C = S + I)	Likelihood (L)	Rationale for likelihood	Key minimum controls	Impact significance (C + L)	Key mitigation measures	Residual impact intensity (I)	Residual consequence	Residual likelihood	Residual impact significance
Bird	Acrocephalidae	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA hornerd Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Acrocephalidae	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Acrocephalidae	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLRT	Negligible	Very Low	Unlikely	Negligible
Bird	Acrocephalidae	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Acrocephalidae	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NTL 4. Still Unlikely because	Noise barrier to minimise light spillage into NTL especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Acrocephalidae	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NTL	High	High	Unlikely	Negligible
Bird	Acrocephalidae	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Acrocephalidae	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Acrocephalidae	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NA		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Acrocephalidae	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback by canberra rd and not open to public		Minor	Signage along NA to deter human presence	High	High	Unlikely	Negligible
Bird	Scolopacidae	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA hornerd Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Scolopacidae	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Scolopacidae	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLRT	Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NTL 4. Still Unlikely because	Noise barrier to minimise light spillage into NTL especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Scolopacidae	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to humna presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NTL	Medium	Medium	Unlikely	Negligible
Bird	Scolopacidae	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Scolopacidae	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NA		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Scolopacidae	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback by canberra rd and not open to public		Minor	Signage along NA to deter human presence	High	High	Unlikely	Negligible
Bee	Megachilidae	Amfiedorium smithii		Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA hornerd Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bee	Megachilidae	Amfiedorium smithii		Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bee	Megachilidae	Amfiedorium smithii		Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict.	Medium	Possible	Based on species' behaviour	Hoarding and WRP	Moderate	Site inspections and BLRT	Medium	Medium	Less Likely	Minor
Bee	Megachilidae	Amfiedorium smithii		Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and able to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bee	Megachilidae	Amfiedorium smithii		Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: aculeate hymenopteran, most aquatic and marine species	Very Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NTL 4. Still Unlikely because	Noise barrier to minimise light spillage into NTL especially during road widening works.	Negligible	Restricted working hours; no night works	Negligible	Very Low	Unlikely	Negligible
Bee	Megachilidae	Amfiedorium smithii		Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Negligible	Species that are not sensitive to human presence	Very Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NTL	Negligible	Very Low	Unlikely	Negligible
Bee	Megachilidae	Amfiedorium smithii		Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Bee	Megachilidae	Amfiedorium smithii		Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict.	Medium	Possible	Species mainly restricted to NTL		Moderate	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Medium	Medium	Less Likely	Minor
Bee	Megachilidae	Amfiedorium smithii		Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: aculeate hymenopteran, most aquatic and marine species	Very Low	Unlikely			Negligible	Consider light strategies in design phase	Negligible	Very Low	Unlikely	Negligible
Bee	Megachilidae	Amfiedorium smithii		Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Negligible	Species that are sensitive to human presence	Very Low	Less likely	Forest is already setback by canberra rd and not open to public		Negligible	Signage along NA to deter human presence	Negligible	Very Low	Unlikely	Negligible
Bird	Apodidae	Apus nipalensis	House swift	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA hornerd Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Apodidae	Apus nipalensis	House swift	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Apodidae	Apus nipalensis	House swift	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLRT	Negligible	Very Low	Unlikely	Negligible
Bird	Apodidae	Apus nipalensis	House swift	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Apodidae	Apus nipalensis	House swift	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NTL 4. Still Unlikely because	Noise barrier to minimise light spillage into NTL especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Apodidae	Apus nipalensis	House swift	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NTL	Low	Low	Unlikely	Negligible
Bird	Apodidae	Apus nipalensis	House swift	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely	High-rise residential buildings operational in NA		Minor	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	Low	Low	Unlikely	Negligible
Bird	Apodidae	Apus nipalensis	House swift	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Apodidae	Apus nipalensis	House swift	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NA		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor

Bird	Ajaxblaise	Ajaxx nipalensis	House swift	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Andreidae	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrest/Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Andreidae	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Andreidae	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Bird	Andreidae	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Andreidae	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds.	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Andreidae	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to humna presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Bird	Andreidae	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Andreidae	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Andreidae	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds.	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Andreidae	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Bird	Andreidae	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrest/Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Andreidae	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Andreidae	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Bird	Andreidae	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bird	Andreidae	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Andreidae	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to humna presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Bird	Andreidae	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely	High-rise residential buildings operational in NA		Minor	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	Low	Low	Unlikely	Negligible
Bird	Andreidae	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Andreidae	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Andreidae	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala aurea		Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrest/Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Lycaenidae	Arhopala aurea		Not Listed	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala aurea		Not Listed	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala aurea		Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NA is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala aurea		Not Listed	Endangered	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala aurea		Not Listed	Endangered	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala aurea		Not Listed	Endangered	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala aurea		Not Listed	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala aurea		Not Listed	Endangered	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala aurea		Not Listed	Endangered	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala myrzala lemnas	Malayan oakblue	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrest/Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Lycaenidae	Arhopala myrzala lemnas	Malayan oakblue	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala myrzala lemnas	Malayan oakblue	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala myrzala lemnas	Malayan oakblue	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NA is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala myrzala lemnas	Malayan oakblue	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala myrzala lemnas	Malayan oakblue	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala myrzala lemnas	Malayan oakblue	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala myrzala lemnas	Malayan oakblue	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Arhopala myrzala lemnas	Malayan oakblue	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible

Butterfly	Lycaenidae	Arhopala myrzala lennas	Malaya an oakblue	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presenc	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ochlo opteru sjama jama	Forest hopper	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrest Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Ochlo opteru sjama jama	Forest hopper	Not Listed	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ochlo opteru sjama jama	Forest hopper	Not Listed	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ochlo opteru sjama jama	Forest hopper	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for fauna l movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ochlo opteru sjama jama	Forest hopper	Not Listed	Endangered	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NA 4. Still Unlikely because	Noise barrier to minimise light spillage into NA, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ochlo opteru sjama jama	Forest hopper	Not Listed	Endangered	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NA	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ochlo opteru sjama jama	Forest hopper	Not Listed	Endangered	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ochlo opteru sjama jama	Forest hopper	Not Listed	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. LRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ochlo opteru sjama jama	Forest hopper	Not Listed	Endangered	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ochlo opteru sjama jama	Forest hopper	Not Listed	Endangered	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presenc	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrest Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for fauna l movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NA is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NA 4. Still Unlikely because	Noise barrier to minimise light spillage into NA, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NA	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. LRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presenc	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrest Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Lycaenidae	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for fauna l movement	High	Low	Species slightly dependent on connected habitats for dispersal and able to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NA 4. Still Unlikely because	Noise barrier to minimise light spillage into NA, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NA	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. LRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presenc	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Oeyleneves acalle niasicus	Plain palm dart	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrest Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Oeyleneves acalle niasicus	Plain palm dart	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Oeyleneves acalle niasicus	Plain palm dart	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Oeyleneves acalle niasicus	Plain palm dart	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for fauna l movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Oeyleneves acalle niasicus	Plain palm dart	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NA 4. Still Unlikely because	Noise barrier to minimise light spillage into NA, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Oeyleneves acalle niasicus	Plain palm dart	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NA	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Oeyleneves acalle niasicus	Plain palm dart	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Oeyleneves acalle niasicus	Plain palm dart	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. LRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Oeyleneves acalle niasicus	Plain palm dart	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible

Butterfly	Hesperiidae	Oreisomes acalle miscous	Plain palm dart	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presnce.	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Mammal (bat)	Molossidae	Chaerephon ter quatus.	Naked bulldog bat	Least Concern	Critically Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Mammal (bat)	Molossidae	Chaerephon ter quatus.	Naked bulldog bat	Least Concern	Critically Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Mammal (bat)	Molossidae	Chaerephon ter quatus.	Naked bulldog bat	Least Concern	Critically Endangered	Yes	No	Construction	Human-wildlife conflict	High	Low	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments.	Low	Less likely	Based on species' behaviour	Hoarding and WRP	Minor	Site inspections and BLEF	Low	Low	Unlikely	Negligible
Mammal (bat)	Molossidae	Chaerephon ter quatus.	Naked bulldog bat	Least Concern	Critically Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Mammal (bat)	Molossidae	Chaerephon ter quatus.	Naked bulldog bat	Least Concern	Critically Endangered	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds.	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Mammal (bat)	Molossidae	Chaerephon ter quatus.	Naked bulldog bat	Least Concern	Critically Endangered	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to humna presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Mammal (bat)	Molossidae	Chaerephon ter quatus.	Naked bulldog bat	Least Concern	Critically Endangered	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Mammal (bat)	Molossidae	Chaerephon ter quatus.	Naked bulldog bat	Least Concern	Critically Endangered	Yes	No	Operational	Human-wildlife conflict	High	Low	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments.	Low	Less likely			Minor	Educational sign boards put up near bus stop at withing residential areas i.e. SEL	Low	Low	Unlikely	Negligible
Mammal (bat)	Molossidae	Chaerephon ter quatus.	Naked bulldog bat	Least Concern	Critically Endangered	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds.	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Mammal (bat)	Molossidae	Chaerephon ter quatus.	Naked bulldog bat	Least Concern	Critically Endangered	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Bird	Cuculidae	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Cuculidae	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Cuculidae	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLEF	Negligible	Very Low	Unlikely	Negligible
Bird	Cuculidae	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NA is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Bird	Cuculidae	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds.	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Cuculidae	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Cuculidae	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	High-rise residential buildings operational in NA5		Moderate	Integrate bird-friendly as detailed in Nyarlo' Birdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Cuculidae	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Educational sign boards put up near bus stop at withing residential areas i.e. SEL	Negligible	Very Low	Unlikely	Negligible
Bird	Cuculidae	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds.	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Cuculidae	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Cisticolidae	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Cisticolidae	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Cisticolidae	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLEF	Negligible	Very Low	Unlikely	Negligible
Bird	Cisticolidae	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected habitats for dispersal and able to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bird	Cisticolidae	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Cisticolidae	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Cisticolidae	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely	High-rise residential buildings operational in NA5		Minor	Integrate bird-friendly as detailed in Nyarlo' Birdsafe guidelines and consider enhancing window panels.	Low	Low	Unlikely	Negligible
Bird	Cisticolidae	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Educational sign boards put up near bus stop at withing residential areas i.e. SEL	Negligible	Very Low	Unlikely	Negligible
Bird	Cisticolidae	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Cisticolidae	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Apodidae	Collocalia affinis	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Apodidae	Collocalia affinis	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Yes	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Apodidae	Collocalia affinis	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Yes	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLEF	Negligible	Very Low	Unlikely	Negligible
Bird	Apodidae	Collocalia affinis	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Apodidae	Collocalia affinis	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Yes	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Apodidae	Collocalia affinis	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Yes	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Bird	Apodidae	Collocalia affinis	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Yes	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely	High-rise residential buildings operational in NA5		Minor	Integrate bird-friendly as detailed in Nyarlo' Birdsafe guidelines and consider enhancing window panels.	Low	Low	Unlikely	Negligible
Bird	Apodidae	Collocalia affinis	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Yes	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Educational sign boards put up near bus stop at withing residential areas i.e. SEL	Negligible	Very Low	Unlikely	Negligible
Bird	Apodidae	Collocalia affinis	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Yes	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor

Bird	Apodidae	Collocalia affinis	Mume-toed swiftlet	Least Concern	Vulnerable	Yes	Yes	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Damselfly	Platycnemididae	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Damselfly	Platycnemididae	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Damselfly	Platycnemididae	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKD	Negligible	Very Low	Unlikely	Negligible
Damselfly	Platycnemididae	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Damselfly	Platycnemididae	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Damselfly	Platycnemididae	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Damselfly	Platycnemididae	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Damselfly	Platycnemididae	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Educational sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Damselfly	Platycnemididae	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Damselfly	Platycnemididae	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Muscicapidae	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Muscicapidae	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Yes	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Muscicapidae	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Yes	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKD	Negligible	Very Low	Unlikely	Negligible
Bird	Muscicapidae	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NS is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bird	Muscicapidae	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Yes	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Muscicapidae	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Yes	Construction	Human disturbance	High	Medium	Species that are sensitive to humna presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Bird	Muscicapidae	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Yes	Operational	Accidental injury or mortality	High	Medium	Species that are mobile but possibly susceptible to accidental injury/mortality from operation activities, and collision with buildings	Medium	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	Medium	Medium	Less Likely	Minor
Bird	Muscicapidae	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Yes	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Educational sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Muscicapidae	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Yes	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Muscicapidae	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Yes	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Bird	Corvidae	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Corvidae	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Yes	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Corvidae	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Yes	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKD	Negligible	Very Low	Unlikely	Negligible
Bird	Corvidae	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Medium	Dependent on connected habitats for dispersal	Medium	Unlikely	NS is already an isolated forest fragment		Negligible		Medium	Medium	Unlikely	Negligible
Bird	Corvidae	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Yes	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Corvidae	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Yes	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Bird	Corvidae	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Yes	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely	High-rise residential buildings operational in NS		Minor	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	Low	Low	Unlikely	Negligible
Bird	Corvidae	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Yes	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Educational sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Corvidae	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Yes	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Corvidae	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Yes	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Dicruridae	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Dicruridae	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Dicruridae	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKD	Negligible	Very Low	Unlikely	Negligible
Bird	Dicruridae	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NS is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Dicruridae	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to change in light levels: nocturnal, crepuscular fauna and nesting/hatching: sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Dicruridae	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Dicruridae	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Dicruridae	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Educational sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Dicruridae	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to change in light levels: nocturnal, crepuscular fauna and nesting/hatching: sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor

Bird	Disruptive	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to humane presence	High	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Butterfly	Nymphalidae	Discophora sondaica deripaditata	Common duffer	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of Nil hornet-ed Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Nymphalidae	Discophora sondaica deripaditata	Common duffer	Not Listed	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Nymphalidae	Discophora sondaica deripaditata	Common duffer	Not Listed	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Butterfly	Nymphalidae	Discophora sondaica deripaditata	Common duffer	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Butterfly	Nymphalidae	Discophora sondaica deripaditata	Common duffer	Not Listed	Endangered	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Nymphalidae	Discophora sondaica deripaditata	Common duffer	Not Listed	Endangered	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Nymphalidae	Discophora sondaica deripaditata	Common duffer	Not Listed	Endangered	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Nymphalidae	Discophora sondaica deripaditata	Common duffer	Not Listed	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Butterfly	Nymphalidae	Discophora sondaica deripaditata	Common duffer	Not Listed	Endangered	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Nymphalidae	Discophora sondaica deripaditata	Common duffer	Not Listed	Endangered	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Columbidae	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of Nil hornet-ed Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Columbidae	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Columbidae	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Bird	Columbidae	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Bird	Columbidae	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Columbidae	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Columbidae	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Columbidae	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Bird	Columbidae	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Columbidae	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Ketion elia	White-spot palmer	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of Nil hornet-ed Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Ketion elia	White-spot palmer	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ketion elia	White-spot palmer	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ketion elia	White-spot palmer	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Ketion elia	White-spot palmer	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ketion elia	White-spot palmer	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ketion elia	White-spot palmer	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ketion elia	White-spot palmer	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ketion elia	White-spot palmer	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Ketion elia	White-spot palmer	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Accipitridae	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of Nil hornet-ed Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Accipitridae	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Accipitridae	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Bird	Accipitridae	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NS is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bird	Accipitridae	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Accipitridae	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to humane presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Bird	Accipitridae	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Medium	Species that are mobile but possibly susceptible to accidental injury/mortality from operation activities and roadkills, and collision with buildings	Medium	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	Medium	Medium	Less Likely	Minor
Bird	Accipitridae	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Bird	Accipitridae	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor

Bird	Accipitridae	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Mammal (bat)	Pteropodidae	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS hornet Area amounts to a total of 29.9 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Mammal (bat)	Pteropodidae	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Mammal (bat)	Pteropodidae	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Low	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments.	Low	Less likely	Based on species' behaviour	Hoarding and WRP	Minor	Site inspections and BLEF	Low	Low	Unlikely	Negligible
Mammal (bat)	Pteropodidae	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Medium	Dependent on connected habitats for dispersal	Medium	Unlikely	NS is already an isolated forest fragment		Negligible		Medium	Medium	Unlikely	Negligible
Mammal (bat)	Pteropodidae	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Mammal (bat)	Pteropodidae	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to humna presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Mammal (bat)	Pteropodidae	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Mammal (bat)	Pteropodidae	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Low	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments.	Low	Less likely			Minor	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Low	Low	Unlikely	Negligible
Mammal (bat)	Pteropodidae	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Mammal (bat)	Pteropodidae	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Butterfly	Lycaenidae	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS hornet Area amounts to a total of 29.9 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Lycaenidae	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLEF	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NS is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Rallidae	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS hornet Area amounts to a total of 29.9 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Rallidae	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Rallidae	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLEF	Negligible	Very Low	Unlikely	Negligible
Bird	Rallidae	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NS is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Rallidae	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Rallidae	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds.	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Rallidae	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Rallidae	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Rallidae	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Rallidae	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to humna presence	High	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Scolopacidae	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS hornet Area amounts to a total of 29.9 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Scolopacidae	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLEF	Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NS is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Scolopacidae	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Scolopacidae	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Scolopacidae	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor

Bird	Scolopacidae	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already settlacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Scolopacidae	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Scolopacidae	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Scolopacidae	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Scolopacidae	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Scolopacidae	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop of withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Scolopacidae	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already settlacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Scolopacidae	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Scolopacidae	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Scolopacidae	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Scolopacidae	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Scolopacidae	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop of withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Scolopacidae	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Scolopacidae	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already settlacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NA is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: adonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop of withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: adonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presnce.	Low	Less likely	Forest is already settlacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Horaga syrma maenala	Ambon onyx	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forrested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Lycaenidae	Horaga syrma maenala	Ambon onyx	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Horaga syrma maenala	Ambon onyx	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Horaga syrma maenala	Ambon onyx	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Horaga syrma maenala	Ambon onyx	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: adonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Horaga syrma maenala	Ambon onyx	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Horaga syrma maenala	Ambon onyx	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Horaga syrma maenala	Ambon onyx	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop of withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Horaga syrma maenala	Ambon onyx	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: adonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible

Butterfly	Lycaenidae	Hypochrysops apollo parhassus	Amboin onyx	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Anseriadae	Dendrocygna eytoni	Eytons whistling duck	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Anseriadae	Dendrocygna eytoni	Eytons whistling duck	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Anseriadae	Dendrocygna eytoni	Eytons whistling duck	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKF	Negligible	Very Low	Unlikely	Negligible
Bird	Anseriadae	Dendrocygna eytoni	Eytons whistling duck	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Anseriadae	Dendrocygna eytoni	Eytons whistling duck	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to change in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NTA 4. Still Unlikely because	Noise barrier to minimise light spillage into NTA especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Anseriadae	Dendrocygna eytoni	Eytons whistling duck	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NTA	High	High	Unlikely	Negligible
Bird	Anseriadae	Dendrocygna eytoni	Eytons whistling duck	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Anseriadae	Dendrocygna eytoni	Eytons whistling duck	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Bird	Anseriadae	Dendrocygna eytoni	Eytons whistling duck	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to change in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NA		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Anseriadae	Dendrocygna eytoni	Eytons whistling duck	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Anseriadae	Isadorychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Anseriadae	Isadorychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Anseriadae	Isadorychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKF	Negligible	Very Low	Unlikely	Negligible
Bird	Anseriadae	Isadorychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Anseriadae	Isadorychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to change in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NTA 4. Still Unlikely because	Noise barrier to minimise light spillage into NTA especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Anseriadae	Isadorychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NTA	High	High	Unlikely	Negligible
Bird	Anseriadae	Isadorychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Anseriadae	Isadorychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Bird	Anseriadae	Isadorychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to change in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NA		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Anseriadae	Isadorychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Strigidae	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Strigidae	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Yes	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Strigidae	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Yes	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKF	Negligible	Very Low	Unlikely	Negligible
Bird	Strigidae	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Medium	Dependent on connected habitats for dispersal	Medium	Unlikely	NA is already an isolated forest fragment		Negligible		Medium	Medium	Unlikely	Negligible
Bird	Strigidae	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Yes	Construction	Light disturbance	High	High	Species that are extremely sensitive to change in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NTA 4. Still Unlikely because	Noise barrier to minimise light spillage into NTA especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Strigidae	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Yes	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds.	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NTA	High	High	Unlikely	Negligible
Bird	Strigidae	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Yes	Operational	Accidental injury or mortality	High	Medium	Species that are mobile but possibly susceptible to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	Medium	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	Medium	Medium	Less Likely	Minor
Bird	Strigidae	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Yes	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Bird	Strigidae	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Yes	Operational	Light disturbance	High	High	Species that are extremely sensitive to change in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NA		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Strigidae	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Yes	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Laniidae	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Laniidae	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Laniidae	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKF	Negligible	Very Low	Unlikely	Negligible
Bird	Laniidae	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Laniidae	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to change in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NTA 4. Still Unlikely because	Noise barrier to minimise light spillage into NTA especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Laniidae	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to human presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NTA	Medium	Medium	Unlikely	Negligible
Bird	Laniidae	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Laniidae	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Bird	Laniidae	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to change in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NA		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor

Bird	Lanidae	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NIS to deter human presence	Medium	Medium	Unlikely	Negligible
Bee	Halictidae	Lipotriches taksanensis		Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bee	Halictidae	Lipotriches taksanensis		Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bee	Halictidae	Lipotriches taksanensis		Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict	Medium	Possible	Based on species' behaviour	Hoarding and WRP	Moderate	Site inspections and BLKD	Medium	Medium	Less Likely	Minor
Bee	Halictidae	Lipotriches taksanensis		Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bee	Halictidae	Lipotriches taksanensis		Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: acuteste hymenopterans, most aquatic and marine species	Very Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NIS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NIS, especially during road widening works.	Negligible	Restricted working hours; no night works	Negligible	Very Low	Unlikely	Negligible
Bee	Halictidae	Lipotriches taksanensis		Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Negligible	Species that are not sensitive to human presence	Very Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NIS	Negligible	Very Low	Unlikely	Negligible
Bee	Halictidae	Lipotriches taksanensis		Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Bee	Halictidae	Lipotriches taksanensis		Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict	Medium	Possible	Species mainly restricted to NIS		Moderate	Educational sign boards put up near bus stop at withing residential areas i.e. SRI.	Medium	Medium	Less Likely	Minor
Bee	Halictidae	Lipotriches taksanensis		Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: acuteste hymenopterans, most aquatic and marine species	Very Low	Unlikely			Negligible	Consider light strategies in design phase	Negligible	Very Low	Unlikely	Negligible
Bee	Halictidae	Lipotriches taksanensis		Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Negligible	Species that are sensitive to human presence	Very Low	Less likely	Forest is already setbacked by canberra str and not open to public		Negligible	Signage along NIS to deter human presence	Negligible	Very Low	Unlikely	Negligible
Bird	Estrildidae	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NIS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Estrildidae	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Estrildidae	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKD	Negligible	Very Low	Unlikely	Negligible
Bird	Estrildidae	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Medium	Dependent on connected habitats for dispersal	Medium	Unlikely	NA is already an isolated forest fragment		Negligible		Medium	Medium	Unlikely	Negligible
Bird	Estrildidae	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NIS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NIS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Estrildidae	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NIS	High	High	Unlikely	Negligible
Bird	Estrildidae	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely	High-rise residential buildings operational in NIS		Minor	Integrate bird-friendly as detailed in Nparks' Biodiversity guidelines and consider enhancing window panels.	Low	Low	Unlikely	Negligible
Bird	Estrildidae	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Educational sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Estrildidae	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from higher-tier buildings into NIS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Estrildidae	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NIS to deter human presence	High	High	Unlikely	Negligible
Bird	Estrildidae	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Estrildidae	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Estrildidae	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKD	Negligible	Very Low	Unlikely	Negligible
Bird	Estrildidae	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Medium	Dependent on connected habitats for dispersal	Medium	Unlikely	NA is already an isolated forest fragment		Negligible		Medium	Medium	Unlikely	Negligible
Bird	Estrildidae	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NIS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NIS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Estrildidae	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NIS	High	High	Unlikely	Negligible
Bird	Estrildidae	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely	High-rise residential buildings operational in NIS		Minor	Integrate bird-friendly as detailed in Nparks' Biodiversity guidelines and consider enhancing window panels.	Low	Low	Unlikely	Negligible
Bird	Estrildidae	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Educational sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Estrildidae	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from higher-tier buildings into NIS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Estrildidae	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NIS to deter human presence	High	High	Unlikely	Negligible
Mammal	Mustelidae	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Mammal	Mustelidae	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Yes	Construction	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	High	Possible	Species likely to be attracted to the risk of accidents during clearance of NA	Hoarding, pre-felling inspections and WRP	Moderate	Directional-site clearance, site inspections, BAT, road calming measures	High	High	Less Likely	Minor
Mammal	Mustelidae	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Yes	Construction	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict	Medium	Possible	Based on species' behaviour	Hoarding and WRP	Moderate	Site inspections and BLKD	Medium	Medium	Less Likely	Minor
Mammal	Mustelidae	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Mammal	Mustelidae	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Yes	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NIS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NIS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Mammal	Mustelidae	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Yes	Construction	Human disturbance	High	Medium	Species that are sensitive to human presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NIS	Medium	Medium	Unlikely	Negligible
Mammal	Mustelidae	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Yes	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	Road widening at Canberra will likely increase flow of traffic		Moderate	Road calming measures	High	High	Less Likely	Minor
Mammal	Mustelidae	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Yes	Operational	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict	Medium	Possible	Known to occasionally venture into urban-matrix		Moderate	Educational sign boards put up near bus stop at withing residential areas i.e. SRI.	Medium	Medium	Less Likely	Minor
Mammal	Mustelidae	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Yes	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from higher-tier buildings into NIS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor

Mammal	Mustelidae	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Yes	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human-presence	Medium	Medium	Unlikely	Negligible
Mammal	Orcopithecidae	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Mammal	Orcopithecidae	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Yes	Construction	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	High	Possible	Species likely to be subjected to the risk of accidents during clearance of NA	Hoarding, pre-felling inspections and WRP	Moderate	Directional site clearance, site inspections, BAT, road calming measures	High	High	Less Likely	Minor
Mammal	Orcopithecidae	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Yes	Construction	Human-wildlife conflict	High	High	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict.	High	Possible	Based on species' behaviour	Hoarding and WRP	Moderate	Site inspections and BLEET	High	High	Less Likely	Minor
Mammal	Orcopithecidae	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Mammal	Orcopithecidae	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Yes	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Mammal	Orcopithecidae	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Yes	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Mammal	Orcopithecidae	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Yes	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	Road widening at Canberra will likely increase flow of traffic		Moderate	Road calming measures	High	High	Less Likely	Minor
Mammal	Orcopithecidae	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Yes	Operational	Human-wildlife conflict	High	High	Species that are typically perceived as both nuisances and threats by construction personnel, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict	High	Possible	Attracted by food waste from humans		Moderate	Education sign boards put up near bus stop at withing residential areas i.e. JEL	High	High	Less Likely	Minor
Mammal	Orcopithecidae	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Yes	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Mammal	Orcopithecidae	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Yes	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human-presence	Low	Low	Unlikely	Negligible
Mammal	Manidae	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Mammal	Manidae	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Yes	Construction	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	High	Possible	Species likely to be subjected to the risk of accidents during clearance of NA	Hoarding, pre-felling inspections and WRP	Moderate	Directional site clearance, site inspections, BAT, road calming measures	High	High	Less Likely	Minor
Mammal	Manidae	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Yes	Construction	Human-wildlife conflict	High	Low	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments.	Low	Less Likely	Based on species' behaviour	Hoarding and WRP	Minor	Site inspections and BLEET	Low	Low	Unlikely	Negligible
Mammal	Manidae	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Medium	Dependent on connected habitats for dispersal	Medium	Unlikely	NA is already an isolated forest fragment		Negligible		Medium	Medium	Unlikely	Negligible
Mammal	Manidae	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Yes	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Mammal	Manidae	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Yes	Construction	Human disturbance	High	Medium	Species that are sensitive to humna presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Mammal	Manidae	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Yes	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	Road widening at Canberra will likely increase flow of traffic		Moderate	Road calming measures	High	High	Less Likely	Minor
Mammal	Manidae	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Yes	Operational	Human-wildlife conflict	High	Low	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments.	Low	Less likely			Minor	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Low	Low	Unlikely	Negligible
Mammal	Manidae	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Yes	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Mammal	Manidae	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Yes	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human-presence	Medium	Medium	Unlikely	Negligible
Bee	Megachilidae	Megachile ornata		Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bee	Megachilidae	Megachile ornata		Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bee	Megachilidae	Megachile ornata		Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict.	Medium	Possible	Based on species' behaviour	Hoarding and WRP	Moderate	Site inspections and BLEET	Medium	Medium	Less Likely	Minor
Bee	Megachilidae	Megachile ornata		Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bee	Megachilidae	Megachile ornata		Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: aculeate hymenopterans, most aquatic and marine species	Very Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Negligible	Very Low	Unlikely	Negligible
Bee	Megachilidae	Megachile ornata		Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Negligible	Species that are not sensitive to human presence	Very Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Negligible	Very Low	Unlikely	Negligible
Bee	Megachilidae	Megachile ornata		Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Bee	Megachilidae	Megachile ornata		Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict.	Medium	Possible	Species mainly restricted to NS		Moderate	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Medium	Medium	Less Likely	Minor
Bee	Megachilidae	Megachile ornata		Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: aculeate hymenopterans, most aquatic and marine species	Very Low	Unlikely			Negligible	Consider light strategies in design phase	Negligible	Very Low	Unlikely	Negligible
Bee	Megachilidae	Megachile ornata		Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Negligible	Species that are sensitive to humna presence	Very Low	Less likely	Forest is already setback ed by canberra str and not open to public		Negligible	Signage along NS to deter human-presence	Negligible	Very Low	Unlikely	Negligible
Bee	Megachilidae	Megachile romera		Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bee	Megachilidae	Megachile romera		Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspections and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bee	Megachilidae	Megachile romera		Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict	Medium	Possible	Based on species' behaviour	Hoarding and WRP	Moderate	Site inspections and BLEET	Medium	Medium	Less Likely	Minor
Bee	Megachilidae	Megachile romera		Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bee	Megachilidae	Megachile romera		Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: aculeate hymenopterans, most aquatic and marine species	Very Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Negligible	Very Low	Unlikely	Negligible
Bee	Megachilidae	Megachile romera		Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Negligible	Species that are not sensitive to human presence	Very Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Negligible	Very Low	Unlikely	Negligible
Bee	Megachilidae	Megachile romera		Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Bee	Megachilidae	Megachile romera		Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict.	Medium	Possible	Species mainly restricted to NS		Moderate	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Medium	Medium	Less Likely	Minor
Bee	Megachilidae	Megachile romera		Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: aculeate hymenopterans, most aquatic and marine species	Very Low	Unlikely			Negligible	Consider light strategies in design phase	Negligible	Very Low	Unlikely	Negligible

Bee	Megachilidae	Megachile ramea		Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Negligible	Species that are sensitive to human presence	Very Low	Less likely	Forest is already setback by canberra str and not open to public		Negligible	Signage along NS to deter human presence	Negligible	Very Low	Unlikely	Negligible
Bird	Accipitridae	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Accipitridae	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Yes	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Accipitridae	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Yes	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Bird	Accipitridae	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bird	Accipitridae	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Yes	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Accipitridae	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Yes	Construction	Human disturbance	High	Medium	Species that are sensitive to humans presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Bird	Accipitridae	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Yes	Operational	Accidental injury or mortality	High	Medium	Species that are mobile but possibly susceptible to accidental injury/mortality from operation activities and roadkills, and collision with buildings	Medium	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels	Medium	Medium	Less Likely	Minor
Bird	Accipitridae	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Yes	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Accipitridae	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Yes	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Accipitridae	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Yes	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Bird	Ardeidae	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Ardeidae	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Yes	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Ardeidae	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Yes	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Bird	Ardeidae	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Medium	Dependent on connected habitats for dispersal	Medium	Unlikely	NA is already an isolated forest fragment		Negligible		Medium	Medium	Unlikely	Negligible
Bird	Ardeidae	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Yes	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Ardeidae	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Yes	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Ardeidae	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Yes	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely	High-rise residential buildings operational in NA		Minor	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels	Low	Low	Unlikely	Negligible
Bird	Ardeidae	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Yes	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Ardeidae	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Yes	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Ardeidae	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Yes	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Wasp	Vespidae	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Wasp	Vespidae	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Wasp	Vespidae	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict.	Medium	Possible	Based on species' behaviour	Hoarding and WRP	Moderate	Site inspections and BIAT	Medium	Medium	Less Likely	Minor
Wasp	Vespidae	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Wasp	Vespidae	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: aculeate hymenopterans, most aquatic and marine species	Very Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Negligible	Very Low	Unlikely	Negligible
Wasp	Vespidae	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Negligible	Species that are not sensitive to human presence	Very Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Negligible	Very Low	Unlikely	Negligible
Wasp	Vespidae	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Wasp	Vespidae	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Medium	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict.	Medium	Possible	Species mainly restricted to NS		Moderate	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Medium	Medium	Less Likely	Minor
Wasp	Vespidae	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: aculeate hymenopterans, most aquatic and marine species	Very Low	Unlikely			Negligible	Consider light strategies in design phase	Negligible	Very Low	Unlikely	Negligible
Wasp	Vespidae	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Negligible	Species that are sensitive to human presence	Very Low	Less likely	Forest is already setback by canberra str and not open to public		Negligible	Signage along NS to deter human presence	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible

Butterfly	Hesperiidae	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS hornerd Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NS is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. LRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pemara pagrans	Pugnacious lancer	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS hornerd Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Pemara pagrans	Pugnacious lancer	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pemara pagrans	Pugnacious lancer	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pemara pagrans	Pugnacious lancer	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Pemara pagrans	Pugnacious lancer	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pemara pagrans	Pugnacious lancer	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pemara pagrans	Pugnacious lancer	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pemara pagrans	Pugnacious lancer	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. LRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pemara pagrans	Pugnacious lancer	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pemara pagrans	Pugnacious lancer	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Placeidae	Placeus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS hornerd Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Placeidae	Placeus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Yes	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Placeidae	Placeus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Yes	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Bird	Placeidae	Placeus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Medium	Dependent on connected habitats for dispersal	Medium	Unlikely	NS is already an isolated forest fragment		Negligible		Medium	Medium	Unlikely	Negligible
Bird	Placeidae	Placeus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Yes	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Placeidae	Placeus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Yes	Construction	Human disturbance	High	Medium	Species that are sensitive to human presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Bird	Placeidae	Placeus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Yes	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely	High-rise residential buildings operational in NS		Minor	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	Low	Low	Unlikely	Negligible
Bird	Placeidae	Placeus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Yes	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. LRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Placeidae	Placeus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Yes	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Placeidae	Placeus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Yes	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Rallidae	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS hornerd Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Rallidae	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Medium	Species that are mobile but possibly subjected to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills	Medium	Possible	Species likely to be subjected to the risk of accidents during clearance of NS	Hoarding, pre-felling inspection and WRP	Moderate	Directional site clearance, site inspections, BAT, road calming measures	Medium	Medium	Less Likely	Minor
Bird	Rallidae	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Bird	Rallidae	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Bird	Rallidae	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Rallidae	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Rallidae	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely	High-rise residential buildings operational in NS		Minor	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	Low	Low	Unlikely	Negligible
Bird	Rallidae	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. LRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Rallidae	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor

Bird	Rallidae	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Pseudocoladenia dan dhyana	Fuhsuu pied flat	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forrest Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Pseudocoladenia dan dhyana	Fuhsuu pied flat	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pseudocoladenia dan dhyana	Fuhsuu pied flat	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKD	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pseudocoladenia dan dhyana	Fuhsuu pied flat	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Pseudocoladenia dan dhyana	Fuhsuu pied flat	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pseudocoladenia dan dhyana	Fuhsuu pied flat	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pseudocoladenia dan dhyana	Fuhsuu pied flat	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pseudocoladenia dan dhyana	Fuhsuu pied flat	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SEL	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pseudocoladenia dan dhyana	Fuhsuu pied flat	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Pseudocoladenia dan dhyana	Fuhsuu pied flat	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Psittaculidae	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forrest Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Psittaculidae	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Yes	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Psittaculidae	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Yes	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKD	Negligible	Very Low	Unlikely	Negligible
Bird	Psittaculidae	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NS is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bird	Psittaculidae	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Yes	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Psittaculidae	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Yes	Construction	Human disturbance	High	Medium	Species that are sensitive to humna presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Bird	Psittaculidae	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Yes	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nyarko' Birdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Psittaculidae	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Yes	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SEL	Negligible	Very Low	Unlikely	Negligible
Bird	Psittaculidae	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Yes	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Psittaculidae	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Yes	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Bird	Psittaculidae	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forrest Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Psittaculidae	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Psittaculidae	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKD	Negligible	Very Low	Unlikely	Negligible
Bird	Psittaculidae	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Bird	Psittaculidae	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Psittaculidae	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds.	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Psittaculidae	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	No	Operational	Accidental injury or mortality	High	Medium	Species that are mobile but possibly susceptible to accidental injury/mortality from operation activities and roadkills, and collision with buildings	Medium	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nyarko' Birdsafe guidelines and consider enhancing window panels.	Medium	Medium	Less Likely	Minor
Bird	Psittaculidae	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SEL	Negligible	Very Low	Unlikely	Negligible
Bird	Psittaculidae	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Psittaculidae	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Columbidae	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forrest Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Columbidae	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Columbidae	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLKD	Negligible	Very Low	Unlikely	Negligible
Bird	Columbidae	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Bird	Columbidae	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Columbidae	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds.	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Columbidae	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nyarko' Birdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Columbidae	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SEL	Negligible	Very Low	Unlikely	Negligible
Bird	Columbidae	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor

