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INFRASTRUCTURE WORKS AT HDB DEVELOPMENT IN ULU PANDAN EAST

Construction Environmental Management and Monitoring Plan



Submitted by:

TEMBUSU
Asia

Description **Construction Environmental Management and Monitoring Plan for Infrastructure Works at HDB Development in Ulu Pandan East**

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ABBREVIATIONS

Abbreviation	Definition
µg/m^3	microgram per cubic meter
ASR	Air Sensitive Receptor
BCA	Building and Construction Authority
BMP	Best Management Practices
CEMMP	Construction Environmental Management and Monitoring Plan
CO	carbon monoxide
COP	Code of Practice
dB(A)	A-weighted decibel
ECM	Earth Control Measure
ECMO	Earth Control Measure Officer
ECO	Environmental Control Officer
EMMP	Environmental Management and Monitoring Plan
EPH	Environmental Public Health
EPHA	Environmental Public Health Act
EPM	Environmental Protection and Management
ERSS	Earth Retaining Stabilizing Systems
GPS	Global Positioning System
HDB	Housing & Development Board
ha	hectare
hr	hour
ISA	International Society of Arboriculture
IUCN	International Union for the Conservation of Nature
kHz	kilohertz
km	kilometre
LA_{eq}	equivalent continuous A-weighted sound power level
Leq	equivalent continuous noise level
m	meter
m^2	meter square
mg/L	milligram per litre
mg/m^3	milligram per cubic meter
mins	minutes
ms	milliseconds
NSR	Noise Sensitive Receptor
NEA	National Environment Agency
NO_2	nitrogen dioxide
NParks	National Parks Board
PCN	Park Connector Network
PM_{10}	particulate matter with diameter ≤ 10 micrometres
$PM_{2.5}$	particulate matter with diameter ≤ 2.5 micrometres

Abbreviation	Definition
PPE	Personal Protective Equipment
ppm	parts per million
PRO	Public Relations Officer
PUB	Public Utilities Board
QECP	Qualified Erosion Control Professional
s	seconds
SS	Singapore Standards
SSO	Singapore Statutes Online
SJ	Surbana Jurong Consultants Pte Ltd
t	Tonnes
TAC	TEMBUSU Asia Consulting Pte Ltd
TPZ	Tree Protection Zone
TSS	Total Suspended Solid
TWPS	Treated Water Pumping Station
URA	Urban Redevelopment Authority
US EPA	United States Environmental Protection Agency
VCO	Vector Control Operator
VSR	Vibration Sensitive Receptor
WHO	World Health Organisation

1 INTRODUCTION

1.1 Project Background

Ulu Pandan has been earmarked for residential development in URA's Master Plan since 2003. The conceptual plans for the Ulu Pandan site were revised based on the findings of the Environmental Baseline Study (EBS) conducted in 2017, feedback from Nature Groups collected in 2019, public feedback upon the disclosure of the EBS report, as well as NParks' Ecological Profiling Exercise.

As shared in 2021, Ulu Pandan East (from Ghim Moh Link to Dover MRT station) will be developed in the near-term, to meet the strong housing demand in mature estates. A green corridor would be established along Ulu Pandan canal along with a proposed park around a retained stream in Ulu Pandan East. Ulu Pandan West would be retained in the medium term, with a sizeable nature park safeguarded. Plans for Ulu Pandan West will continue to be studied and revisited sometime around 2030, taking into consideration Singapore's land use needs at that time.

TEMBUSU Asia Consulting (TAC) has proposed a Construction Environmental Management and Monitoring Plan (CEMMP) to manage the identified environmental impacts during the the earthworks and infrastructure works phase. The CEMMP is informed by an Environmental Study for Ulu Pandan East, conducted by TAC in 2022 (please see Annex 1), covering an updated baseline study of the project site, and studying the potential impacts from the proposed infrastructure works.

1.2 Objective of the CEMMP

The CEMMP sets out a systematic approach to mitigate environmental impacts and monitor the implementation of these mitigation measures to ensure that the proposed project being implemented within any sensitive areas will not cause any significant adverse impact to the site's environment and its surrounding. It is also a useful tool to assess whether the mitigation measures taken are effective to reduce or mitigate potential impacts caused by this project to minimal and acceptable levels during the construction phase.

1.3 General Scope of the CEMMP

Before the construction works start, the appointed Contractor and Environmental Consultant is required to establish a detailed CEMMP presented in this document, which is to be implemented and monitored during the construction phase.

This CEMMP includes the identified mitigation measures from the Environmental Study and addresses the methodologies of the construction works prior to their commencement. Additionally, Wildlife and Flora Management Plans are recommended and finetuned, to implement the ecological mitigation measures recommended in the Environmental Study. The CEMMP also includes waste management practices including restricting use & spillage of chemicals during construction phase into surrounding forested area.

The CEMMP includes the requirements for the monitoring of environmental parameters.

Monitoring activities include compliance inspections for the prescribed mitigation measures, collection of ambient environmental data, sample collection, and analysis. The environmental monitoring aims to ensure that the project does not cause any significant long-term environmental impacts, in particular cumulative impacts, and that the existing environmental conditions and biodiversity are maintained.

Monthly environmental monitoring reports with all monitoring results (compliance and ambient monitoring), identified problems and additional actions taken to mitigate these problems will be prepared and submitted to the relevant authorities during the construction phase.

1.4 Summary of Environmental Study

Prior to developing the CEMMP, an Environmental Study was conducted to provide an updated baseline assessment of the project site, identify the sensitive receptors, assess the potential impacts, recommend appropriate mitigation measures to reduce the residual impacts to acceptable levels during the earthworks and infrastructure works phase. Details can be found in Annex 1. The potential impacts on the following environmental aspects have been considered in this assessment:

- Biodiversity
- Noise
- Hydrology & Water Quality
- Ambient Air Quality
- Vibration
- Light
- Waste Management
- Vector Control

Overall, environmental impacts from this development project are expected from activities associated with vegetation clearance and earthworks, which may impact flora and fauna within and around the site, as well as the human receptors around the site. These impacts are of slight to moderate negative levels. With the diligent implementation of mitigation measures, these impacts can be reduced to minor levels and lower. The main findings of each environmental aspect studied have been summarised in the executive summary within Annex 1.