Bird	Columbidae	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Pycnonotidae	Pycnonotus zeylanicus	Straw-headed Bulbul	Critically Endangered	Endangered	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forrest/Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Pycnonotidae	Pycnonotus zeylanicus	Straw-headed Bulbul	Critically Endangered	Endangered	Yes	Yes	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Pycnonotidae	Pycnonotus zeylanicus	Straw-headed Bulbul	Critically Endangered	Endangered	Yes	Yes	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLEF	Negligible	Very Low	Unlikely	Negligible
Bird	Pycnonotidae	Pycnonotus zeylanicus	Straw-headed Bulbul	Critically Endangered	Endangered	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Bird	Pycnonotidae	Pycnonotus zeylanicus	Straw-headed Bulbul	Critically Endangered	Endangered	Yes	Yes	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Pycnonotidae	Pycnonotus zeylanicus	Straw-headed Bulbul	Critically Endangered	Endangered	Yes	Yes	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Pycnonotidae	Pycnonotus zeylanicus	Straw-headed Bulbul	Critically Endangered	Endangered	Yes	Yes	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels	High	High	Less Likely	Minor
Bird	Pycnonotidae	Pycnonotus zeylanicus	Straw-headed Bulbul	Critically Endangered	Endangered	Yes	Yes	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Pycnonotidae	Pycnonotus zeylanicus	Straw-headed Bulbul	Critically Endangered	Endangered	Yes	Yes	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Pycnonotidae	Pycnonotus zeylanicus	Straw-headed Bulbul	Critically Endangered	Endangered	Yes	Yes	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Butterfly	Lycaenidae	Rachana jalindra barbana	Banded royal	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forrest/Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Lycaenidae	Rachana jalindra barbana	Banded royal	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Rachana jalindra barbana	Banded royal	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLEF	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Rachana jalindra barbana	Banded royal	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Medium	Dependent on connected habitats for dispersal	Medium	Unlikely	NS is already an isolated forest fragment		Negligible		Medium	Medium	Unlikely	Negligible
Butterfly	Lycaenidae	Rachana jalindra barbana	Banded royal	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Rachana jalindra barbana	Banded royal	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Rachana jalindra barbana	Banded royal	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Rachana jalindra barbana	Banded royal	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Rachana jalindra barbana	Banded royal	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Rachana jalindra barbana	Banded royal	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Rostratulidae	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forrest/Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Rostratulidae	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Medium	Species that are mobile but possibly susceptible to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Medium	Possible	Species likely to be subjected to the risk of accidents during clearance of NS	Hoarding, pre-felling inspections and WRP	Moderate	Directional-site clearance, site inspections, BAT, road calming measures	Medium	Medium	Less Likely	Minor
Bird	Rostratulidae	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BLEF	Negligible	Very Low	Unlikely	Negligible
Bird	Rostratulidae	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Bird	Rostratulidae	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Rostratulidae	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Rostratulidae	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	No	Operational	Accidental injury or mortality	High	Medium	Species that are mobile but possibly susceptible to accidental injury/mortality from operation activities and roadkills, and collision with buildings	Medium	Possible	High-rise residential buildings operational in NS		Moderate	Integrate bird-friendly as detailed in Nparks' Birdable guidelines and consider enhancing window panels	Medium	Medium	Less Likely	Minor
Bird	Rostratulidae	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Rostratulidae	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Rostratulidae	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Snake	Colubridae	Sibynophis melanocephalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forrest/Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NS	Major	No mitigation measures	Medium	Medium	Certain	Major
Snake	Colubridae	Sibynophis melanocephalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	High	Possible	Species likely to be subjected to the risk of accidents during clearance of NS	Hoarding, pre-felling inspections and WRP	Moderate	Directional-site clearance, site inspections, BAT, road calming measures	High	High	Less Likely	Minor
Snake	Colubridae	Sibynophis melanocephalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	High	Species that are typically perceived as both nuisances and threats by construction personnel, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict.	High	Possible	Based on species' behaviour	Hoarding and WRP	Moderate	Site inspections and BLEF	High	High	Less Likely	Minor
Snake	Colubridae	Sibynophis melanocephalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NS is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Snake	Colubridae	Sibynophis melanocephalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Snake	Colubridae	Sibynophis melanocephalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to humna presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Snake	Colubridae	Sibynophis melanocephalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	Road widening at Canberra will likely increase flow of traffic		Moderate	Road calming measures	High	High	Less Likely	Minor
Snake	Colubridae	Sibynophis melanocephalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	High	Species that are typically perceived as both nuisances and threats by construction personnel, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict.	High	Possible	Species mainly restricted to NS		Moderate	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	High	High	Less Likely	Minor
Snake	Colubridae	Sibynophis melanocephalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor

Snake	Colubridae	Dibamophis metanesomphalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Bird	Accipitridae	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Accipitridae	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Accipitridae	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJAT	Negligible	Very Low	Unlikely	Negligible
Bird	Accipitridae	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bird	Accipitridae	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Accipitridae	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to human presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Bird	Accipitridae	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	No	Operational	Accidental injury or mortality	High	Medium	Species that are mobile but possibly susceptible to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	Medium	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	Medium	Medium	Less Likely	Minor
Bird	Accipitridae	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SIT.	Negligible	Very Low	Unlikely	Negligible
Bird	Accipitridae	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Accipitridae	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Bird	Strigidae	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Strigidae	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Strigidae	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJAT	Negligible	Very Low	Unlikely	Negligible
Bird	Strigidae	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Bird	Strigidae	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Strigidae	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to human presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Bird	Strigidae	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Medium	Species that are mobile but possibly susceptible to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	Medium	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	Medium	Medium	Less Likely	Minor
Bird	Strigidae	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SIT.	Negligible	Very Low	Unlikely	Negligible
Bird	Strigidae	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Strigidae	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Bird	Cuculidae	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Cuculidae	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Cuculidae	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJAT	Negligible	Very Low	Unlikely	Negligible
Bird	Cuculidae	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NA is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Bird	Cuculidae	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Cuculidae	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds.	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Cuculidae	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Cuculidae	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SIT.	Negligible	Very Low	Unlikely	Negligible
Bird	Cuculidae	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Cuculidae	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback ed by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Tapena thwaitesi borneo	Dark flat	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Tapena thwaitesi borneo	Dark flat	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Tapena thwaitesi borneo	Dark flat	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Tapena thwaitesi borneo	Dark flat	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NA is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Tapena thwaitesi borneo	Dark flat	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Tapena thwaitesi borneo	Dark flat	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Tapena thwaitesi borneo	Dark flat	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Tapena thwaitesi borneo	Dark flat	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SIT.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Tapena thwaitesi borneo	Dark flat	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible

Butterfly	Hesperiidae	Toxerea theastrenibonnea	Dark flat	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA homed Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NA. 3. Still Unlikely because	Noise barrier to minimise light spillage into NA, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NA	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NA		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Trifurcata augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA homed Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Hesperiidae	Telicota linna	Linna palm dart	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Telicota linna	Linna palm dart	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Telicota linna	Linna palm dart	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NA is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Butterfly	Hesperiidae	Telicota linna	Linna palm dart	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NA. 3. Still Unlikely because	Noise barrier to minimise light spillage into NA, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Telicota linna	Linna palm dart	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NA	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Telicota linna	Linna palm dart	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Telicota linna	Linna palm dart	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Butterfly	Hesperiidae	Telicota linna	Linna palm dart	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NA		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Hesperiidae	Telicota linna	Linna palm dart	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence.	Low	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Bird	Columbidae	Trereron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA homed Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Columbidae	Trereron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Columbidae	Trereron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Bird	Columbidae	Trereron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NA is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Bird	Columbidae	Trereron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NA. 3. Still Unlikely because	Noise barrier to minimise light spillage into NA, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Columbidae	Trereron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds.	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NA	High	High	Unlikely	Negligible
Bird	Columbidae	Trereron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Columbidae	Trereron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Columbidae	Trereron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NA		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Columbidae	Trereron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setbacked by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Bird	Columbidae	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA homed Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Columbidae	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Columbidae	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BIAT	Negligible	Very Low	Unlikely	Negligible
Bird	Columbidae	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	NA is already an isolated forest fragment		Negligible		High	High	Unlikely	Negligible
Bird	Columbidae	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	No	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NA. 3. Still Unlikely because	Noise barrier to minimise light spillage into NA, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Columbidae	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds.	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NA	High	High	Unlikely	Negligible
Bird	Columbidae	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in Nparks' Birdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Columbidae	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. SRI.	Negligible	Very Low	Unlikely	Negligible
Bird	Columbidae	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	No	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NA		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor

Bird	Columbidae	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	High	High	Unlikely	Negligible
Freshwater fish	Clupheonnidae	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA Forested Area amounts to a total of 29.5 % of total biodiversity Study Area; semi-naturalised drain situated in NA Forested Area	Medium	Certain	Semi-naturalised drain will be completely cleared	Soil erosion control measures	Major	Rescue and relocation of species	Medium	Medium	Certain	Major
Freshwater fish	Clupheonnidae	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	NA	NA	Negligible	NA	Low	Low	Unlikely	Negligible
Freshwater fish	Clupheonnidae	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	NA	NA	Negligible	NA	Negligible	Very Low	Unlikely	Negligible
Freshwater fish	Clupheonnidae	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Semi-naturalised drain will be completely cleared	High	Unlikely	NA	NA	Negligible	NA	High	High	Unlikely	Negligible
Freshwater fish	Clupheonnidae	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: aculeate hymenopterans, most aquatic and marine species	Very Low	Unlikely	NA	NA	Negligible	NA	Negligible	Very Low	Unlikely	Negligible
Freshwater fish	Clupheonnidae	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	NA	NA	Negligible	NA	Low	Low	Unlikely	Negligible
Freshwater fish	Clupheonnidae	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Not Assessed during op stage			8%/A		Low	Low	Not Assessed during op stage	8%/A
Freshwater fish	Clupheonnidae	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Not Assessed during op stage			8%/A		Negligible	Very Low	Not Assessed during op stage	8%/A
Freshwater fish	Clupheonnidae	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	Negligible	Species that are not sensitive to changes in light levels: aculeate hymenopterans, most aquatic and marine species	Very Low	Not Assessed during op stage			8%/A		Negligible	Very Low	Not Assessed during op stage	8%/A
Freshwater fish	Clupheonnidae	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Not Assessed during op stage			8%/A		Low	Low	Not Assessed during op stage	8%/A
Butterfly	Papilionidae	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NA Forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NA inevitable	Proper set up of Construction Hoarding at Canberra Rd, ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Papilionidae	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Papilionidae	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Raised on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BAT	Negligible	Very Low	Unlikely	Negligible
Butterfly	Papilionidae	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Butterfly	Papilionidae	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Papilionidae	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Papilionidae	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Papilionidae	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop or writing residential areas i.e. SEL	Negligible	Very Low	Unlikely	Negligible
Butterfly	Papilionidae	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Papilionidae	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Less likely	Forest is already setback by canberra str and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Negligible	Absence of bamboo clusters in NA Forested Area	Very Low	Unlikely	Bamboo bats are located in the eastern end of NS Forested Area. Construction impacts to this species are not applicable	NA	Negligible	NA	Negligible	Very Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	High	Unlikely	Bamboo bats are located in the eastern end of NS Forested Area. Construction impacts to this species are not applicable	NA	Negligible	NA	High	High	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Low	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments.	Low	Unlikely	Bamboo bats are located in the eastern end of NS Forested Area. Construction impacts to this species are not applicable	NA	Negligible	NA	Low	Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment	NA	Negligible	NA	Negligible	Very Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds.	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	NA	High	High	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to human presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely		NA	Minor	NA	Low	Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Low	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments.	Low	Less likely		NA	Minor	NA	Low	Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds.	High	Possible	Increased light pollution from highrise buildings into NS	NA	Moderate	NA	High	High	Less Likely	Minor
Mammal (bat)	Vespertilionidae	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setback by canberra str and not open to public	NA	Minor	Signage along NS to deter human presence	Medium	Medium	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Negligible	Absence of bamboo clusters in NA Forested Area	Very Low	Unlikely	Bamboo bats are located in the eastern end of NS Forested Area. Construction impacts to this species are not applicable	NA	Negligible	NA	Negligible	Very Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	High	Unlikely	Bamboo bats are located in the eastern end of NS Forested Area. Construction impacts to this species are not applicable	NA	Negligible	NA	High	High	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Low	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments.	Low	Unlikely	Bamboo bats are located in the eastern end of NS Forested Area. Construction impacts to this species are not applicable	NA	Negligible	NA	Low	Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment	NA	Negligible	NA	Negligible	Very Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds.	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works 3. Widening road works at Canberra Rd is more concerning as the works are adjacent to NS. 4. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	NA	High	High	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	Medium	Species that are sensitive to human presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely		NA	Minor	NA	Low	Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Low	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments.	Low	Less likely		NA	Minor	NA	Low	Low	Unlikely	Negligible
Mammal (bat)	Vespertilionidae	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds.	High	Possible	Increased light pollution from highrise buildings into NS	NA	Moderate	NA	High	High	Less Likely	Minor

Mammal (bat)	Vespertilionidae	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setbacked by canberra rd and not open to public	NA	Minor	Signage along NS to deter human-presence	Medium	Medium	Unlikely	Negligible
Butterfly	Lycaenidae	Virachola kenzuma derbachus	Pitcher blue	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Butterfly	Lycaenidae	Virachola kenzuma derbachus	Pitcher blue	Not Listed	Endangered	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Virachola kenzuma derbachus	Pitcher blue	Not Listed	Endangered	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Virachola kenzuma derbachus	Pitcher blue	Not Listed	Endangered	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Low	Species slightly dependent on connected wooded habitats for dispersal and adaptable to traverse urban infrastructure if needed	Low	Unlikely	NA is already an isolated forest fragment		Negligible		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Virachola kenzuma derbachus	Pitcher blue	Not Listed	Endangered	Yes	No	Construction	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Virachola kenzuma derbachus	Pitcher blue	Not Listed	Endangered	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Virachola kenzuma derbachus	Pitcher blue	Not Listed	Endangered	Yes	No	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely			Minor		Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Virachola kenzuma derbachus	Pitcher blue	Not Listed	Endangered	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Butterfly	Lycaenidae	Virachola kenzuma derbachus	Pitcher blue	Not Listed	Endangered	Yes	No	Operational	Light disturbance	High	Low	Species that are slightly sensitive to changes in light levels: odonates, butterflies.	Low	Less likely	Increased light pollution from highrise buildings into NS		Minor	Consider light strategies in design phase	Low	Low	Unlikely	Negligible
Butterfly	Lycaenidae	Virachola kenzuma derbachus	Pitcher blue	Not Listed	Endangered	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Less likely	Forest is already setbacked by canberra rd and not open to public		Minor	Signage along NS to deter human-presence	Low	Low	Unlikely	Negligible
Bird	Rallidae	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Rallidae	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	No	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Rallidae	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Bird	Rallidae	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Rallidae	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Bird	Rallidae	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	No	Construction	Human disturbance	High	High	Species that are extremely sensitive to human presence, and nesting birds	High	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	High	High	Unlikely	Negligible
Bird	Rallidae	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	High-rise residential buildings operational in NA		Moderate	Integrate bird-friendly as detailed in NparksBirdsafe guidelines and consider enhancing window panels.	High	High	Less Likely	Minor
Bird	Rallidae	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Bird	Rallidae	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor
Bird	Rallidae	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	No	Operational	Human disturbance	High	High	Species that are sensitive to human presence	High	Less likely	Forest is already setbacked by canberra rd and not open to public		Minor	Signage along NS to deter human-presence	High	High	Unlikely	Negligible
Bird	Zosteropidae	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Bird	Zosteropidae	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Yes	Construction	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	Low	Unlikely	Violent and highly-mobile	Hoarding, pre-felling inspection and WRP	Negligible	Directional-site clearance, site inspections, BAT, road calming measures	Low	Low	Unlikely	Negligible
Bird	Zosteropidae	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Yes	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Bird	Zosteropidae	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Yes	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	Negligible	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Very Low	Unlikely	NA is already an isolated forest fragment		Negligible		Negligible	Very Low	Unlikely	Negligible
Bird	Zosteropidae	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Yes	Construction	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Unlikely	1. Existing Canberra Rd already lit (baseline) 2. Assumes night works at Canberra Rd is more concerning as the works are adjacent to NS. 3. Still Unlikely because	Noise barrier to minimise light spillage into NS, especially during road widening works.	Negligible	Restricted working hours; no night works	Medium	Medium	Unlikely	Negligible
Bird	Zosteropidae	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Yes	Construction	Human disturbance	High	Medium	Species that are sensitive to human presence	Medium	Unlikely	Works kept strictly within hoarding	Hoarding	Negligible	No encroachment in NS	Medium	Medium	Unlikely	Negligible
Bird	Zosteropidae	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Yes	Operational	Accidental injury or mortality	High	Low	Species with low susceptibility to accidental injury/mortality from operation activities, roadkills, and collision with buildings.	Low	Less likely	High-rise residential buildings operational in NA		Minor	Integrate bird-friendly as detailed in NparksBirdsafe guidelines and consider enhancing window panels.	Low	Low	Unlikely	Negligible
Bird	Zosteropidae	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Yes	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Bird	Zosteropidae	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Yes	Operational	Light disturbance	High	Medium	Species that are sensitive to changes in light levels: diurnal birds, reptiles and mammals	Medium	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	Medium	Medium	Less Likely	Minor
Bird	Zosteropidae	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Yes	Operational	Human disturbance	High	Medium	Species that are possibly sensitive to human presence	Medium	Less likely	Forest is already setbacked by canberra rd and not open to public		Minor	Signage along NS to deter human-presence	Medium	Medium	Unlikely	Negligible
Turtle	Geoemydidae	Cuora mouhotii	Malayan box terrapin	Endangered	Near Threatened	Yes	No	Construction	Loss of/reduction in habitats and food sources	High	Medium	Loss of NS forested Area amounts to a total of 29.5 % of total biodiversity Study Area	Medium	Certain	Clearance of entire NS inevitable	Proper set-up of hoarding, especially at Canberra Rd. ensuring clearance do not extend into NA	Major	No mitigation measures	Medium	Medium	Certain	Major
Turtle	Geoemydidae	Cuora mouhotii	Malayan box terrapin	Endangered	Near Threatened	Yes	No	Construction	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkills.	High	Possible	Species likely to be subjected to the risk of accidents during clearance of NS	Hoarding, pre-felling inspection and WRP	Moderate	Directional-site clearance, site inspections, BAT, road calming measures	High	High	Less Likely	Minor
Turtle	Geoemydidae	Cuora mouhotii	Malayan box terrapin	Endangered	Near Threatened	Yes	No	Construction	Human-wildlife conflict	High	Negligible	Species that are not perceived as nuisances or threats by construction personnel.	Very Low	Unlikely	Based on species' behaviour	Hoarding and WRP	Negligible	Site inspections and BJEP	Negligible	Very Low	Unlikely	Negligible
Turtle	Geoemydidae	Cuora mouhotii	Malayan box terrapin	Endangered	Near Threatened	Yes	No	Construction	Loss of/reduction in ecological connectivity for faunal movement	High	High	Highly dependent on connected habitats for dispersal	High	Unlikely	Not Assessed		Negligible		High	High	Unlikely	Negligible
Turtle	Geoemydidae	Cuora mouhotii	Malayan box terrapin	Endangered	Near Threatened	Yes	No	Construction	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Unlikely	Not affected	Not affected	Negligible	Restricted working hours; no night works	High	High	Unlikely	Negligible
Turtle	Geoemydidae	Cuora mouhotii	Malayan box terrapin	Endangered	Near Threatened	Yes	No	Construction	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Unlikely	Not Assessed	Hoarding	Negligible	No encroachment in NS	Low	Low	Unlikely	Negligible
Turtle	Geoemydidae	Cuora mouhotii	Malayan box terrapin	Endangered	Near Threatened	Yes	No	Operational	Accidental injury or mortality	High	High	Species with high susceptibility to accidental injury/mortality from operation activities and roadkills, and collision with buildings.	High	Possible	High-rise residential buildings operational in NA		Moderate	Road calming measures	High	High	Less Likely	Minor
Turtle	Geoemydidae	Cuora mouhotii	Malayan box terrapin	Endangered	Near Threatened	Yes	No	Operational	Human-wildlife conflict	High	Negligible	Not a nuisance or threat	Very Low	Unlikely			Negligible	Education sign boards put up near bus stop at withing residential areas i.e. JEL	Negligible	Very Low	Unlikely	Negligible
Turtle	Geoemydidae	Cuora mouhotii	Malayan box terrapin	Endangered	Near Threatened	Yes	No	Operational	Light disturbance	High	High	Species that are extremely sensitive to changes in light levels: nocturnal, crepuscular fauna and nesting/hatching sea turtle species, migratory birds	High	Possible	Increased light pollution from highrise buildings into NS		Moderate	Consider light strategies in design phase	High	High	Less Likely	Minor

Turtle	Emoeydidae	Cuora amboinensis	Malayan box terrapin	Endangered	Near Threatened	Yes	No	Operational	Human disturbance	High	Low	Species that are slightly sensitive to human presence	Low	Less likely	Forest is already fortified by canberra st and not open to public		Minor	Signage along NS to deter human presence	Low	Low	Unlikely	Negligible

Appendix N
Tree Protection and Conservation Guidelines

Delivering a better world

TREE PROTECTION AND CONSERVATION GUIDELINES

By

Derek Yap

Lead Arborist

Camphora Pte Ltd

ISA certified

SG-0117A

CONTENT REQUIREMENTS

This document outlines specific measures to protect trees during construction or other site disturbance. The content and scope of the document will vary based on the site, type of construction, tree species, tree location and other factors.

TREE PROTECTION AND CONSERVATION GUIDELINES

This section outlines the general provisions for tree protection before, during and after construction. Additional measures may be added by the attending arborist on a case-by-case basis.

PRE-DEMOLITION/PILING/CONSTRUCTION

1. Pre-Construction Meeting

   The attending arborist shall attend a pre-construction meeting with the project contractor or construction supervisor to explain the tree protection and monitoring requirements as outlined in this document.

   In addition, the project contractor or construction supervisor shall complete the 'VERIFICATION OF TREE PROTECTION CHECKLIST' as attached in Annex A before the onset of the construction.

1.1 Tree Protection Zone

Prior to any site clearing (demolition works), piling works, grading, trenching or other soil disturbance, a tree protection zone (TPZ) must be installed as follows:

i. Type

The barriers should be temporary, made of a hard material, 1.8-m tall and firmly installed into the ground.

ii. Ground protection

Mulching material (can be compost or woodchips) at 100-mm thick to be laid within the TPZ. If woodchips are used, termicide treatment is necessary to prevent the introduction of harmful termites.

Apply complete fertilizer (N:P:K 15:15:15) upon or together with the application of mulch.

iii. Signage

A readily-visible and waterproof sign shall be installed on all sides of the fencing around each individual protected tree. The size of each sign must be a minimum of 300mm wide and must contain the wording below:

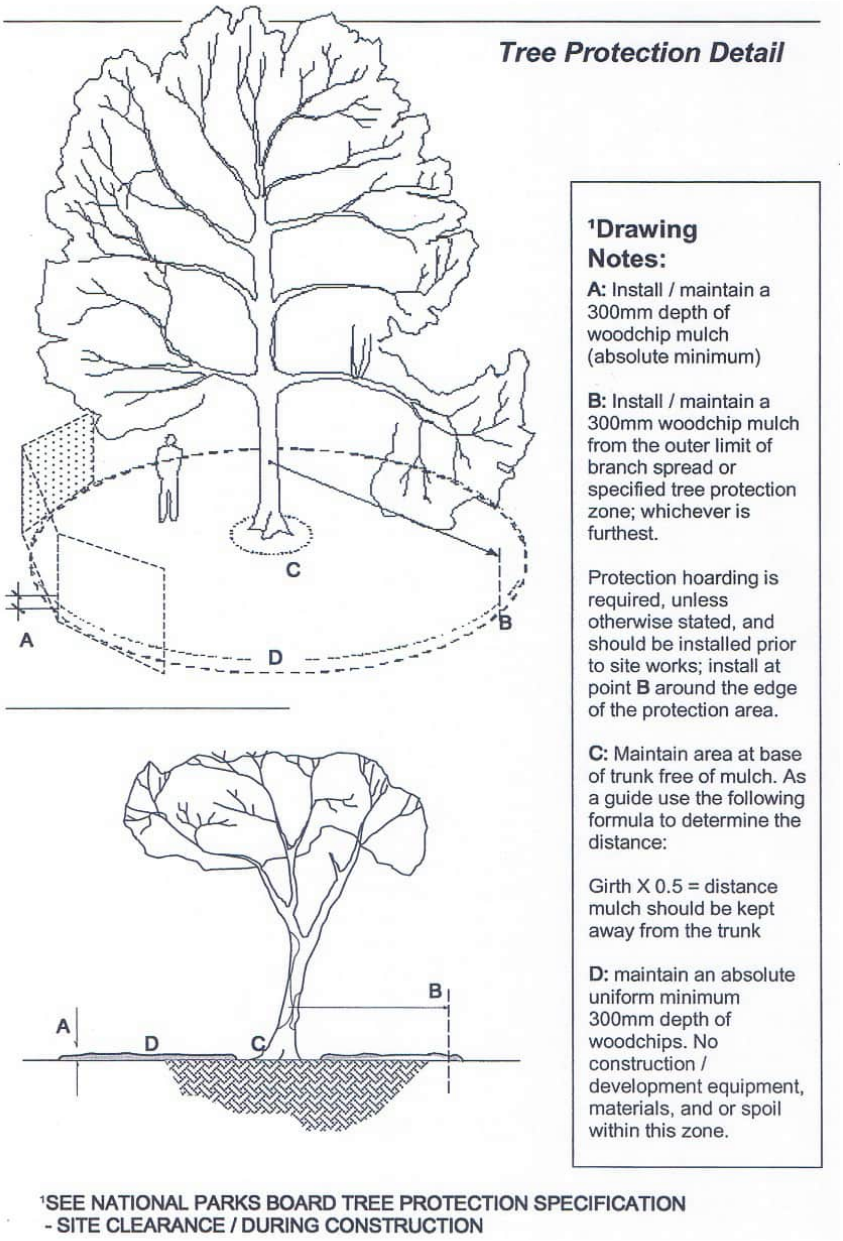
KEEP OUT!
TREE PROTECTION ZONE

Entry prohibited. This fence shall remain in place throughout the entire construction period.

iv. Fencing installation

Installation must be approved by the attending arborists and/or the approved authority prior to construction.

A diagrammatic representation of a proper Tree protection zone is presented below.



1.2 Tree pruning and removal

Various trees may need to be pruned away from structures or proposed construction activity. ***Construction or contractor personnel shall not attempt pruning or removal.*** Consultation and written approval with attending arborist must be obtained prior to pruning.

Removal of trees adjacent to trees that are to be retained requires planning and skilled arboriculture workers. Trees should not be removed by pushing with excavators/heavy

machinery or with lumberjack (one cut) methods. Directional felling methods (notch and back-cut) should be deployed during removal of trees.

Removal of trees that extend into branches or roots of protected trees shall not be attempted by the demolition or construction crew, or by grading or other heavy equipment. Before removing tree stumps, the project manager shall seek the advice from the attending arborist determine if roots are entangled with trees that are to remain. If so, these stumps shall have their roots severed before extracting them.

1.3 Site Clearance

To avoid lumber jack felling of trees that may severely damage the canopy of conserved trees, it is recommended that qualified (see Point 4.3 Tree Conservation Guidelines) Arboriculture contractors be engage to fell trees adjacent to protected trees to ensure that the trees (when cut) fall away from the protected trees and their associated TPZs.

Contractors carry out tree felling works near assigned TPZs of conserved trees should

i. Employ directional felling through the use of notch and back cuts

ii. Deploy cranes to tension trunks in the direction of the drop

iii. Carry out pruning of canopy branches to remove entangling branches

iv. If trees to be removed are taller than neighbouring trees to be retained, removal of branches should be carried out in a controlled manner using ropes and cranes to avoid damaging canopy of the lower trees.

v. To avoid pruning of conserved trees at the proximity unless consultation and approval from attending arborist has been obtained.

vi. No tree should be removed by pushing with an excavator or heavy machinery.

DURING DEMOLITION/PILING/CONSTRUCTION

2. Tree Protection Zone Restrictions

- No ground disturbance, grading, trenching or other construction activities shall occur within the TPZ except as specified and/or approved by the attending arborist or authority.
- No construction material, debris, machinery (e.g. generators) or other construction waste shall be stored within the TPZ. Weight and presence of these materials increases

soil compaction and reduces the area exposed for water infiltration and gaseous exchange.



Figure 1: Construction material and heavy machinery are prohibited within the TPZ

- Excavation works within the TPZ are strictly prohibited. Unless otherwise specified by the attending arborist, all work done within the TPZ shall be completed with manual trenching with hand tools or other hand held power tools that will not cause any root/tree damage.

  If roots need to be cut, it shall be done using proper equipment (e.g. pruning saw, chain saw) under the supervision of the attending arborist.



Figure 2: Trial trench by skilled workers using hand tools exposing root architecture

- Nailing, tying or pasting of materials on trees is prohibited. The tree shall not be used

as an anchor for supporting structures during the construction.



Figure 3: Using tree as anchor may damage its bark.



Figure 4: No nails shall be driven into the tree as it promotes infiltration of pests/diseases

- Phytotoxic materials such as fuels, oils, cement, chemicals, and paint shall be kept away and stored/mixed at least 2.5m from the tree protection zone. Such chemicals can significantly change the cation exchange capacity and pH of the soil, rendering nutrient uptake inefficient and creating an environment too toxic for the roots to grow.

  Construction slug especially from piling works should not be deposited within the TPZ. Such sludge is usually high in clay content and when layered over and within the TPZ could significantly alter the water infiltration and gaseous exchange rates of the root absorption area of the tree.

Canvass sheets/Eco-mat must be laid on the existing soil near the tree in view of soil protection during the demolition, drilling or other construction activities pertaining to concrete structures.



Figure 5: Construction cement deposited at tree base.



Figure 6: Tree showing signs of decline overtime.

- Lowering the grade around trees can have an immediate and long-term effect on trees. Typically, most roots are within the top 1m of soil, and most of the fine roots active in water and nutrient absorption are in the top 300mm.

  A) Grade changes within the TPZ are not permitted.

  B) Grade changes outside the TPZ shall not significantly alter drainage.

  C) Grade changes under specifically approved circumstances shall not allow more than

200mm of fill soil or allow more than 150mm of existing soil to be removed from natural grade, unless mitigated.

D) Grade fills over 200mm or impervious overlay shall incorporate an approved permanent aeration system, permeable material, or other approved mitigation.

E) Grade cuts exceeding 150mm shall incorporate retaining walls or an appropriate transition equivalent.

No removal of the TPZ will be permitted under any circumstances.



Figure 7: Inappropriate installation/maintenance of TPZ during construction.

2.2 Proximity of Heavy machinery/vehicles

Heavy vehicles and machinery (e.g. excavators, piling cranes, 10 wheelers) movement should be limited near TPZs. Temporary access/passageways should be planned to avoid conserved trees.



Figure 8: Tree branches were severed due to the negligence of the crane operator.

2.3 Drainage Considerations

In the event that water ponding conditions develop in the course of construction due to change in grade/platform levels, construction events or any other unforeseeable factors, the contractor is required to improve drainage around or within the TPZ in consultation with the attending arborist.

2.4 Trenching, Excavation and Equipment use

Trenching, excavation or boring within the TPZ shall be limited to activities approved by the architect and/or attending Arborist. Explore alternatives for trenching outside the root zone. Avoid exposing roots during hot, dry weather. Backfill trenches as soon as possible with soil and soak with water the same day. Small roots can die in 10 to 15 minutes and large roots may not survive an hour of exposure. If the trench must be left open all roots must be kept moist by wrapping them in peat moss and burlap.

i. Root Severance

No roots greater than 0.2m in diameter shall be cut without approval of the attending Arborist. Tunneling under roots is the approved alternative. Prior to excavation for foundation/footing/walls, or grading or trenching within the TPZ, roots shall be severed cleanly outside the TPZ to the depth of the planned excavation. When roots must be cut, they shall be cut cleanly with a sharp saw to sound wood and flush with the trench site.

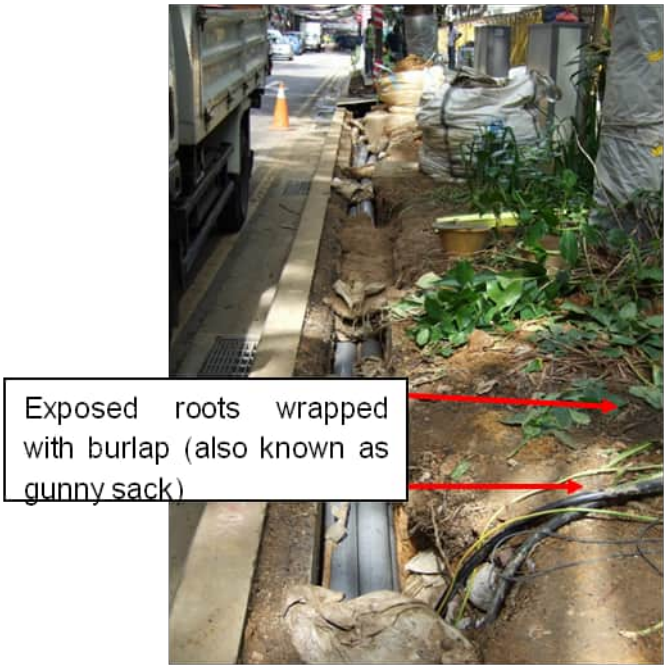


Figure 9: Tunneling under roots.

ii. Excavation

Any approved excavation, demolition, or extraction of material shall be performed with equipment that is placed outside the TPZ. Hand digging, hydraulic, or pneumatic excavation (e.g. air spading) are permitted methods for excavation within the TPZ.



Figure 10: Root exploratory works using an air spade. Air spading avoids damage of structural and even feeder roots of the tree.

iii. Heavy Equipment

Use of backhoes, Ditch-Witches, steal tread tractors or other heavy vehicles within the TPZ is prohibited unless approved by the attending Arborist. If allowed, a protective root buffer is required.

2.5 Tree Care

In the course of construction, the following measures may be necessary to reduce the effects of construction stress on protected trees. Quantum, duration and extent to be advised by attending arborist.

(A) Fertilization

A1 Vertical trenches and Nutrient Sinks

Create vertical trenching and nutrient sinks. These nutrient sinks should go down to at least 300mm deep and should be filled with high grade compost and 12% Humic acid (dilution 1:100). These sinks will act to reduce construction stress by conditioning the soil, increasing soil microbiological activity and increasing organic matter At least 24 numbers of vertical trenches / nutrient sinks are required for trees greater than 2m in girth. Vertical trenches for trees under 2m in girth will be

determined empirically by the attending arborist and will take into account site conditions, tree species and its pre construction vigor. Top up nutrient sinks every 3 months.

A2 Soil Injection of Biostimulants

Mandatory if TPZ has been infringed into, soil compaction has occurred, tree condition has observed to have declined (indicators: reduction in Live crown ratios, twig die back at canopy and change in leaf colour/size/density)

- **Purpose :** To de-compact soil using a hydraulic pressurized delivery of biostimulants that both hydrates and aerates at the same time. Aim to reduce compaction to less than 400psi in the first 500mm of the soil.
- Mixed bio stimulants – serves 2 functions

  Decompaction
- Humic acid – as soil conditioner and chelating agent (Nutrients are mobilized in forms that the plants can accept), facilitate release of nutrients and reduces leaching. Also improves water holding capacities of soil.
- Liquid gypsum / Dolomite – soil conditioner, improve soil structure and facilitate release of nutrients in clay soils typical of local conditions.

  To feed and increase soil microbiology to increase tree vigor post damage. Soil microbiology helps nutrient uptake and encourages healthy root growth critical to prevent construction stress.

- Mollases – High CE for immediate uptake,
- Fish Kelp – Protein source. Organic fertilisers
- Slow release fertilizers (Osmocote)

(B) Watering

- Water supplement during periods of drought.
- Watering duration and extent depends on site conditions and species.
- Watering is carried out until first signs of inundation are observed (i.e. water infiltration observe to slow down significantly).