1.5 Document Structure

The CEMMP is structured as follows:

- Chapter 1 introduces the purpose and general scope of CEMMP.
- Chapter 2 provides the project background and site utilisation plan.
- Chapter 3 outlines applicable legislation, regulations, and guidelines to CEMMP.
- Chapter 4 provides the CEMMP management framework.
- Chapter 5 outlines the management plans for biodiversity, covering the Wildlife Management Plan, Wildlife Rescue Protocol, and Flora Management Plan.
- Chapter 6 presents Environmental Management Plans for various aspects.
- Chapter 7 discusses Environmental Monitoring Plan.
- Chapter 8 presents the CEMMP reporting requirements.
- Chapter 9 presents the references cited.

2 PROJECT OVERVIEW

2.1 Project Location

The project site is located southwest of Singapore, adjacent to Dover MRT station. It is bounded by Ulu Pandan Park Connector to the north, Ghim Moh Link to the east, and Commonwealth Avenue West to the south.

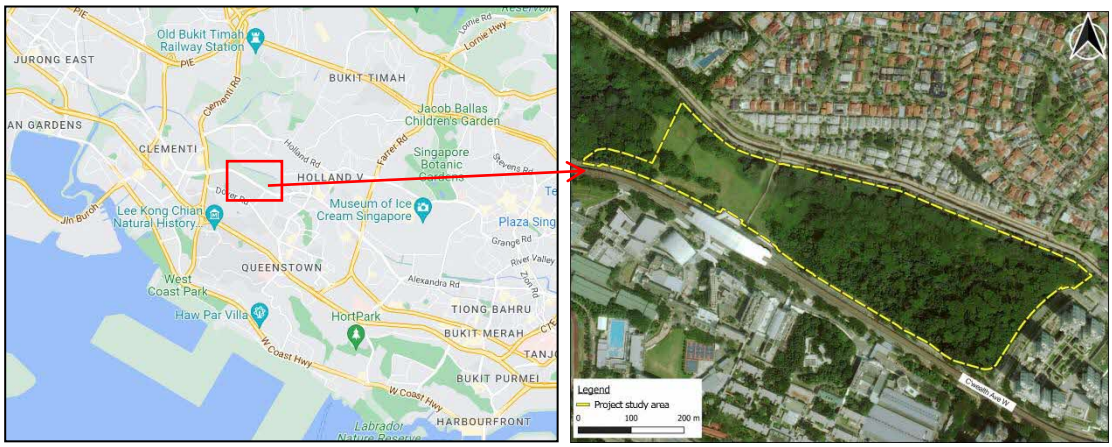


Figure 2.1. Project location plan

2.2 Project Scope and Implementation Schedule

The infrastructure works involve clearance of vegetated areas, earthworks, pipe jacking by the means of slurry shield jacking machine or hand shield, and other related activities. The following infrastructures will also be constructed:

- Underground piping and services
- Earth-retaining structures
- Drains and other supporting features (e.g., pipe culverts, sumps, inspection chambers, temporary shafts)
- Sewer line along the northern boundary of the project site
- Cycling path along Commonwealth Avenue West and Ghim Moh Link with markings, signages, and other related works

The project will be conducted in six phases, with Phase 4 further divided spatially into 3 areas. Works from Phase 2 onwards will be carried out concurrently. The implementation schedule is provided in Table 2.1.

Table 2.1. Implementation schedule of entire project

Phase	Description of Works
1	Preliminary works, setting out, and CEMMP
2	Whole construction of drains, pipe culverts, sumps, inspection chambers, etc. and all related works
3	Construction of 1800 mm diameter sewer line, including diversion of 1676 mm diameter sewer line, etc. and all related works
4A	Whole earthworks for Zone 3, including site clearance works, backfilling, construction

Phase	Description of Works
	of temporary silt trap, drains at site areas
4B	Whole earthworks for Zone 2, including site clearance works, backfilling, construction of temporary silt trap, drains at site areas
4C	Whole earthworks for Zone 1, including site clearance works, backfilling, construction of temporary silt trap, drains at site areas
5	Construction of cycling path and all related works
6	Ground Improvement Works (GIW)

2.3 Site Layout

The project site is shown in Figure 2.2. and described below. **Appendix A** provides the overall site layout of the project area, which has been revised to include the realigned outlet drains. Any temporary diversions made to the Park Connector Network (PCN) shall be made in consultation with NParks.