(C) Myconate treatment

- To trigger and stimulate growth of existing mycorrhizae.

(D) Pesticide treatment

- To control pest (e.g. termites, borers, caterpillars etc) when it occurs.
- Fungicide or bacteriocide as required or as determined by attending arborist to control microbe pathogens.

(E) Additonal pruning

To be carried out in consultation with the attending Arborist. Trees are living things and may require some form of pruning during the course of the development.

- Crown cleansing- Prune to remove dead branches that may have developed through time.
- Crown lifting- Prune to lift crown to avoid new amenities.
- Crown thinning- Prune to reduce canopy branches and loading.

Structural pruning (including crown reduction) to remove branches that may obstruct new amenities and/or movement of critically necessary equipment may require the planning and standing supervision of the attending arborist.

2.6 Engaging Arboriculture Contractors

All arboriculture works should be carried out by skilled and trained arboriculture teams. As such, it is preferred that only Arboriculture contractors which have at least 8 years working experience and must show previous work experience in developments of similar size or complexity. Arboriculture contractors should meet NParks safety requirements for work at height, LTA's requirements for temporary works along roadsides (where necessary) and have a certified arborist to supervise the pruning/felling/planting works.

All arboriculture workers engaged in tree climbing and chainsaw work shall possess a valid basic tree climbing certification base upon demonstrated competence in the WSQ module conducted by CUGE or an equivalent WSQ approved training organization.

Each Arboriculture crew shall possess the following VALID competences,
Operation of chainsaw for ground work (LS-MT-103E-1)
Chainsaw safety and maintenance (LS-MT-102E-1)
Perform formative pruning of young trees (LS-MT-114E-1)
Provide Arboriculture support on site (LS-MT-116E-1)
Workplace safety and health – operators (ES-WSH-101G-1)
Respond to Emergency (LS-HM-208E-1)
Perform advance rigging and climbing techniques (LS-HM-308S-1)
Perform aerial tree access and aerial rescue skills (Ls-HM-204S-1)
Implement and apply appropriate risk and safety management to sector practices (LS-BP-301S-1)
Prepare risk assessment report (LS-HM-406S-1)
Operate and work from an elevated work platform (CUGE-ARB-3501)

POST-CONSTRUCTION

3. Soft Landscaping

Ground works, site preparation and implementation of all landscaping near protected trees must be undertaken carefully.

TPZ barriers can only be removed at this juncture for the purpose. However, when working near trees, cultivation of soils in these areas must be cautiously handled using hand tools. Planting of shrubs shall be at a distance of at least 300mm away from existing root collar.

Avoid changes to ground levels or unnecessary compaction of soils within proximity to existing trees during the course.



Figure 10: New plantings at a minimum distance of 300mm (all round) from root collar

ANNEX A

VERIFICATION OF TREE PROTECTION CHECKLIST

Note: The project contractor or construction supervisor shall verify in writing that all **preconstruction** tree preservation conditions have been met as follows:

Submitted by: _____

Company/Project: _____

Date/Time: _____

S/N	Action	Checked (✔)	Remarks
1	Installation of tree fencing around identified trees within/near site (hard material at 1.8m tall)		
2	Tree protection zone (TPZ) dimensions meets specifications (from NParks and/or attending arborist)		
3	Warning signs prominently displayed on all sides of the fencing, including designated tree number		
4	Removal of construction material (ie machinery, debris, tools etc) within TPZ		
5	Mulching of high grade compost of 100mm thick around identified trees		
6	Completion of tree pruning (if necessary) under the supervision/written approval with the attending arborist		
7	Establishment of a tree maintenance schedule according to arborist recommendations (to be submitted to attending arborist)		

Verified by (attending arborist): _____

Date/Time: _____

Appendix O
Guidelines for Sapling Harvesting and Tree Transplantation and Tree Maintenance

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Appendix A

Guidelines for Sapling and Tree Transplantation and Tree Maintenance

CONTENT REQUIREMENTS

This document outlines guidelines for sapling harvesting and tree transplantation prior to construction works, and guidelines to tree maintenance and care for retained trees during construction or other site disturbance. The content and scope of the document will vary based on the site, type of construction, tree species, tree location and other factors.

SAPLING HARVESTING AND TREE TRANSPLANTING

This section outlines the general guidelines for sapling harvesting and tree transplanting prior to construction. Additional measures may be added by the attending arborist on a case-by-case basis.

SPECIMEN SELECTION

Prior to site clearance works, any viable saplings and conservation significant trees that are suitable for harvesting shall be identified by the Arborist. Saplings or trees suitable for transplanting should:

I. Exhibit good physiological health and vigour
II. Have no structural defects
III. Have good branch form

As a guidance, the size of the root ball that is to be extracted shall be based on the girth of the saplings or trees to be harvested

Girth (m)	**Minimum root ball diameter to extract (m)**
<0.1	0.4
0.1–0.2	0.6
0.2–0.3	0.8
0.3–0.4	1.2
0.4–0.5	1.5
>0.5	To be determined by Arborist

Prior to transplanting, dead branches and climbers shall be cleared from the plant and canopy load and spread will be reduced where necessary, in consultation with the Arborist. Manual trenching shall be carried out to determine the shape and size of root ball to be extracted. Where possible, feeder roots shall be retained without cutting. The root ball shall be burlapped with cellophane sheet to reduce desiccation effects. When directed by the Flora specialist or Arborist, leaves of the canopy may also need to be enclosed and covered by cellophane or clear plastic bags. The root ball shall be secured to the trunk to reduce risk of root ball disintegrating. When handling/carrying the plant, care shall be taken not to damage any vegetative parts.

Where trees and vegetation are moved or translocated within the Project area, the Arborist shall review the method statement proposed by the tree transplanting contractor and advise on additional recommendations necessary to ensure the tree's health during transplanting. The transplanting contract shall ensure in their best effort, intact and secured root balls at the point of extraction, during the lifting processes and during the installation at the receiving site. The transplant effort shall be documented for each individual tree to show intact root balls at all the stages mentioned. Transplanted trees shall be managed through adequate watering and monitoring of their health to ensure their long-term survival. Advice shall be sought from the Arborist if the tree exhibit signs of stress, e.g., peeling bark, withered leaves.

TREE MAINTENANCE AND CARE

This section outlines the general guidelines for tree maintenance and care during construction works. Additional measures may be added by the attending arborist on a case-by-case basis.

Where disease outbreaks are identified, the Arborist shall advise measures to manage them. Measures can include using selected insecticides/fungicides to control outbreaks; reduction of stressors (dust, water, etc.). The plant may be removed or quarantined if it poses a threat to surrounding individuals.

Where forest edges are exposed following site clearance and where impacts to vegetation are evident (e.g., vegetation shows signs of drying out), additional watering shall be carried out to improve moisture differentials around forest edges.

The use of herbicides and pesticides shall be minimised. If herbicides or pesticides are used within the Project area, techniques that limit spray or non-target spray drift shall be used. These techniques include but are not limited to: cut and paint techniques and drilling injection. All use of herbicides and pesticides shall be conducted in accordance with the relevant Material Safety Data Sheet (MSDS). Any incidents of off label use, spillage or damage to non-target species shall be reported and investigated.

When the site experiences seven continuous days without rainfall, the Contractor shall carry out additional watering of conserved trees within the TPZs and at the forest edge (up to 10 m) around the development boundary. Post-heavy rainfall, any snapped hanging branches that pose imminent hazards to workers within the site should be removed immediately.

Appendix P
Wildlife Incident Form

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Wildlife Incident Form

Date (YYYY/MM/DD):	Time:
Description of Location:	GPS Coordinates:
Wildlife Observed:	Animal Condition (circle): Alive / Killed / Dead / Injured Animal activity (circle): Moving / Resting / Trapped
Photographs Taken:	MFLG and NParks notified: Yes / No Name of staff notified:
Describe Incident (e.g., activities being carried out; what animal was doing; personnel involved):	
Actions Taken:	
Reported by:	Reported to:
Contact no.:	Contact no:
Remarks:	

Appendix Q
Baseline Surface Water Quality Report

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TEST REPORT

Our Reference No.	:	**R235889**	Date Received	:	20/07/2023
Project Code / Ref.	:	Sembawang	Date Commenced	:	20/07/2023
			Date Reported	:	31/07/2023
Customer Ref. No.	:	60702777			
Customer Name	:	AECOM Singapore Pte Ltd			
Customer Address	:	300 Beach Road #23-00 The Concourse Singapore 199555			
Attention To		Ms Celine Cho			
Sample Description	:	9 Water samples as per received.			
RESULTS	:	Refer to Page 2 to 3			

Tan Thuan Piang
Senior 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.

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Branch (Site and Laboratory): 216 Tuas South Ave 2, West Point Bizhub Singapore 637213 ☎ : +65 6262 3736 (Lab) ☎ : +65 6262 3726 / 3776 (Site)
Website: www.mls.sg

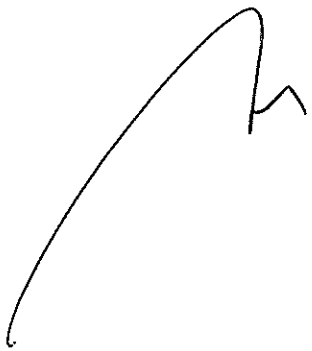
R235889

RESULTS

Test Parameter	Unit	Test Method	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
			WQ1	WQ2	WQ3	WQ4	WQ5
			20/07/2023	20/07/2023	20/07/2023	20/07/2023	20/07/2023
Total Suspended Solids, TSS	mg/L	APHA 2540D	16.8	23.9	19.7	18.0	39.3
Total Dissolved Solids, TDS	mg/L	APHA 2540C	94.0	69.0	64.0	68.0	92.0
Phosphate as PO4-P	mg/L	APHA 4500-P (G)	0.031	0.030	0.028	0.030	0.040
Total Phosphorus as TP	mg/L	APHA 4500-P (J)	0.046	0.052	0.048	0.045	0.057
Nitrate as NO3-N	mg/L	APHA 4500-NO3 (I)	1.56	0.54	0.57	0.61	0.65
Total Nitrogen as TN	mg/L	APHA 4500-P (J)	3.10	1.39	1.24	1.27	1.28

Note:

1. APHA is a standard method for Determination of Water and Waste Water (APHA 24th Edition, 2023)
2. LOR = Limit of Reporting. This value may also represent Detection Limit required for the project.



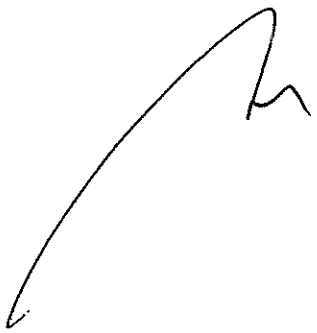
R235889

RESULTS

Test Parameter	Unit	Test Method	Sample 6 WQ6 20/07/2023	Sample 7 WQ7 20/07/2023	Sample 8 WQ8 20/07/2023	Sample 9 WQ9 20/07/2023	LOR
Total Suspended Solids, TSS	mg/L	APHA 2540D	35.5	15.9	14.8	11.6	1
Total Dissolved Solids, TDS	mg/L	APHA 2540C	94.0	92.0	101	139	10
Phosphate as PO4-P	mg/L	APHA 4500-P (G)	0.039	0.038	0.038	0.048	0.005
Total Phosphorus as TP	mg/L	APHA 4500-P (J)	0.049	0.044	0.047	0.056	0.01
Nitrate as NO3-N	mg/L	APHA 4500-NO3 (I)	0.65	0.72	0.76	0.77	0.005
Total Nitrogen as TN	mg/L	APHA 4500-P (J)	1.24	1.41	1.39	1.41	0.01

Note:

1. APHA is a standard method for Determination of Water and Waste Water (APHA 24th Edition, 2023)
2. LOR = Limit of Reporting. This value may also represent Detection Limit required for the project.



MARCHWOOD LABORATORY SERVICES PTE LTD

MLS-QF 001 Rev (4), Mar 2017

CHAIN OF CUSTODY DOCUMENT / ANALYSIS REQUEST

20 JUL 2023 (21/7)

Priority Queue / Urgent / Report Needed by: _____

1/2

CLIENT	: AECOM
CONTACT (Name / Tel / email)	: Celine Cho qianceline.cho1@aecom.com
ADDRESS / COUNTRY	:
PROJECT Code / Ref.	: 60702777
SITE	: Sembawang
QUOTATION / JOB REQUEST / PO No.	:
SEND REPORT TO	: qianceline.cho1@aecom.com grujica.sarenac@aecom.com
COMMENT / SPECIAL INSTRUCTION	:
STORAGE / DISPOSAL	:

MLS LAB USE ONLY

Job No.: P2255889

PRESERVATION DONE:

☐ On Site

☐ By Lab

Cold Box temp. at receipt: ____°C (if applicable)

☐ Sampling done by MLS

S/N	SAMPLE ID / LOCATION	SAMPLING DEPTH (m)	MATRIX* (Water/Soil/Sand/Sed/Sludge/Air)	DATE (DD/MM/YY)	TIME (HRS)	TOTAL NOs OF CONTAINERS# / SAMPLING MEDIA$	STORAGE CONDITION**	Sample Seal (Y / N) ☐ Tick if all sealed	ANALYSIS PARAMETER (Enter "x" below to indicate Request) Table A	REMARKS / OBSERVATION / SAMPLE CONDITION
1	WQ1		W	20-Jul-23		2P	C		x	
2	WQ2		W	20-Jul-23		2P	C		x	
3	WQ3		W	20-Jul-23		2P	C		x	
4	WQ4		W	20-Jul-23		2P	C		x	
5	WQ5		W	20-Jul-23		2P	C		x	
6	WQ6		W	20-Jul-23		2P	C		x	
7	WQ7		W	20-Jul-23		2P	C		x	
8	WQ8		W	20-Jul-23		2P	C		x	
9	WQ9		W	20-Jul-23		2P	C		x	
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

RELINQUISHED BY:	DATE / TIME
Name: Celine	20/7/2023
Sign: celine	hrs
Company: AECOM	

RECEIVED BY:	DATE / TIME
Name: [illegible]	20/7/23
Sign: [illegible]	1630 hrs
Company: [illegible]	

RELINQUISHED BY:	DATE / TIME
Name:	
Sign:	hrs
Company:	

RECEIVED BY:	DATE / TIME
Name:	
Sign:	hrs
Company:	

SHIPMENT BY COURIER:

Courier Co. / Carrier Name:

Consignment Note/Airway Bill:

* = For Water sample: Please Indicate FW (Fresh Water), SW (Seawater), BW (Ballast Water), DW (Drinking Water), GW (Ground water), WW (Wastewater), OW (Other type of water e.g. canal/storm water)

Type of Sampling Containers/Bottles: G = Glass; P = Plastic; T = Tube; V = VOC vial; S = Steriled bottle/bag; B = Bag.

$ Type of Sampling Media: ST = Sorbent Tube; IM = Impinger solution; F = Filter; RT = Resin Trap; AP = Agar Plate; W = Wipe Sample; Others (PUF, etc. - please specify).

** Storage Condition: C = Refrigerate at 4 °C; R = Room Temperature; P = Preserved as per Lab's instruction.

Aqum R235889 9 Samples

Table A 20 JUL 2023 (2/7)

Test parameter
Total Suspended Solids
Total Dissolved Solids
Phosphate (PO_4) as P
Total Phosphorus
Nitrate (NO_3) as N
Total Nitrogen

TEST REPORT

Our Reference No.	:	**R235938**	Date Received	:	24/07/2023
Project Code / Ref.	:	Sembawang	Date Commenced	:	24/07/2023
			Date Reported	:	01/08/2023
Customer Ref. No.	:	60702777			
Customer Name	:	AECOM Singapore Pte Ltd			
Customer Address	:	300 Beach Road #23-00 The Concourse Singapore 199555			
Attention To		Mr Grujica Sarenac			
Sample Description	:	11 Water samples as per received.			
RESULTS	:	Refer to Page 2 to 3			

Tan Thuan Piang
Senior Technical Manager

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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.

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Branch (Site and Laboratory): 216 Tuas South Ave 2, West Point Bizhub Singapore 637213 ☎ : +65 6262 3736 (Lab) ☎ : +65 6262 3726 / 3776 (Site)
Website: www.mls.sg

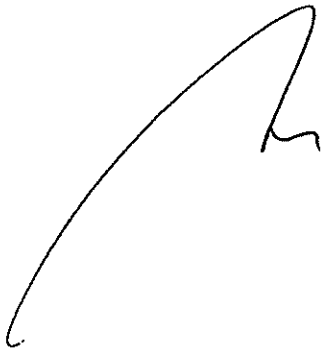
R235938

RESULTS

Test Parameter	Unit	Test Method	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
			WQ1	WQ2	WQ3	WQ4	WQ5	WQ6
			24/07/2023	24/07/2023	24/07/2023	24/07/2023	24/07/2023	24/07/2023
Total Suspended Solids, TSS	mg/L	APHA 2540D	48.7	20.8	12.9	6.71	5.71	22.5
Total Dissolved Solids, TDS	mg/L	APHA 2540C	115	158	152	153	159	171
Phosphate as PO4-P	mg/L	APHA 4500-P (G)	0.035	0.038	0.040	0.044	0.046	0.045
Total Phosphorus as TP	mg/L	APHA 4500-P (J)	0.047	0.054	0.068	0.069	0.062	0.068
Nitrate as NO3-N	mg/L	APHA 4500-NO3 (I)	0.046	0.094	0.13	0.11	0.11	0.12
Total Nitrogen as TN	mg/L	APHA 4500-P (J)	0.81	1.13	1.08	0.94	1.03	1.09

Note:

1. APHA is a standard method for Determination of Water and Waste Water (APHA 24th Edition, 2023)
2. LOR = Limit of Reporting. This value may also represent Detection Limit required for the project.



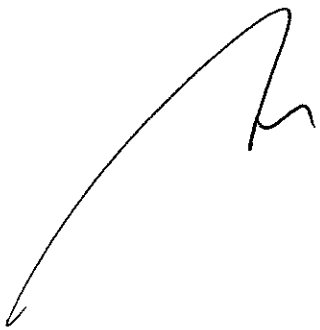
R235938

RESULTS

Test Parameter	Unit	Test Method	Sample 7 WQ7 24/07/2023	Sample 8 WQ8 24/07/2023	Sample 9 WQ9 24/07/2023	Sample 10 WQ10 24/07/2023	Sample 11 WQ11 24/07/2023	LOR
Total Suspended Solids, TSS	mg/L	APHA 2540D	16.8	12.0	2.86	3.90	5.30	1
Total Dissolved Solids, TDS	mg/L	APHA 2540C	180	190	674	25,121	24,413	10
Phosphate as PO4-P	mg/L	APHA 4500-P (G)	0.047	0.049	0.097	0.075	0.075	0.005
Total Phosphorus as TP	mg/L	APHA 4500-P (J)	0.072	0.074	0.13	0.083	0.085	0.01
Nitrate as NO3-N	mg/L	APHA 4500-NO3 (I)	0.12	0.13	0.077	0.20	0.19	0.005
Total Nitrogen as TN	mg/L	APHA 4500-P (J)	1.08	1.14	1.52	0.83	0.91	0.01

Note:

1. APHA is a standard method for Determination of Water and Waste Water (APHA 24th Edition, 2023)
2. LOR = Limit of Reporting. This value may also represent Detection Limit required for the project.



MARCHWOOD LABORATORY SERVICES PTE LTD

CHAIN OF CUSTODY DOCUMENT / ANALYSIS REQUEST

24 JUL 2023

Priority Queue / Urgent / Report Needed by: _____

CLIENT	: AECOM
CONTACT (Name / Tel / email)	: Grujica Sarenac grujica.sarenac@aecom.com
ADDRESS / COUNTRY	:
PROJECT Code / Ref.	: 60702777
SITE	: Sembawang
QUOTATION / JOB REQUEST / PO No.	:
SEND REPORT TO	: grujica.sarenac@aecom.com
COMMENT / SPECIAL INSTRUCTION	:
STORAGE / DISPOSAL	:

MLS LAB USE ONLY

Job No.: R235938

PRESERVATION DONE:

☐ On Site

☐ By Lab

Cold Box temp. at receipt: ____°C (if applicable)

☐ Sampling done by MLS

S/N	SAMPLE ID / LOCATION	SAMPLING DEPTH (m)	MATRIX* (Water/Soil/Sand/ Sed/Sludge/Air)	DATE (DD/MM/YY)	TIME (HRS)	TOTAL NOs OF CONTAINERS# / SAMPLING MEDIA$	STORAGE CONDITION**	Tick if all ☐ sealed / Sample Seal (Y / N)	ANALYSIS PARAMETER (Enter "x" below to indicate Request) Table A										REMARKS / OBSERVATION / SAMPLE CONDITION
1	WQ1		W	24-Jul-23		2P	C		x										
2	WQ2		W	24-Jul-23		2P	C		x										
3	WQ3		W	24-Jul-23		2P	C		x										
4	WQ4		W	24-Jul-23		2P	C		x										
5	WQ5		W	24-Jul-23		2P	C		x										
6	WQ6		W	24-Jul-23		2P	C		x										
7	WQ7		W	24-Jul-23		2P	C		x										
8	WQ8		W	24-Jul-23		2P	C		x										
9	WQ9		W	24-Jul-23		2P	C		x										
10	WQ10		W	24-Jul-23		2P	C		x										
11	WQ11		W	24-Jul-23		2P	C		x										
12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
20																			

RELINQUISHED BY:		DATE / TIME
Name:	Grujica	7/24/2023
Sign:	Gru	
Company:	AECOM	hrs

RECEIVED BY:		DATE / TIME
Name:	CJL	24/7/23
Sign:		1700 hrs
Company:	MLS	

RELINQUISHED BY:		DATE / TIME
Name:		
Sign:		
Company:		hrs

RECEIVED BY:		DATE / TIME
Name:		
Sign:		
Company:		hrs

SHIPMENT BY COURIER:

Courier Co. / Carrier Name:

Consignment Note/Airway Bill:

* = **For Water sample:** Please indicate FW (Fresh Water), SW (Seawater), BW (Ballast Water), DW (Drinking Water), GW (Ground water), WW (Wastewater), OW (Other type of water e.g. canal/storm water)

\# **Type of Sampling Containers/Bottles:** G = Glass; P = Plastic; T = Tube; V = VOC vial; S = Steriled bottle/bag; B = Bag.

** **Storage Condition:** C = Refrigerate at 4 °C; R = Room Temperature; P = Preserved as per Lab's instruction.

$ **Type of Sampling Media:** ST = Sorbent Tube; IM = Impinger solution; F = Filter; RT = Resin Trap; AP = Agar Plate; W = Wipe Sample; Others (PUF, etc. - please specify).

24 JUL 2023

R235938

Aecom

11 samples

Table A

Test parameter
Total Suspended Solids
Total Dissolved Solids
Phosphate (PO_4) as P
Total Phosphorus
Nitrate (NO_3) as N
Total Nitrogen

TEST REPORT

Our Reference No.	:	**R237401**	Date Received	:	13/09/2023
Project Code / Ref.	:	Sembawang	Date Commenced	:	13/09/2023
			Date Reported	:	19/09/2023
Customer Ref. No.	:	60702777			
Customer Name	:	AECOM Singapore Pte Ltd			
Customer Address	:	300 Beach Road #23-00 The Concourse Singapore 199555			
Attention To		Ms. Tan Yi Leng			
Sample Description	:	11 Water samples as per received.			
RESULTS	:	Refer to Page 2 to 3			

Tan Thuan Piang
Senior Technical Manager

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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.

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Branch (Site and Laboratory): 216 Tuas South Ave 2, West Point Bizhub Singapore 637213 ☎ : +65 6262 3736 (Lab) ☎ : +65 6262 3726 / 3776 (Site)
Website: www.mls.sg

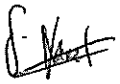
R237401

RESULTS

Test Parameter	Unit	Test Method	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
			WQ1	WQ2	WQ3	WQ4	WQ5	WQ6
			13/09/2023	13/09/2023	13/09/2023	13/09/2023	13/09/2023	13/09/2023
Total Suspended Solids, TSS	mg/L	APHA 2540D	9.20	15.6	10.1	7.20	5.50	8.20
Total Dissolved Solids, TDS	mg/L	APHA 2540C	121	163	158	158	159	171
Phosphate as PO4-P	mg/L	APHA 4500-P (G)	0.031	0.032	0.035	0.037	0.039	0.038
Total Phosphorus as TP	mg/L	APHA 4500-P (J)	0.034	0.040	0.038	0.038	0.041	0.049
Nitrate as NO3-N	mg/L	APHA 4500-NO3 (I)	0.068	0.14	0.18	0.16	0.17	0.18
Total Nitrogen as TN	mg/L	APHA 4500-P (J)	0.74	1.12	0.99	1.03	1.00	1.08

Note:

1. APHA is a standard method for Determination of Water and Waste Water (APHA 24th Edition, 2023)
2. LOR = Limit of Reporting. This value may also represent Detection Limit required for the project.



R237401

RESULTS

Test Parameter	Unit	Test Method	Sample 7 WQ7 13/09/2023	Sample 8 WQ8 13/09/2023	Sample 9 WQ9 13/09/2023	Sample 10 WQ10 13/09/2023	Sample 11 WQ11 13/09/2023	LOR
Total Suspended Solids, TSS	mg/L	APHA 2540D	8.40	9.80	6.90	3.30	3.10	1
Total Dissolved Solids, TDS	mg/L	APHA 2540C	176	196	698	15,087	19,310	10
Phosphate as PO4-P	mg/L	APHA 4500-P (G)	0.039	0.039	0.072	0.21	0.22	0.005
Total Phosphorus as TP	mg/L	APHA 4500-P (J)	0.048	0.048	0.072	0.23	0.23	0.01
Nitrate as NO3-N	mg/L	APHA 4500-NO3 (I)	0.16	0.16	0.082	0.38	0.18	0.005
Total Nitrogen as TN	mg/L	APHA 4500-P (J)	1.07	1.09	1.11	1.54	1.54	0.01

Note:

1. APHA is a standard method for Determination of Water and Waste Water (APHA 24th Edition, 2023)
2. LOR = Limit of Reporting. This value may also represent Detection Limit required for the project.



MARCHWOOD LABORATORY SERVICES PTE LTD

MLS-QF 001 Rev (4), Mar 2017
Page 1 of 1

CHAIN OF CUSTODY DOCUMENT / ANALYSIS REQUEST

13 SEP 2023

Priority Queue / Urgent / Report Needed by: _____

CLIENT	: AECOM
CONTACT (Name / Tel / email)	: Tan Yi Leng YiLeng.Tan@aecom.com
ADDRESS / COUNTRY	:
PROJECT Code / Ref.	: 60702777
SITE	: Sembawang
QUOTATION / JOB REQUEST / PO No.	:
SEND REPORT TO	: YiLeng.Tan@aecom.com grujica.sarenac@aecom.com
COMMENT / SPECIAL INSTRUCTION	:
STORAGE / DISPOSAL	:

MLS LAB USE ONLY

Job No.: R237401

PRESERVATION DONE:

☐ On Site
☐ By Lab

Cold Box temp. at receipt: ____°C (if applicable)

☐ Sampling done by MLS

S/N	SAMPLE ID / LOCATION	SAMPLING DEPTH (m)	MATRIX* (Water/Soil/Sand/ Sed/Sludge/Air)	DATE (DD/MM/YY)	TIME (HRS)	TOTAL NOs OF CONTAINERS# / SAMPLING MEDIA$	STORAGE CONDITION**	Sample Seal (Y / N) ☐ Tick if all sealed	ANALYSIS PARAMETER (Enter "x" below to indicate Request) Table A	REMARKS / OBSERVATION / SAMPLE CONDITION
1	WQ1		W	13/09/23		2P	C		x	
2	WQ2		W	13/09/23		2P	C		x	
3	WQ3		W	13/09/23		2P	C		x	
4	WQ4		W	13/09/23		2P	C		x	
5	WQ5		W	13/09/23		2P	C		x	
6	WQ6		W	13/09/23		2P	C		x	
7	WQ7		W	13/09/23		2P	C		x	
8	WQ8		W	13/09/23		2P	C		x	
9	WQ9		W	13/09/23		2P	C		x	
10	WQ10		W	13/09/23		2P	C		x	
11	WQ11		W	13/09/23		2P	C		x	
12										
13										
14										
15										
16										
17										
18										
19										
20										

RELINQUISHED BY:	DATE / TIME
Name: Yi Leng	13/09/2023
Sign: yileng	hrs
Company: AECOM	

RECEIVED BY:	DATE / TIME
Name: CYC	13/9/23
Sign:	1330 hrs
Company: MLS	

RELINQUISHED BY:	DATE / TIME
Name:	
Sign:	hrs
Company:	

RECEIVED BY:	DATE / TIME
Name:	
Sign:	hrs
Company:	

SHIPMENT BY COURIER:

Courier Co. / Carrier Name:

Consignment Note/Airway Bill:

* = **For Water sample:** Please Indicate FW (Fresh Water), SW (Seawater), BW (Ballast Water), DW (Drinking Water), GW (Ground water), WW (Wastewater), OW (Other type of water e.g. canal/storm water)

\# **Type of Sampling Containers/Bottles:** G = Glass; P = Plastic; T = Tube; V = VOC vial; S = Steriled bottle/bag; B = Bag.

$ **Type of Sampling Media:** ST = Sorbent Tube; IM = Impinger solution; F = Filter; RT = Resin Trap; AP = Agar Plate; W = Wipe Sample; Others (PUF, etc. - please specify).

** **Storage Condition:** C = Refrigerate at 4 °C; R = Room Temperature; P = Preserved as per Lab's instruction.

Table A

Test parameter
Total Suspended Solids
Total Dissolved Solids
Phosphate (PO_4) as P
Total Phosphorus
Nitrate (NO_3) as N
Total Nitrogen

13 SEP 2023

R237401

11 spls

MLS

TEST REPORT

Our Reference No.	:	**R239001**	Date Received	:	16/11/2023
Project Code / Ref.	:	Sembawang	Date Commenced	:	16/11/2023
			Date Reported	:	24/11/2023
Customer Ref. No.	:	60702777			
Customer Name	:	AECOM Singapore Pte Ltd			
Customer Address	:	300 Beach Road #23-00 The Concourse Singapore 199555			
Attention To		Ms. Tan Yi Leng			
Sample Description	:	2 Water samples as per received.			
RESULTS	:	Refer to Page 2			

Tan Thuan Piang
Senior Technical Manager

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Branch (Site and Laboratory): 216 Tuas South Ave 2, West Point Bizhub Singapore 637213 ☎ : +65 6262 3736 (Lab) ☎ : +65 6262 3726 / 3776 (Site)
Website: www.mls.sg

R239001

RESULTS

Test Parameter	Unit	Test Method	Sample 1 WQ10 16/11/2023	Sample 2 WQ11 16/11/2023	LOR
Total Suspended Solids, TSS	mg/L	APHA 2540D	33.7	39.0	1
Total Dissolved Solids, TDS	mg/L	APHA 2540C	3,813	4,760	10
Phosphate as PO4-P	mg/L	APHA 4500-P (G)	0.031	0.032	0.005
Total Phosphorus as TP	mg/L	APHA 4500-P (J)	0.041	0.040	0.01
Nitrate as NO3-N	mg/L	APHA 4500-NO3 (I)	0.62	0.62	0.005
Total Nitrogen as TN	mg/L	APHA 4500-P (J)	1.13	1.13	0.01
Turbidity	NTU	APHA 2130B	17	18	0.01

Note:

1. APHA is a standard method for Determination of Water and Waste Water (APHA 24th Edition, 2023)
2. LOR = Limit of Reporting. This value may also represent Detection Limit required for the project.

CHAIN OF CUSTODY DOCUMENT / ANALYSIS REQUEST

16 NOV 2023 (17/11)

Priority Queue / Urgent / Report Needed by: _____

1 | 2

CLIENT	: AECOM
CONTACT (Name / Tel / email)	: Grujica Sarenac grujica.sarenac@aecom.com
ADDRESS / COUNTRY	:
PROJECT Code / Ref.	: 60702777
SITE	: Sembawang
QUOTATION / JOB REQUEST / PO No.	:
SEND REPORT TO	: grujica.sarenac@aecom.com, yileng.tan@aecom.com
COMMENT / SPECIAL INSTRUCTION	:
STORAGE / DISPOSAL	:

MLS LAB USE ONLY

Job No.: ~~R238~~ R239001

PRESERVATION DONE:
- ☐ On Site
- ☐ By Lab

Cold Box temp. at receipt: ____°C (If applicable)

☐ Sampling done by MLS

S/N	SAMPLE ID / LOCATION	SAMPLING DEPTH (m)	MATRIX* (Water/Soil/Sand/Sed/Sludge/Air)	DATE (DD/MM/YY)	TIME (HRS)	TOTAL NOs OF CONTAINERS# / SAMPLING MEDIA$	STORAGE CONDITION**	Sample Seal (Y / N) ☐ Tick if all sealed	ANALYSIS PARAMETER (Enter "x" below to indicate Request) Table A										REMARKS / OBSERVATION / SAMPLE CONDITION
1	WQ10		W	16-Nov-23		2P	C		x										
2	WQ11		W	16-Nov-23		2P	C		x										
3																			
4																			
5																			
6																			
7																			
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10																			
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12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
20																			

RELINQUISHED BY:	DATE / TIME
Name: Grujica	16/11/2023
Sign: Grujica	hrs
Company: AECOM	

RECEIVED BY:	DATE / TIME
Name: LY	16/11/23
Sign:	1700 hrs
Company: MLS	

RELINQUISHED BY:	DATE / TIME
Name:	
Sign:	hrs
Company:	

RECEIVED BY:	DATE / TIME
Name:	
Sign:	hrs
Company:	

SHIPMENT BY COURIER:
Courier Co. / Carrier Name:

Consignment Note/Airway Bill:

* = For Water sample: Please indicate FW (Fresh Water), SW (Seawater), BW (Ballast Water), DW (Drinking Water), GW (Ground water), WW (Wastewater), OW (Other type of water e.g. canal/storm water)

Type of Sampling Containers/Bottles: G = Glass; P = Plastic; T = Tube; V = VOC vial; S = Steriled bottle/bag; B = Bag.

** Storage Condition: C = Refrigerate at 4 °C; R = Room Temperature; P = Preserved as per Lab's instruction.

$ Type of Sampling Media: ST = Sorbent Tube; IM = Impinger solution; F = Filter; RT = Resin Trap; AP = Agar Plate; W = Wipe Sample; Others (PUF, etc. - please specify).

(AECOM)

16 NOV 2023 (17:11) 2/2

~~R239001~~ 21/11 R239001

2 samples

Table A

Test parameter
Total Suspended Solids
Total Dissolved Solids
Phosphate (PO_4) as P
Total Phosphorus
Nitrate (NO_3) as N
Total Nitrogen
Turbidity

Appendix R
Groundwater Borelogs

Delivering a better world

BOREHOLE LOG BH01

PROJECT NUMBER 60702777 **DATE** 17 Oct 23
PROJECT NAME HDB Sembawang N4 EIA
LOCATION Sembawang
DRILLING METHOD Hand Auger
SAMPLING METHOD Grab

LOGGED BY SN **WATER FIRST NOTICED (m BGS)** 1.1
COMMENTS Borehole approximately 6 m away from stream.

RECOVERY	SAMPLE ID	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
					TOPSOIL	Topsoil.	0.20
					MLS	Claey SILT, Pale brown, Moist, Firm, Moderate plasticity, No sheen, No odour.	0.50
			0.5		MLS	Some coarse grain, poorly graded sand inclusions.	
			1.0		MLS	Wet	1.10
			1.5				
			2.0		MLS	Total Depth: 2.00 m	2.00

HDB N4 SEMBAWANG EIA_00.GPJ 23/10/23

BOREHOLE LOG BH02

PROJECT NUMBER 60702777 **DATE** 17 Oct 23
PROJECT NAME HDB Sembawang N4 EIA
LOCATION Sembawang
DRILLING METHOD Hand Auger
SAMPLING METHOD Grab

LOGGED BY SN **WATER FIRST NOTICED (m BGS)** 1.6
COMMENTS Borehole approximately 8 m away from stream.

RECOVERY	SAMPLE ID	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
			0		TOPSOIL	Topsoil.	0.20
					ML	SILT, Orange, Moist, Firm, Low plasticity, No sheen, No odour.	
			0.5				
			1.0		ML	Some grey inclusions	1.00
			1.5		ML	Wet	1.60
			2.0				
			2.5		SP-SM	Silty SAND, Dark brown, Wet, Loose, Coarse grained, Poorly grade sand, with some wooden debris	2.50
			3.0		SP-SM	Total Depth: 3.00 m	3.00

HDB N4 SEMBAWANG EIA_00.GPJ 23/10/23

BOREHOLE LOG BH03

PROJECT NUMBER 60702777 **DATE** 17 Oct 23
PROJECT NAME HDB Sembawang N4 EIA
LOCATION Sembawang
DRILLING METHOD Hand Auger
SAMPLING METHOD Grab

LOGGED BY SN **WATER FIRST NOTICED (m BGS)** 1.3
COMMENTS Borehole approximately 4 m away from stream.