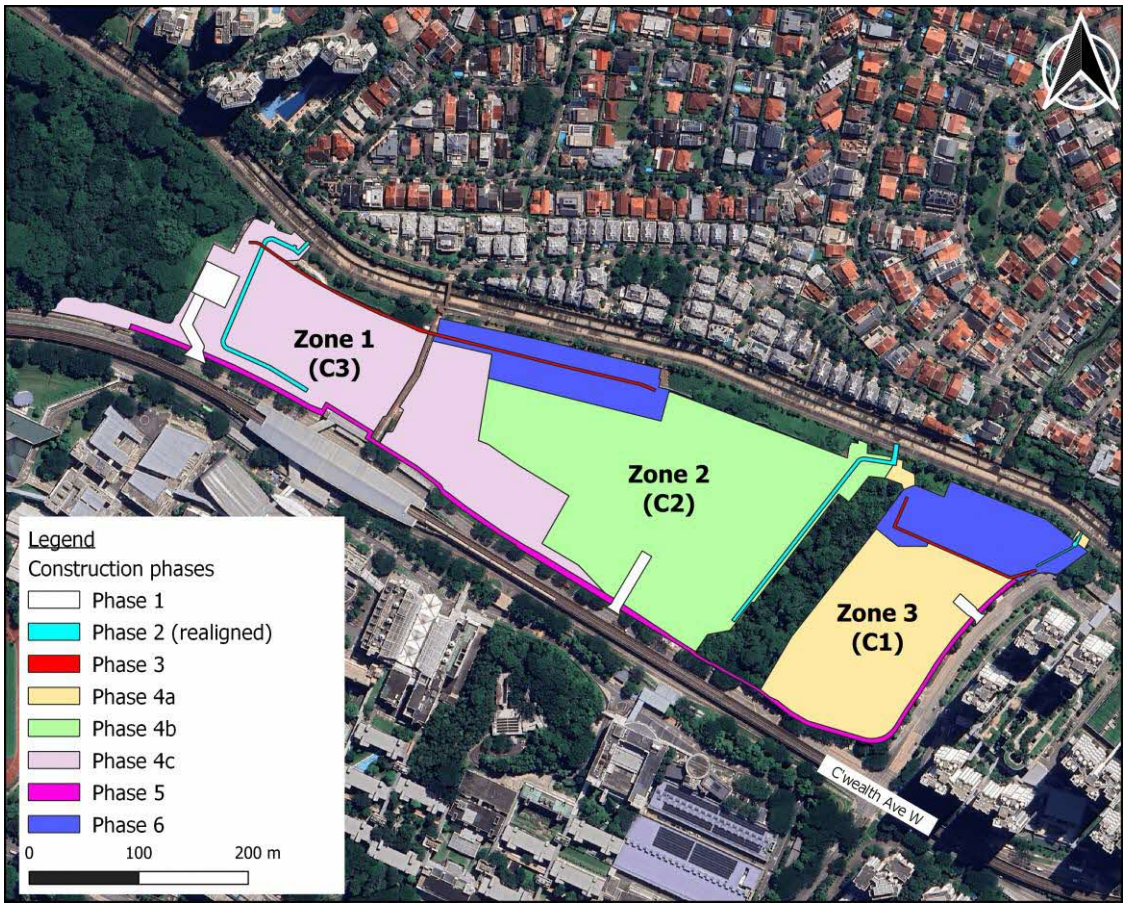


Figure 2.2. Phased construction areas in the project site

Phase 1 – Preliminary Works, Setting Out, and CEMMP

The project will begin with preliminary works, covering the construction of site office and temporary access roads, establishment of hoarding along the contract boundary, mobilization of equipment into the site areas, as well as felling of trees along the hoarding line and in the temporary access road areas. This phase also includes the setting out of the detailed Construction EMMP.

Phase 2 – Construction of Drains and Other Supporting Features

Three drain alignments with their supporting features (i.e., pipe culverts, sumps, inspection chambers) will be constructed to support the existing drainage system in the project site. Drain no. 1 in the west of project site will be 2 m wide, drain no. 2 at the west of Stream 1 will be 1.5 m wide, while drain no. 3 at the eastern edge of project site will be 1.2 m wide. The drain alignments were revised due to existing services in the areas adjacent to the site. Drains no. 1 and 3 shall employ the open-cut method which will involve tree felling and partial closure of the Park Connector Network (PCN). Drain no. 2 shall employ the pipejacking method with access routes from both parcels C1 and C2. The access routes will require undergrowth clearance, though it is noted no large trees will be felled. Construction of drain no. 2 shall be conducted 6 m underground.



Figure 2.3. Layout plan for outlet drains, obtained from the Contractor

Phase 3 – Construction of 1800 mm diameter Sewer Line and All Related Works

Approximately 570 m long underground sewerage alignment will be constructed by pipe jacking by means of slurry machine or hand shield method, divided into two sewers of approximately 170 m in Zone 3 at the east of the project site and approximately 400 m in Zone 2 at the west of the site. These sewer alignments, which will have the diameter of 1800 mm, will be constructed along the northern edge of the project site, parallel to the Ulu Pandan PCN. A total of 12 manholes will be created for the sewer (see Figure 2.4 to Figure 2.6). In addition, the existing 1676 mm diameter sewer line will be diverted at three locations as a result of these new alignments. Piling activities will be conducted for each manhole of the sewer alignment only when required, subject to the outcome of soil investigation works and utilising bored micropiles to minimise impacts on the environment. Piling of the micropiles is scheduled to be the last activity of this phase.

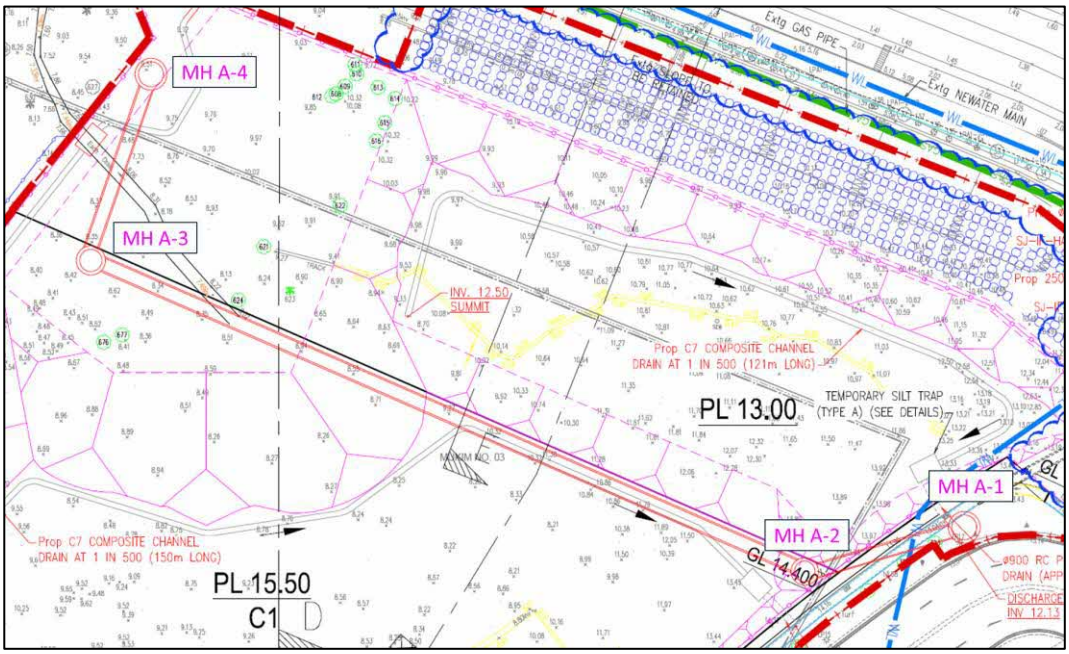


Figure 2.4. Manhole layout plan for MH A-1 to A-4 in C1

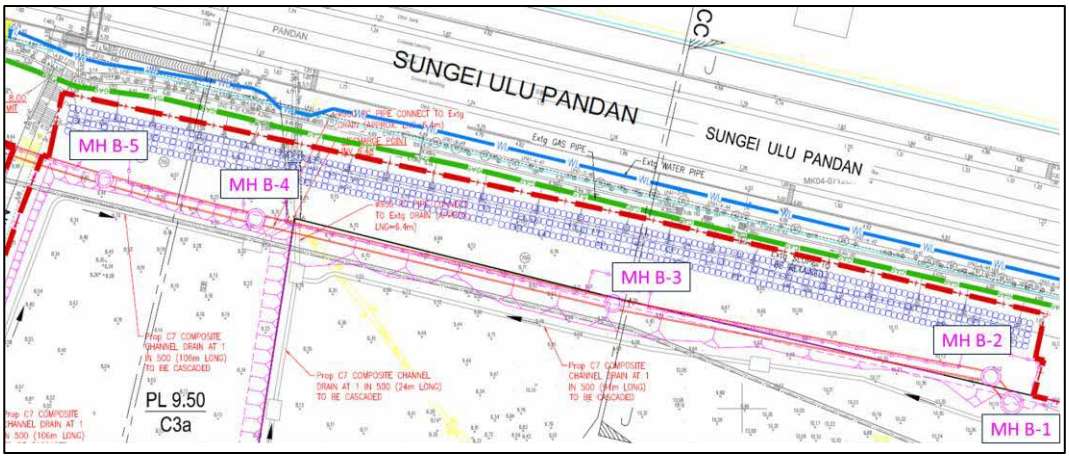


Figure 2.5. Manhole locations for MH B-1 to B-5 in C2

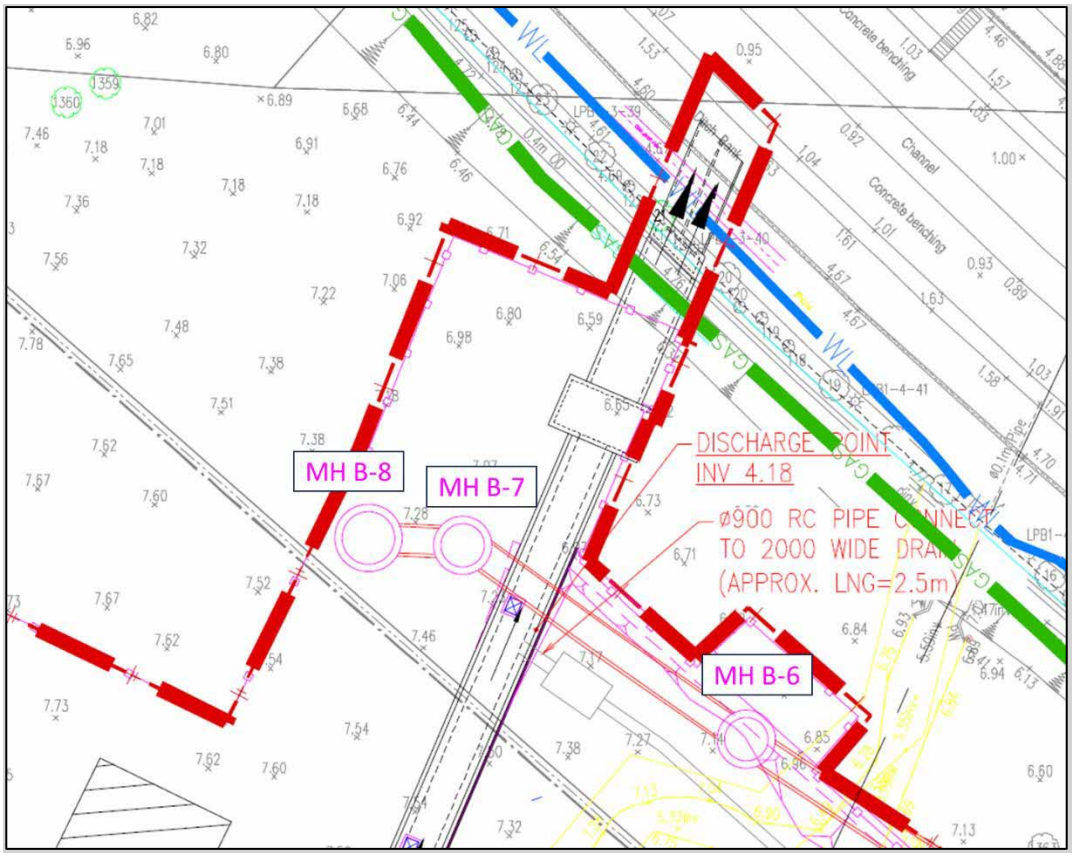


Figure 2.6. Manhole locations for MH B-6 to B-8 in C3

Phase 4 – Earthworks for Zones 1, 2, and 3

Work areas in Phase 4 cover a major portion of the project site, which span over existing forested areas and has an uneven terrain with elevation range of 9–22 m throughout. Site clearance and earthworks will be carried out to remove unsuitable soil and form the platform level required for future housing development at the site. Related activities in this phase include backfilling as well as construction of temporary silt traps and drains in the work areas.

Phase 5 – Construction of Cycling Path and All Related Works

The cycling path and footpath with related markings and signages will be constructed along Commonwealth Avenue West and Ghim Moh Link, spanning approximately 1 km long.

Phase 6 – Ground Improvement Works (GIW)

Ground improvement works are proposed to enhance ground stability of the site near Ulu Pandan Canal. The sequence of works are as follows: (1) Excavation; (2) Mass Soil Mixing (MSM) or Deep Cement Mixing (DCM); and (3) Backfill. Figure 2.7 below shows an example of the general sequence of events using the indicative ground levels at one location in C1. The exact ground levels vary throughout the site.

The existing soil will first be excavated to the required platform level, whereby MSM or DCM will be conducted next.

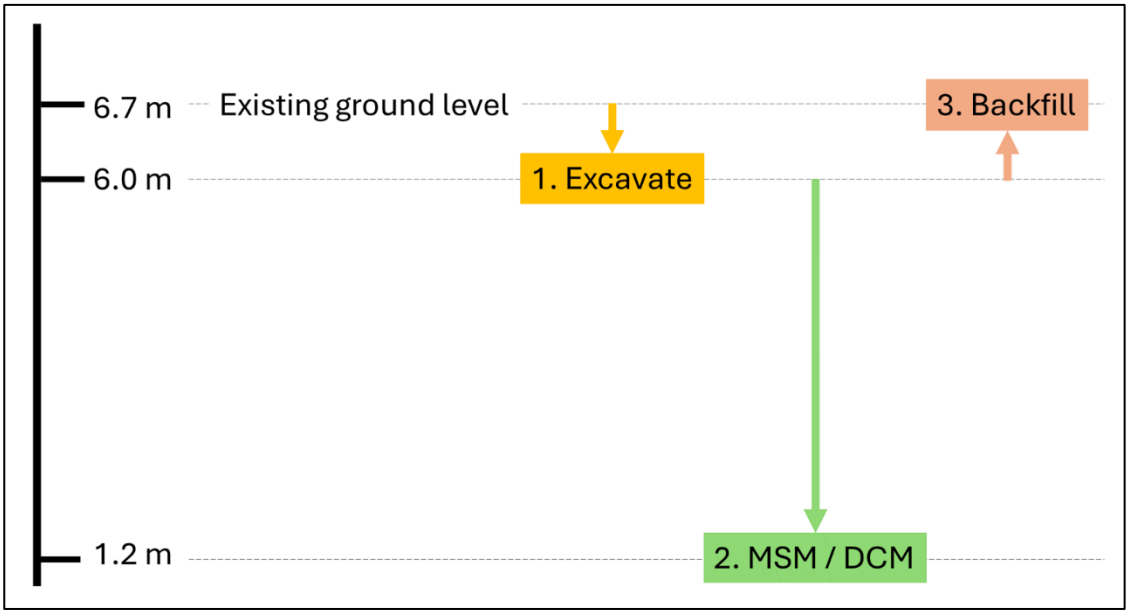


Figure 2.7. Example sequence of events and indicative levels for Ground Improvement Works at one location in C1