RECOVERY	SAMPLE ID	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
					TOPSOIL	Topsoil.	0.20
					ML	SILT, Orange, Moist, Firm, Low plasticity, No sheen, No odour.	0.50
			0.5		ML	Pale brown, Moderate plasticity	
			1.0				1.30
					MLS	Silty CLAY, Light brown, Wet, Firm, Moderate plasticity, No sheen, No odour	
			1.5				
			2.0				2.30
					MLS	Some coarse grained sand inclusions, poorly graded	2.50
			2.5		MLS	Total Depth: 2.50 m	

HDB N4 SEMBAWANG EIA_00.GPJ 23/10/23

BOREHOLE LOG BH04

PROJECT NUMBER 60702777 **DATE** 17 Oct 23
PROJECT NAME HDB Sembawang N4 EIA
LOCATION Sembawang
DRILLING METHOD Hand Auger
SAMPLING METHOD Grab

LOGGED BY SN **WATER FIRST NOTICED (m BGS)** 1.2
COMMENTS Borehole approximately 9 m away from stream.

RECOVERY	SAMPLE ID	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
					TOPSOIL	Topsoil.	0.20
					MLS	Claey SILT, Orange, Moist, Firm, Moderate plasticity, No sheen, No odour.	
			0.5		MLS	Light brown	0.50
			1.0		MLS	Wet	1.20
			1.5				
			2.0				
					MLS	Total Depth: 2.20 m	2.20

HDB N4 SEMBAWANG EIA_00.GPJ 23/10/23

BOREHOLE LOG BH05

PROJECT NUMBER 60702777 **DATE** 17 Oct 23
PROJECT NAME HDB Sembawang N4 EIA
LOCATION Sembawang
DRILLING METHOD Hand Auger
SAMPLING METHOD Grab

LOGGED BY SN **WATER FIRST NOTICED (m BGS)** 1.5
COMMENTS Borehole approximately 5 m away from stream.

RECOVERY	SAMPLE ID	ANALYSED	DEPTH (m BGL)	GRAPHIC LOG	USCS CLASS	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
					TOPSOIL	Topsoil.	0.20
			0.5		ML	SILT, Dark brown, Moist, Soft, Low plasticty, No Sheen, No odour	
			1.0		MLS	Claey SILT, Brown with orange inlcusions, Moist, Firm, Low plasticity, No sheen, No odour.	1.00
			1.5		MLS	Light brown, Wet, Moderate plasticity	1.50
			2.0				
			2.5				
			3.0		MLS	Total Depth: 3.00 m	3.00

HDB N4 SEMBAWANG EIA_00.GPJ 23/10/23

Appendix S
Baseline Airborne Noise Monitoring Report

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ONE WEEK OVERALL/AVERAGE

Location	Date of Monitoring	$L_{Aeq(12\ hour)}$, dB		$L_{Aeq(1\ hour)}$, dB						$L_{Aeq(5\ min)}$, dB									$L_{Aeq(15\ min)}$, dB								
		7am-7pm	7pm-7am	7pm - 10pm			10pm - 7am			7am-7pm			7pm-10pm			10pm-7am			7am-7pm			7pm-11pm			11pm-7am		
		Overall		Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
NM01: Sembawang	08 August 2023 - 14 August 2023	54	44	43	55	45	41	46	44	42	78	50	41	61	45	40	51	43	43	77	50	42	58	45	40	49	43
NM01: Sembawang (remove rainfall)	08 August 2023 - 14 August 2023	50	44	43	55	45	41	46	44	42	63	47	41	61	45	40	51	43	41	60	47	42	58	45	40	49	43

MONDAY - SATURDAYS

Location	Date of Monitoring	$L_{Aeq(12\ hour)}$, dB		$L_{Aeq(1\ hour)}$, dB						$L_{Aeq(5\ min)}$, dB									$L_{Aeq(15\ min)}$, dB								
		7am-7pm	7pm-7am	7pm - 10pm			10pm - 7am			7am-7pm			7pm-10pm			10pm-7am			7am-7pm			7pm-11pm			11pm-7am		
		Overall		Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
NM01: Sembawang	08 August 2023 - 14 August 2023	52	44	43	55	45	41	46	44	43	74	50	41	61	45	40	51	44	44	73	50	42	58	45	40	49	43
NM01: Sembawang (remove rainfall)	08 August 2023 - 14 August 2023	50	44	43	55	45	41	46	44	43	63	48	41	61	45	40	51	44	44	60	48	42	58	45	40	49	43

SUNDAYS

Location	Date of Monitoring	$L_{Aeq(12\ hour)}$, dB		$L_{Aeq(1\ hour)}$, dB						$L_{Aeq(5\ min)}$, dB									$L_{Aeq(15\ min)}$, dB								
		7am-7pm	7pm-7am	7pm - 10pm			10pm - 7am			7am-7pm			7pm-10pm			10pm-7am			7am-7pm			7pm-11pm			11pm-7am		
		Overall		Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
NM01: Sembawang	08 August 2023 - 14 August 2023	63	44	43	45	44	41	45	43	42	78	50	41	46	44	40	49	43	43	77	51	42	46	44	41	48	42
NM01: Sembawang (remove rainfall)	08 August 2023 - 14 August 2023	49	44	43	45	44	41	45	43	42	57	43	41	46	44	40	49	43	41	54	44	42	46	44	41	48	42

Appendix T
Auditory Sensitivity Fauna List

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Type	Family	Receptor (scientific name)	Receptor (common name)	Global status (IUCN/CITES)	National status	Species.of.Conservation.Significance	Auditory sensitivity
Bee	*Megachilidae*	Anthidiellum smithii		Not Listed	Vulnerable	Yes	Priority 1
Bee	*Halictidae*	Lipotriches takauensis		Not Listed	Vulnerable	Yes	Priority 1
Bee	*Megachilidae*	Megachile ornata		Not Listed	Vulnerable	Yes	Priority 1
Bee	*Megachilidae*	Megachile ramera		Not Listed	Vulnerable	Yes	Priority 1
Bird	*Acrocephalidae*	Acrocephalus orientalis	Oriental reed warbler	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Scolopacidae*	Actitis hypoleucos	Common sandpiper	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Apodidae*	Apus nipalensis	House swift	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Ardeidae*	Ardea alba	Great egret	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Ardeidae*	Ardea purpurea	Purple heron	Least Concern	Endangered	Yes	Priority 1
Bird	*Cuculidae*	Chrysococcyx xanthorhynchus	Violet cuckoo	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Cisticolidae*	Cisticola juncidis	Zitting cisticola	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Apodidae*	Collocalia affinis	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Muscicapidae*	Copsychus saularis	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Corvidae*	Corvus macrorhynchos	Large-billed crow	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Dicruridae*	Dicrurus macrocercus	Black drongo	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Columbidae*	Ducula aenea	Green imperial pigeon	Least Concern	Endangered	Yes	Priority 1
Bird	*Accipitridae*	Elanus caeruleus	Black-winged kite	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Rallidae*	Gallicrex cinerea	Watercock	Least Concern	Endangered	Yes	Priority 1
Bird	*Scolopacidae*	Gallinago gallinago	Common snipe	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Scolopacidae*	Gallinago megala	Swinhoe's snipe	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Scolopacidae*	Gallinago stenura	Pin-tailed snipe	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Ardeidae*	Ixobrychus cinnamomeus	Cinnamon bittern	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Ardeidae*	Ixobrychus sinensis	Yellow bittern	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Strigidae*	Ketupa ketupu	Buffy fish owl	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Laniidae*	Lanius cristatus	Brown shrike	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Estrildidae*	Lonchura atricapilla	Chestnut munia	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Estrildidae*	Lonchura striata	White-rumped munia	Least Concern	Critically Endangered	Yes	Priority 1
Bird	*Accipitridae*	Nisaetus cirrhatus	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Ardeidae*	Nycticorax nycticorax	Black-crowned night heron	Least Concern	Endangered	Yes	Priority 1
Bird	*Ploceidae*	Ploceus philippinus	Baya weaver	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Rallidae*	Poliolimnas cinereus	White-browed crake	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Psittaculidae*	Psittacula longicauda	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Priority 1
Bird	*Psittaculidae*	Psittinus cyanurus	Blue-rumped parrot	Near Threatened	Endangered	Yes	Priority 1
Bird	*Columbidae*	Ptilinopus jambu	Jambu fruit dove	Near Threatened	Vulnerable	Yes	Priority 1
Bird	*Pycnonotidae*	Pycnonotus zeylanicus	Straw-headed bulbul	Critically Endangered	Endangered	Yes	Priority 1
Bird	*Rostratulidae*	Rostratula benghalensis	Greater painted-snipe	Least Concern	Endangered	Yes	Priority 1
Bird	*Accipitridae*	Spilornis cheela	Crested serpent eagle	Least Concern	Critically Endangered	Yes	Priority 1
Bird	*Strigidae*	Strix seloputo	Spotted wood owl	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Cuculidae*	Surniculus lugubris	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Columbidae*	Treron curvirostra	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Columbidae*	Treron fulvicollis	Cinnamon-headed green pigeon	Near Threatened	Endangered	Yes	Priority 1
Bird	*Rallidae*	Zapornia pusilla	Baillon's crake	Least Concern	Vulnerable	Yes	Priority 1
Bird	*Zosteropidae*	Zosterops simplex	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Priority 1
Butterfly	*Lycaenidae*	Arhopala aurea		Not Listed	Endangered	Yes	Priority 1
Butterfly	*Lycaenidae*	Arhopala myrzala lammas	Malayan oakblue	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Hesperiidae*	Astictopterus jama jama	Forest hopper	Not Listed	Endangered	Yes	Priority 1
Butterfly	*Hesperiidae*	Caltoris philippina philippina	Philippine swift	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Lycaenidae*	Catochrysops strabo strabo	Forget-me-not	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Hesperiidae*	Cephrenes acalle niasicus	Plain palm dart	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Nymphalidae*	Discophora sondaica despoliata	Common duffer	Not Listed	Endangered	Yes	Priority 1
Butterfly	*Hesperiidae*	Eetion elia	White spot palmer	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Lycaenidae*	Everes lacturnus rileyi	Indian cupid	Not Listed	Endangered	Yes	Priority 1
Butterfly	*Hesperiidae*	Halpe ormenes vilasina	Dark banded ace	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Lycaenidae*	Horaga syrinx maenala	Ambon onyx	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Hesperiidae*	Pelopidas assamensis	Great swift	Not Listed	Endangered	Yes	Priority 1
Butterfly	*Hesperiidae*	Pelopidas conjunctus conjunctus	Conjoined swift	Not Listed	Endangered	Yes	Priority 1
Butterfly	*Hesperiidae*	Pemara pugnans	Pugnacious lancer	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Hesperiidae*	Pseudocoladenia dan dhyana	Fulvous pied flat	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Lycaenidae*	Rachana jalindra burbona	Banded royal	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Hesperiidae*	Tapena thwaitesi bornea	Dark flat	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Hesperiidae*	Telicota augias augias	Pale palm dart	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Hesperiidae*	Telicota linna	Linna palm dart	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Papilionidae*	Troides helena cerberus	Common birdwing	Not Listed	Vulnerable	Yes	Priority 1
Butterfly	*Lycaenidae*	Virachola kessuma deliochus	Pitcher blue	Not Listed	Endangered	Yes	Priority 1
Damselfly	*Platycnemididae*	Copera vittata	Variable featherlegs	Least Concern	Vulnerable	Yes	Priority 2
Freshwater fish	*Osphronemidae*	Trichopodus trichopterus	Threespot gourami	Least Concern	Vulnerable	Yes	Priority 2
Mammal	*Mustelidae*	Lutrogale perspicillata	Smooth-coated otter	Vulnerable	Endangered	Yes	Priority 1
Mammal	*Cercopithecidae*	Macaca fascicularis	Long-tailed macaque	Endangered	Least Concern	Yes	Priority 1
Mammal	*Manidae*	Manis javanica	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Priority 1
Mammal (bat)	*Molossidae*	Cheiromeles torquatus	Naked bulldog bat	Least Concern	Critically Endangered	Yes	Priority 2
Mammal (bat)	*Pteropodidae*	Eonycteris spelaea	Cave nectar bat	Least Concern	Vulnerable	Yes	Priority 1
Mammal (bat)	*Vespertilionidae*	Tylonycteris fulvida	Lesser bamboo bat	Not Listed	Vulnerable	Yes	Priority 2
Mammal (bat)	*Vespertilionidae*	Tylonycteris malayana	Greater bamboo bat	Least Concern	Vulnerable	Yes	Priority 2
Snake	*Colubridae*	Sibynophis melanocephalus	Black-headed collared snake	Least Concern	Vulnerable	Yes	Priority 2
Turtle	Geomydidae	*Cuora amboinensis*	Malayan box terrapin	Endangered	Near Threatened	Yes	Priority 2
Wasp	*Vespidae*	Parischnogaster unicuspata		Not Listed	Vulnerable	Yes	Priority 1

Appendix U
Equipment Inventory List

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Proposed Residential Development _Sembawang BTO Parcels

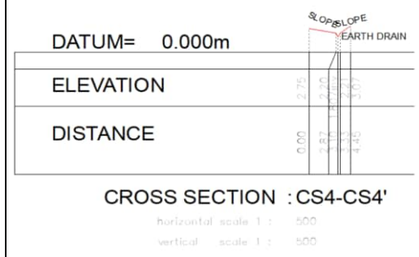
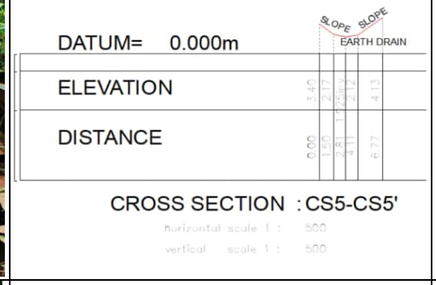
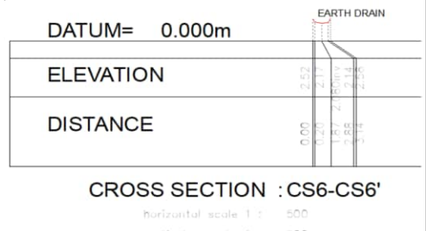
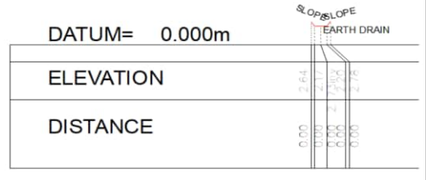
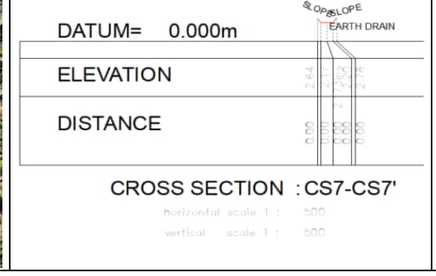
Note: Please kindly input based on one (1) Parcel (see list of BTO parcels below)

No.	Phase of Construction	PME	Approximate no of months for this activity (in months)	DAY - LAeq(12hrs) Activities 7:00am - 7:00pm: No [Quantity of that particular construction equipment used for that particular construction activity]	DAY - LAeq(12hrs) Activities 7:00am - 7:00pm: On-time(%) / daily working hours [how long in percentage that particular equipment will be used in a day]	DAY - LAeq(12hrs) Activities 7:00am - 7:00pm: PWL dB(A)	EVE - LAeq(3hrs) Activities 7:00pm - 10:00pm: No [Quantity of that particular construction equipment used for that particular construction activity]	EVE - LAeq(3hrs) Activities 7:00pm - 10:00pm: On-time(%) / daily working hours [how long in percentage that particular equipment will be used in a day]	EVE - LAeq(3hrs) Activities 7:00pm - 10:00pm: PWL dB(A)	NIGHT - LAeq(7hrs) Activities 10:00pm - 7:00am: No [Quantity of that particular construction equipment used for that particular construction activity]	NIGHT - LAeq(7hrs) Activities 10:00pm - 7:00am: On-time(%) / daily working hours [how long in percentage that particular equipment will be used in a day]	NIGHT - LAeq(7hrs) Activities 10:00pm - 7:00am: PWL dB(A)	DAY - LAeq(5mins) Activities 7:00am - 7:00pm: No [Quantity of that particular construction equipment used for that particular construction activity]	DAY - LAeq(5mins) Activities 7:00am - 7:00pm: On-time(%) / daily working hours [how long in percentage that particular equipment will be used in a day]	DAY - LAeq(5mins) Activities 7:00am - 7:00pm: PWL dB(A)	EVE - LAeq(5mins) Activities 7:00pm - 10:00pm: No [Quantity of that particular construction equipment used for that particular construction activity]	EVE - LAeq(5mins) Activities 7:00pm - 10:00pm: On-time(%) / daily working hours [how long in percentage that particular equipment will be used in a day]	EVE - LAeq(5mins) Activities 7:00pm - 10:00pm: PWL dB(A)	NIGHT - LAeq(5mins) Activities 10:00pm - 7:00am: No [Quantity of that particular construction equipment used for that particular construction activity]	NIGHT - LAeq(5mins) Activities 10:00pm - 7:00am: On-time(%) / daily working hours [how long in percentage that particular equipment will be used in a day]	NIGHT - LAeq(5mins) Activities 10:00pm - 7:00am: PWL dB(A)
1. Site Clearance and Earthworks - 30 months (from 4Q 2024 - 2Q 2027)																						
1	Site Clearance and Earthworks to prepare platform	Excavator	30	2	50%	106	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	100%	109	NA	NA	NA	NA	NA	NA
		Lorry	30	15	50%	116	NA	NA	NA	NA	NA	NA	NA	NA	NA	15	100%	119	NA	NA	NA	NA	NA	NA
		Generator	30	2	50%	106	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	100%	109	NA	NA	NA	NA	NA	NA
		Concrete Vibrator	30	1	50%	94	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	100%	97	NA	NA	NA	NA	NA	NA
		Air Compressor	30	1	50%	100	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	100%	103	NA	NA	NA	NA	NA	NA
2	Construction Access	Lorry	6	1	50%	104	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	100%	107	NA	NA	NA	NA	NA	NA
		Excavator	6	1	50%	98	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	100%	101	NA	NA	NA	NA	NA	NA
						117			NA						NA			120			NA			NA
2. Foundation Work (Substructures including piles and pile caps) - 30 months (from Jul 2025 - Dec 2027)																							
1	Erection of crawler crane & boring rig	Mobile Crane	6	1	90%	110	1	50%	107	1	90%	110	0	25%		1	100%	110	1	100%	110	0	0%	
2	Installation of Casing	Crawler Crane	27	2	90%	117	2	50%	114	2	90%	117	0	25%		2	100%	117	2	100%	117	0	0%	
3	Boring Work	Bored Piling Machine	27	4	90%	123	4	50%	120	4	90%	123	0	25%		4	100%	123	4	100%	123	0	0%	
4	Rebar Cage & Tremix Pipe Installation	Crawler Crane	27	2	90%	117	2	50%	114	2	90%	117	0	25%		2	100%	117	2	100%	117	0	0%	
5	Concreting works	Ready Mix Concrete Truck & Crawler Crane	27	2	90%	110	2	50%	107	2	90%	110	0	25%		2	100%	110	2	100%	110	0	0%	
6	Pile Head hacking	Excavator via breaker and 40 pounds breaker	27	2	90%	109	2	50%	106	2	90%	109	0	25%		2	100%	109	2	100%	109	0	0%	
7	Hot works - welding of steel beams, brackets, etc	Welding Equipment	27	1	90%	101	1	50%	98	1	90%	101	0	25%		1	100%	101	1	100%	101	0	0%	
8	Delivery of Steel sections	40 ft Trailer	27	2	90%	111	2	50%	108	2	90%	111	0	25%		2	100%	111	2	100%	111	0	0%	
9	Hoisting of Waler & Struts	Excavator with liftinx appliance	27	1	90%	106	1	50%	103	1	90%	106	0	25%		1	100%	106	1	100%	106	0	0%	
10	Stage excavation for walers & struts	Excavator with liftinx appliance	27	1	90%	106	1	50%	103	1	90%	106	0	25%		1	100%	106	1	100%	106	0	0%	
11	Stage Excavation	Excavator	27	4	90%	112	4	50%	109	4	90%	112	0	25%		4	100%	112	4	100%	112	0	0%	
		Mini Excavator	27	2	90%	99	2	50%	96	2	90%	99	0	25%		2	100%	99	2	100%	99	0	0%	
12	Spoil and slurry removal	Dump trucks	27	2	90%	110	2	50%	107	2	90%	110	0	25%		2	100%	110	2	100%	110	0	0%	
						125			123			125			NA			126			126			NA
3. Superstructure (Prefab installation) - 36 months (from Jul 2026 - Jun 2029)																							
1	Pumping of water from ground or rain	Temporary Water Pump	36	2	90%	96	2	50%	93	2	70%	94	2	70%	94	2	100%	96	2	100%	96	2	100%	96
2	Power supply for lighting, pumps and temporary ventilation	Generator	36	2	90%	109	2	50%	106	2	70%	107	2	70%	107	2	100%	109	2	100%	109	2	100%	109
3	Excavation below surface for working platform	Excavator	36	4	90%	112	4	50%	109	4	70%	110	4	70%	110	4	100%	112	4	100%	112	4	100%	112
4	Stage Excavation to prepare Lean concrete	Mini Excavator	36	2	90%	99	2	50%	96	2	70%	97	2	70%	97	2	100%	99	2	100%	99	2	100%	99
5	Excavation below surface - removal of spoil	Crane	36	2	90%	101	2	50%	98	2	70%	99	2	70%	99	2	100%	101	2	100%	101	2	100%	101
6	Spoil removal	Dump Trucks	36	2	90%	110	2	50%	107	2	70%	108	2	70%	108	2	100%	110	2	100%	110	2	100%	110
7	Air compressor for cleaning formwork before casting	Compressor	36	1	90%	103	1	50%	100	1	70%	101	1	70%	101	1	100%	103	1	100%	103	1	100%	103
8	Handle re-bar & hoisting of false work, scaffolding, temporo	Mobile Crane	36	1	90%	110	1	50%	107	1	70%	108	1	70%	108	1	100%	110	1	100%	110	1	100%	110
9	For Casting	Ready Mix Concrete Truck	36	2	90%	110	2	50%	107	2	70%	108	2	70%	108	2	100%	110	2	100%	110	2	100%	110
		Concrete pump	36	1	90%	106	1	50%	103	1	70%	104	1	70%	104	1	100%	106	1	100%	106	1	100%	106
						117			115			116			116			118			120			118
4. Landscape Works - 24 months (from Jul 2028 - Jun 2030)																							
1	Landscape works	Generator	24	2	90%	109	2	50%	106	2	70%	107	0	0%		2	100%	109	2	100%	109	0	0%	
		Excavator mounted sheet pile vibrator	24	2	90%	119	2	50%	116	2	70%	117	0	0%		2	100%	119	2	100%	119	0	0%	
		Mobile Crane: 50T	24	2	90%	99	2	50%	96	2	70%	94	0	0%		2	100%	99	2	100%	99	0	0%	
		welding/cutting equipment	24	4	90%	107	4	50%	104	4	70%	105	0	0%		4	100%	107	4	100%	107	0	0%	
						119			117			118			NA			120			120			NA
5. Remove all temporary works and re-instatement - 24 months (from Jul 2028 - Jun 2030)																							
1	Removal of ERSS	Generator	24	2	90%	109	2	50%	106	2	70%	107	2	70%	107	2	100%	109	2	100%	109	2	100%	109
		Excavator mounted sheetpile vibrator	24	2	90%	119	2	50%	116	2	70%	117	2	70%	117	2	100%	119	2	100%	119	2	100%	119
		Mobile Crane: 50T	24	2	90%	99	2	50%	96	2	70%	94	2	70%	94	2	100%	99	2	100%	99	2	100%	99
		Welding/Cutting equipment	24	4	90%	107	4	50%	104	4	70%	105	4	70%	105	4	100%	107	4	100%	107	4	100%	107
2	Reinstate working area to original condition or required condition	Lorry	24	2	90%	110	2	50%	107	2	70%	108	2	70%	108	2	100%	110	2	100%	110	2	100%	110
						120			117			118			118			120			120			120
										As a separate activity, does not fall under BTO parcles													
Road Construction - 30 months (from 1Q 2027 - 3Q 2029)																							
1	Clearing and Excavation	Excavator	18	1	50%	103	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	100%	106	NA	NA	NA	NA	NA	NA
2	Mounting	Excavator	18	1	50%	103	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	100%	106	NA	NA	NA	NA	NA	NA
3	Fine Grading/Surface Levelling	Grader	12	1	50%	104	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	100%	106	NA	NA	NA	NA	NA	NA
4	Aggregrate Base (Aggregate Laying Truck)	Concrete Truck	12	1	50%	104	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	100%	107	NA	NA	NA	NA	NA	NA
5	Asphalt Paving	Roller	12	1	50%	98	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	100%	101	NA	NA	NA	NA	NA	NA
						110												113						

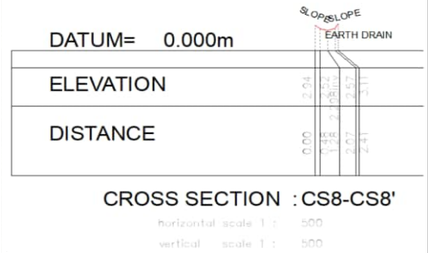
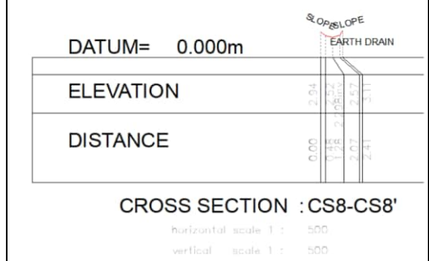
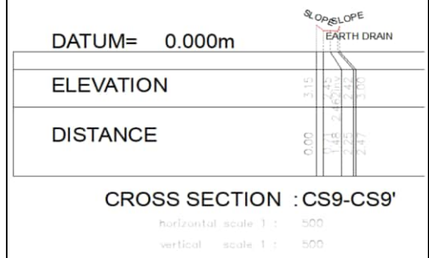
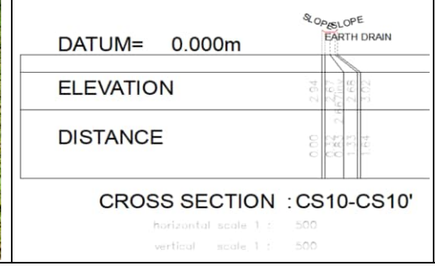
Appendix V
Detailed Records of Stream Mapping

Delivering a better world

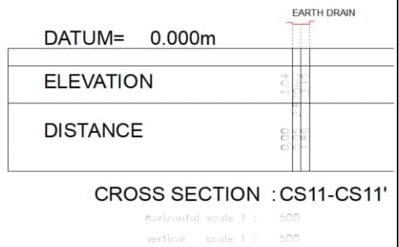
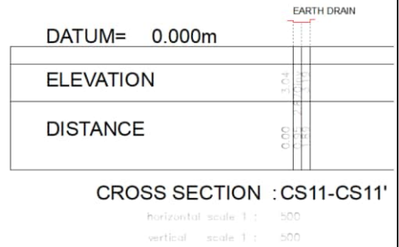
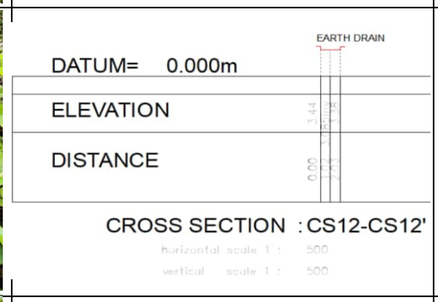
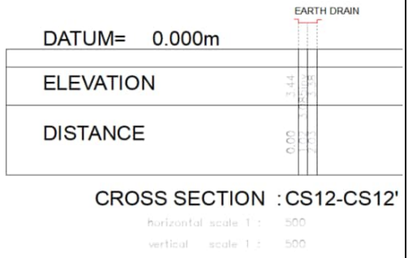
Detailed Records of Stream Mapping

Stream Mapping Point No.	Cross-section No.	Longitude	Latitude	Photo (In the order of: Upstream, Stream Bed and Downstream)	Cross-section	Channel Wetted Width (m)	Stream Depth (cm)	Flow Velocity (dry weather) (m/s)	Bed Substrate and Bank Conditions	Riparian Vegetation
SM1	**CS5**	103°49'8.58"E	1°27'36.22"N			0.68 - 1.61	6 - 7	0.20 - 0.25	Sandy bed with sloping earth banks covered in vegetation	*Refer to Appendix G (List of Plant Species Along the Stream)*
SM2	**CS5**	103°49'8.99"E	1°27'35.82"N			1.50 - 1.55	7	0.08 - 0.085	Sandy bed with sloping earth banks covered in vegetation	
SM3	**CS6**	103°49'9.37"E	1°27'35.32"N			1.35 - 1.40	21	0.06	Sandy bed, presence of leaf litter and steep earth banks covered in vegetation	
SM4	**CS7**	103°49'9.79"E	1°27'34.82"N			0.63	28	0.06	Sandy bed, presence of leaf litter and steep earth banks covered in vegetation	
SM5	**CS7**	103°49'10.24"E	1°27'34.54"N			1.5	13	0.13	Sandy bed, presence of leaf litter and steep earth banks covered in vegetation	

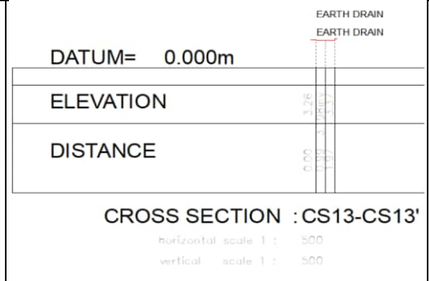
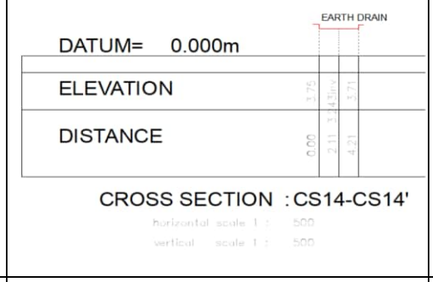
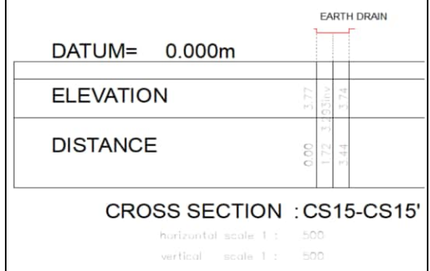
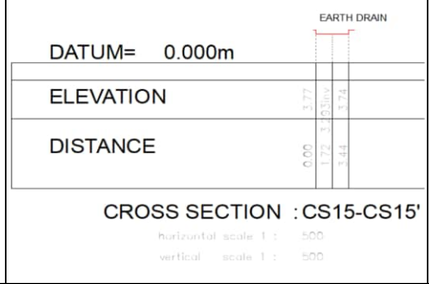
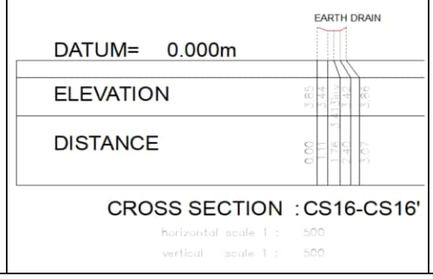
Detailed Records of Stream Mapping

Stream Mapping Point No.	Cross-section No.	Longitude	Latitude	Photo (In the order of: Upstream, Stream Bed and Downstream)	Cross-section	Channel Wetted Width (m)	Stream Depth (cm)	Flow Velocity (dry weather) (m/s)	Bed Substrate and Bank Conditions	Riparian Vegetation
SM6	CS8	103°49'10.81"E	1°27'33.98"N			0.93	26	0.08	Sandy bed with presence of small rocks. Earth banks are steep and vegetated.	
SM7	CS8	103°49'11.05"E	1°27'33.33"N			1.52	22	0.0588	Sandy bed substrate with presence of leaf litter. Earth banks are vegetated	
SM8	CS9	103°49'11.29"E	1°27'32.92"N			0.46	3	0.333	Sandy bed substrate with presence of leaf litter. Earth banks are densely vegetated.	
SM9	CS10	103°49'11.55"E	1°27'32.15"N			0.82	33	0.04	Sandy bed. Sloping earth banks that are vegetated.	

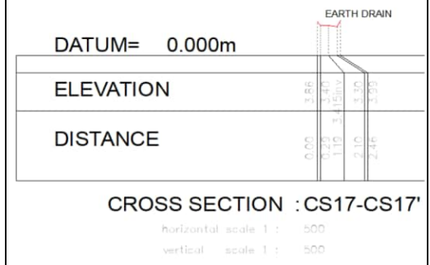
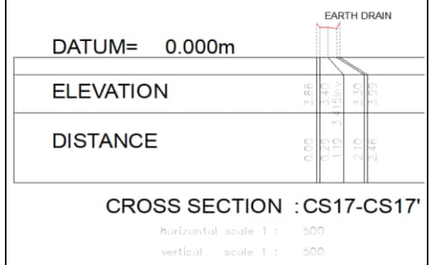
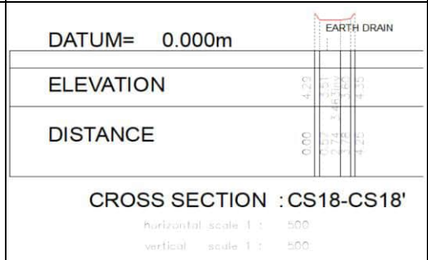
Detailed Records of Stream Mapping

Stream Mapping Point No.	Cross-section No.	Longitude	Latitude	Photo (In the order of: Upstream, Stream Bed and Downstream)	Cross-section	Channel Wetted Width (m)	Stream Depth (cm)	Flow Velocity (dry weather) (m/s)	Bed Substrate and Bank Conditions	Riparian Vegetation
SM10	**CS11**	103°49'11.95"E	1°27'31.54"N			0.77	5	0.222	Sandy bed with presence of small rocks. Earth banks are sloping and vegetated.	
SM11	**CS11**	103°49'12.28"E	103°49'11.95"E			0.58	16	0.25	Sandy bed. Vegetated esarth banks.	
SM12	**CS12**	103°49'12.50"E	1°27'30.56"N			2.1	11	0.0588	Sandy bed with some leaf litter. Densely vegetated esarth banks.	
SM13	**CS12**	103°49'12.93"E	1°27'29.89"N			0.9	8	0.2	Sandy bed substrate with leaf litter and small rocks. Degraded concretet slab can be observed. Earth banks are low and sparsely vegetated.	

Detailed Records of Stream Mapping

Stream Mapping Point No.	Cross-section No.	Longitude	Latitude	Photo (In the order of: Upstream, Stream Bed and Downstream)	Cross-section	Channel Wetted Width (m)	Stream Depth (cm)	Flow Velocity (dry weather) (m/s)	Bed Substrate and Bank Conditions	Riparian Vegetation
SM14	CS13	103°49'13.12"E	1°27'29.45"N			1.62	3.5	0.2	Sandy bed with leaf litter and tree logs. Sloping earth banks that are vegetated.	
SM15	CS14	103°49'13.41"E	1°27'28.69"N			0.99	4	0.222	Sandy bed with presence of leaf litter and fallen tree logs. Earth banks are steep and vegetated.	
SM16	CS15	103°49'13.91"E	1°27'28.13"N			2.5	13.5	0	Sandy bed with much leaf litter, tree roots and fallen branches. Earth banks are vegetated.	
SM17	CS15	103°49'13.98"E	1°27'27.58"N			1.28	4	0.2	Sandy bed wih some leaf litter and small rocks/ Earth banks are vegetated but show some signs of erosion	
SM18	CS16	103°49'14.48"E	1°27'27.16"N			1.61	13	0.1666	Sandy bed substrate. Earth banks are vegetated.	

Detailed Records of Stream Mapping

Stream Mapping Point No.	Cross-section No.	Longitude	Latitude	Photo (In the order of: Upstream, Stream Bed and Downstream)	Cross-section	Channel Wetted Width (m)	Stream Depth (cm)	Flow Velocity (dry weather) (m/s)	Bed Substrate and Bank Conditions	Riparian Vegetation
SM19	CS17	103°49'15.14"E	1°27'26.62"N			1.8	24	0	Sandy bed substrate with some leaf litter and rocks. Earth banks are densely vegetated	
SM20	CS17	103°49'15.54"E	1°27'26.06"N			1.8	18	0	Sandy bed with a few leaves and small rocks. Vegetated earth banks.	
SM21	CS18	103°49'16.05"E	1°27'25.51"N			5	45	0	Concrete bed covered in layer of sandy substrate. Much leaf litter and debris. Earth banks high and densely vegetated, with evidence of erosion.	