MSM and DCM are two different methods proposed in this project. Either method may be conducted at C1 and/or C2. Both methods aim to increase ground stability by enhancing the engineering properties of the existing soft soil. MSM is a process that loosens the existing soft soil, adds grout to the soil, then mixes them to create a homogenous mud. The grout is formed by hydrating the 'binder' with water, whereby the 'binder' is typically made of cement and/or lime. Soils from depths of 5 to 6 m may be used for MSM treatment (Keller ASEAN, 2023b).

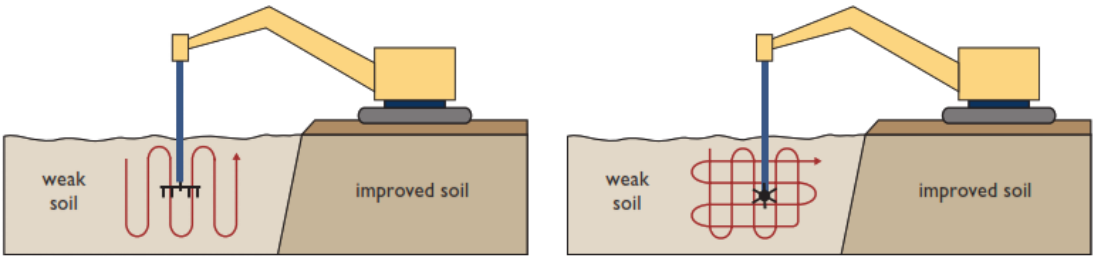


Figure 2.8. Example of Mass Soil Mixing (MSM) installation

DCM is another soil-improvement technique used to create a cemented soil material that has higher strength, lower permeability, and lower compressibility. Overall, DCM improves the ultimate bearing capacity of soils (Pourakbar, 2015). Cement or slurry will be injected into the ground to the required depth based on the assessment of ground conditions and will be mechanically mixed with the soil for slope stabilisation. The toe level of DCM columns shall penetrate to at least 1 m into the Jurong Formation layer. The DCM columns have a diameter of 1300 mm and are estimated to be installed to depths of up to approximately 10 m below the existing ground level.

After MSM or DCM for that area is complete, the ground will be backfilled up to the required platform level. Backfilling and compaction shall be carried out in layers of 500 mm.

The figures below show the locations and arrangements of the DCM columns at Ulu Pandan East.

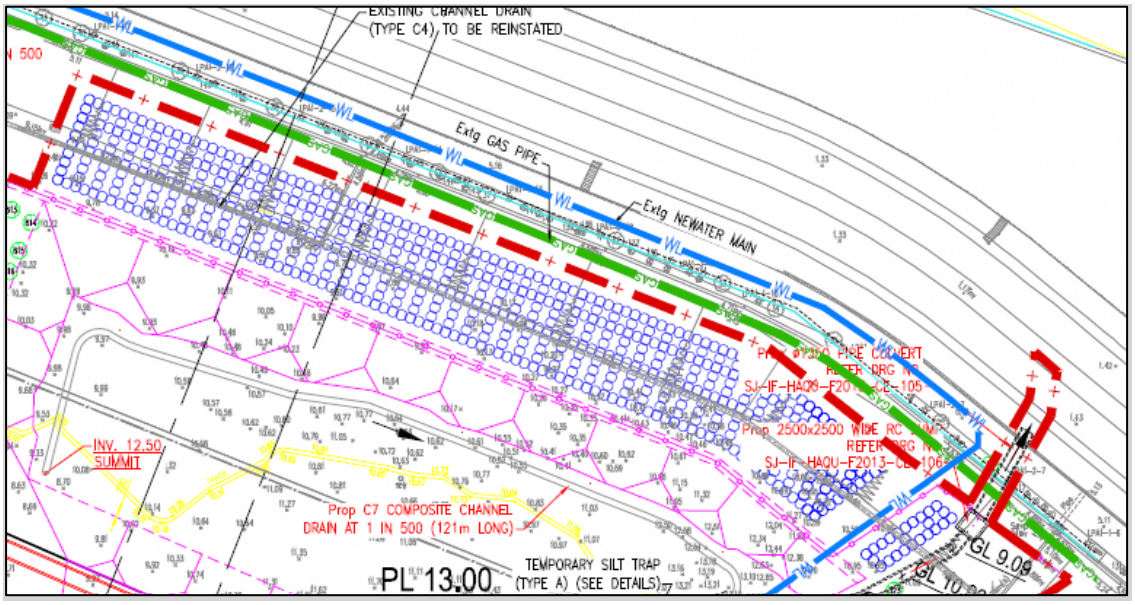


Figure 2.9. Blue circles show proposed GIW in C1

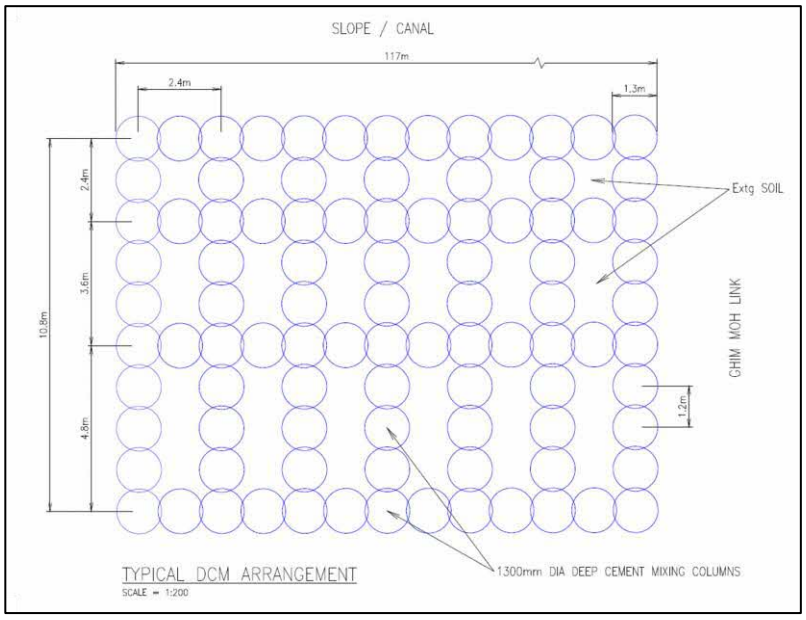


Figure 2.10. Typical DCM arrangement at C1

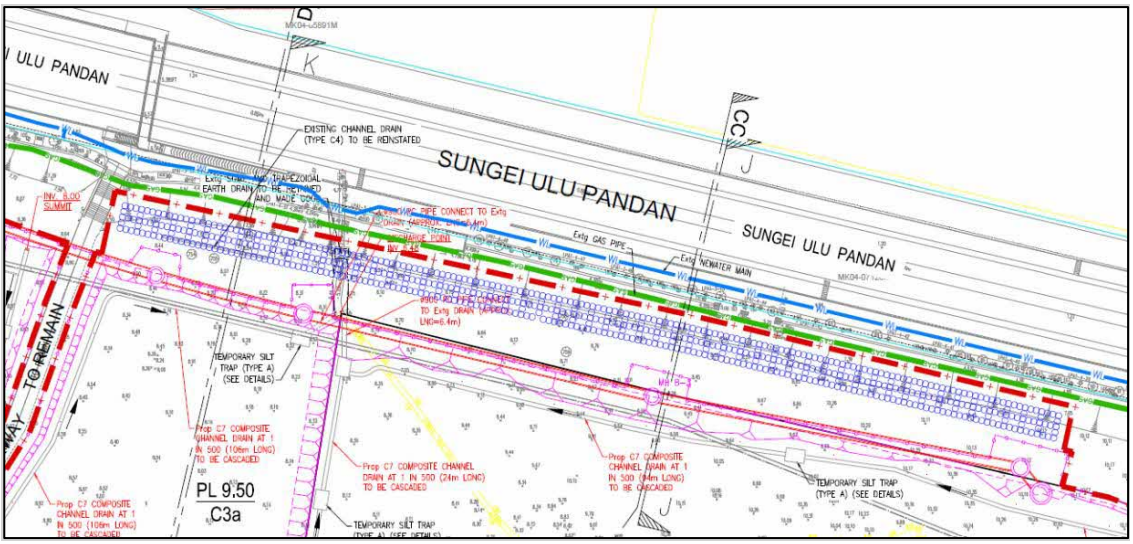


Figure 2.11. Blue circles show proposed GIW in C2 and C3

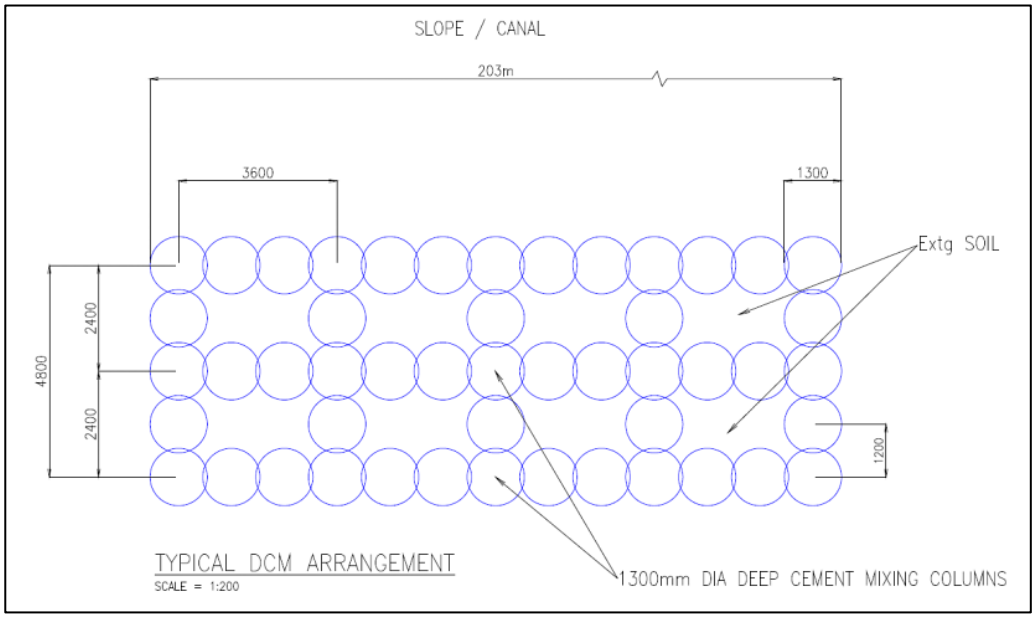


Figure 2.12. Typical DCM arrangement at C2

2.4 Construction Activities Associated with Proposed Project

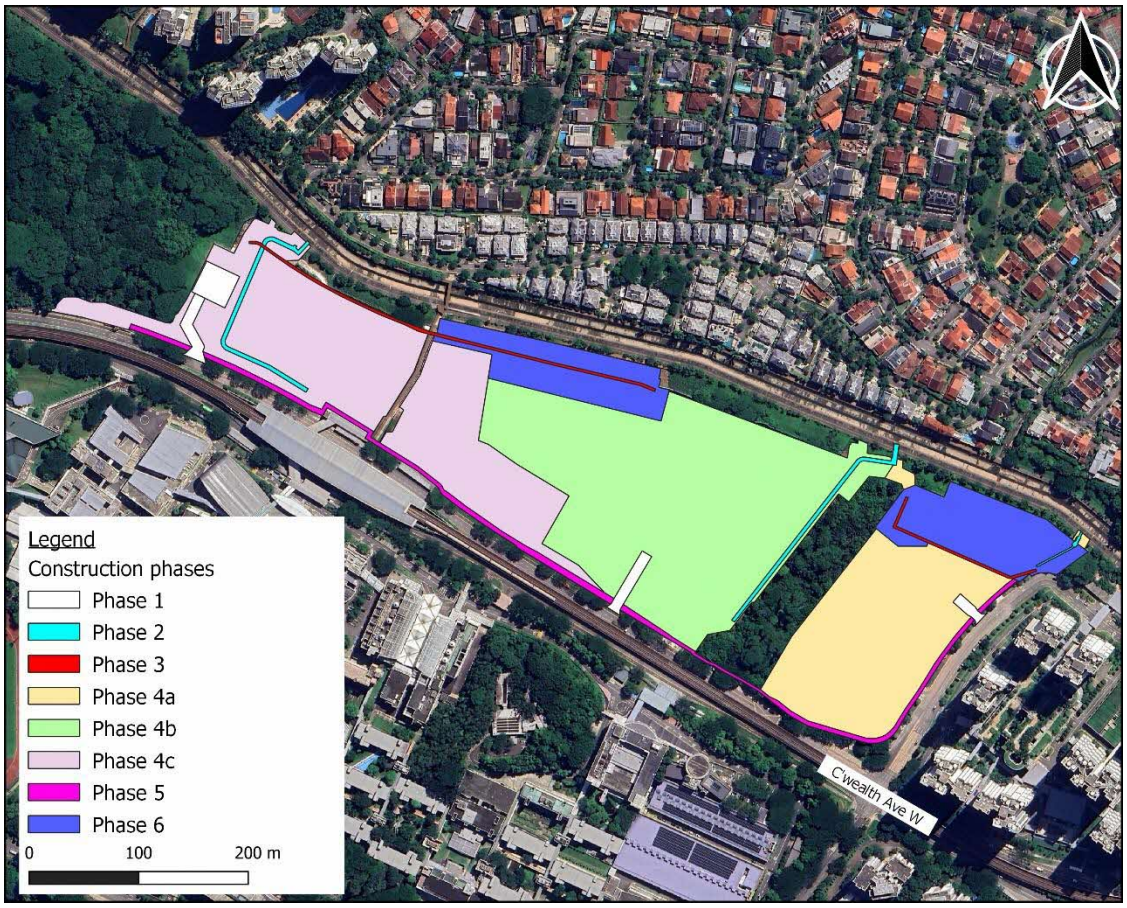


Figure 2.13. Phased construction areas

Temporary Construction Access Road

The construction will begin with the creation of temporary access road indicated in white (Phase 1) in Figure 2.13. Three temporary construction access roads are proposed to create a separate entry into each of the three zones. The temporary access roads would allow easier transport of construction resources into the works areas and thus contribute to timely completion of the construction activities. Upon completion of works, the temporary roads will be removed and reinstated to suit the new housing development.

Construction of Drains and Other Supporting Features

Trial trenches and services detections will be first conducted along and around designated drain alignments to determine all services that may affect critical works. Excavation will then proceed in accordance with the approved construction drawings, to be carried out in stages to minimise disturbance to the surrounding ground. Subsequent construction of drains, sumps, and other supporting features will follow the details specified in the construction drawings and PUB/LTA Standard Details.

Three drain outlets comprise a 1.2 m drain at C1, 2.0 m drain at C3, and 1.5 m drain at the retained stream park area. All affected trees, vegetation, and park accessibility shall be made known to NParks prior to any clearance.

At parcels C1 and C3, the 1.2 m and 2.0 m drains shall be constructed using the approved open cut method. The works are expected to proceed in the following sequence: (1) excavation to the required level; (2) canvas to be placed on the slope to act as an earth control measure; (3) final levelling using hardcore and sand; (4) lean concrete to be casted and precast drains to be placed with proper interlocking; (5) construction of drain with benching, wall construction, and top slab.

At the retained stream park area, the 1.5 m drain shall be constructed using pipe-jacking. The size of the jacking pit shall be suitable for both jacking operation as well as for the construction of the permanent sump.

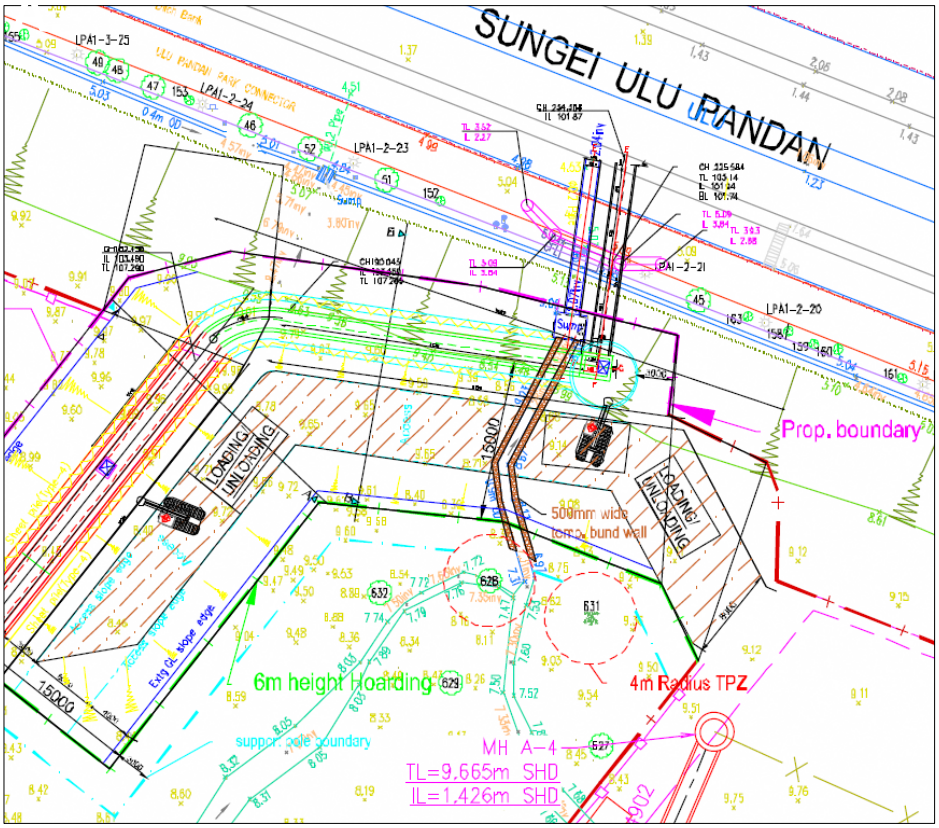


Figure 2.14. Working boundary downstream of Stream 1

Construction of Temporary Shafts

Temporary shafts will be constructed prior to pipe jacking. Once pipe jacking works are completed, the manholes will be constructed within the temporary shafts before they are backfilled, have their shoring extracted, and the affected area around the shafts are reinstated. Locations of the shafts/manholes will be confirmed and finalised after trial holes and all existing service diversions (if any) are carried out as necessary, which will ensure that the proposed jacking and receiving shafts can be constructed. Excavators, mini excavators, and tipper trucks will be deployed in the project site for the shaft excavation. The working platform will be cast with concrete. Settlement markers will be installed around the shaft area to monitor any ground movement.

Pipe Jacking for Construction of Sewers

The pipe jacking will be executed mainly using slurry shield jacking machine. The hand-

shield method will be used as an alternative if the ground condition is suitable. Horizontal grouting will be conducted prior to hand-shield works due to the soft ground condition. Timber lagging at the face of the shield will be installed if required (i.e., when excavation stops for a prolonged period).

Site Clearance and Earthworks

As the terrain is uneven, the proposed platform levels will be designed to minimise cut-and-fill works as well as the number of earth retaining structures required. This approach will not only ease construction but also minimise impact to the nearby environment. The vegetation clearance plan will be submitted to and approved by NParks prior to removal of shrubs and trees in the project site. Tree felling will be conducted by the means of chainsaw, excavator, and lorry operations.

Soil Investigation (SI) works

There are proposed SI boreholes at this site. The number of boreholes should follow the Building and Construction Authority's (BCA) requirements on ground investigation, load test, and quality control test for building foundations (BCA, 2016). All the boreholes should be more than 10 m away from the natural stream. Any SI borehole works in the retained stream area should be conducted manually and vegetation clearance is to be kept to a minimum.

Ground Improvement Works (GIW)

Cementitious soil will be used to stabilise the slopes along Ulu Pandan Canal. Using soil-cement material for ground improvement works has a relatively lower environmental impact as compared to soil reinforcement or foundations (Hessouh, et al., 2023). Hessouh et al. (2023) stated that there are two widely known methods for using soil-cement material. The first is known as "deep soil mixing", which is mechanical mixing of the soil using mixing blades such augers or paddles to mix the soil with the binder. The other is known as "jet grouting", which uses high pressure jet fluids to break up the soil to combine it with the binder. Given how the GIW is close to Ulu Pandan West and the park area in between C1 and C2, the current methodology proposes to use augers and/or paddles for mechanical mixing to reduce the intensity of vibrations produced.

Cementitious soil can be utilised using either MCM or DCM. If the MSM method is used, an excavator with an attached mixing tool that resembles screw propellers having a centrally provided nozzle for binders will be used. The mixing tool is inserted into ground under rotation while pumping grout to create a mixed mud-grout material. The mixing head will continue to penetrate the ground until it has reached the required depth and at which binder will be introduced to the ground while mixing continues. Once the binder has been introduced into a defined block, the blades will continue to rotate to ensure a continuous block is formed till the required height.

If the DCM method is used, the drilling machine will be assembled on-site. The position of the DCM columns will be pegged following the approved drawings, and drilling will proceed to the required depth. The drilling rods will then be withdrawn, and cement grout will be discharged into the DCM column.

Both MSM and DCM techniques are reported to be quiet and free of vibration (Keller

ASEAN, 2023a; Keller ASEAN, 2023b). DCM columns do not require heavy drilling works and instead use mechanical augers to mix the soil mass. Mechanical augers are less vibrationally intensive and do not produce as much noise as compared to using other drill bits such as power drills or jet grouting.

To provide adequate working space for GIW works, total vegetation clearance is required, which involves the felling of a few trees. The hoarding line will also be extended out in C1 facing Ghim Moh Link for manhole works and in C2 facing Ulu Pandan Canal for slope stabilization works. The new hoarding facing Ulu Pandan Canal shall remain at 6 m height.

Overlap with Building Works

The site will be occupied by both the Infra Contractor and Building Contractor at the same time until the Infra Main Contractor has completed their work. Temporary hoarding or a physical barrier shall be installed to indicate the working space occupied by each Contractor. Upon completion of works by the Infra Contractor at each working space, the working space shall be handed over to the Building Contractor.

2.5 Site Utilisation Plan

The components of site utilisation plan are described as follows:

- Boundary Hoarding – A hoarding to be installed along the project boundary line to demarcate the project worksite and to control the access
- Access Roads – There are two site access roads along Commonwealth Ave West and another access road along Ghim Moh Link
- Washing Bay – to be installed at each access road
- ECM Tank and Drain
- Rest Area – rest areas for construction personnel to utilise during inclement weather
- Portable Toilets – To be provided at each rest area for construction personnel
- A site office building at the west of the project
- Parking areas

3 APPLICABLE LEGISLATIONS AND GUIDELINES

The table below lists relevant legislations, regulations, and guidelines which govern the various environmental parameters within Singapore, which are to be complied during the implementation of CEMMP.

Table 3.1. List of applicable Singapore legislations, regulations, and guidelines

Parameter	Legislation, Regulations and Guidelines
General	• Code of Practice on Pollution Control SS593, 2013 • Environmental Protection and Management Act, rev. 2020 • Environmental Public Health Act, rev. 2020
Biodiversity	• Animals and Birds Act, 2020 • Endangered Species (Import and Export) Act, 2020 • Fisheries Act, 2020 • Parks & Trees Act, 2020 • Parks & Trees Regulations, 2006 • Parks & Trees Preservation Order, 1998 • Parks & Trees (Composition of Offences) Regulations, 2006 • Parks & Trees (Heritage Road Green Buffers) Order, 2006 • Parks & Trees (Planning Areas) Notifications, 2006 • Wildlife Act, 2020 • NParks Biodiversity Impact Assessment (BIA) Guidelines, 2021 • CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as the Washington Convention), 1983 • IUCN Red List of Threatened Species, 2023 • Singapore Red Data Book, Third Edition (online), 2023
Surface Water Quality	• Code of Practice on Pollution Control SS593, 2013 • Environmental Protection and Management Act 2020, Part V on water pollution • Environmental Protection and Management Act (Trade Effluent) Regulations, 2008 • PUB Code of Practice on Surface Water Drainage, 2018 • PUB Guidebook on Erosion and Sediment Control at Construction Sites, 2018 • PUB Handbook on Managing Urban Runoff, 2013 • Sewerage and Drainage Act, rev. 2020 • Sewerage and Drainage (Surface Water Drainage) Regulations, rev. 2007 • Sewerage and Drainage (Trade Effluent) Regulations, rev. 2007
Noise	• Code of Practice for Noise Control on Construction and Demolition Sites SS602, 2014 • Code of Practice on Pollution Control SS593, 2013 • Environmental Protection and Management Act 2020, Part VIII Noise Control • Environmental Protection and Management (Control of Noise at Construction Sites) Regulations, 2008
Air Quality	• Code of Practice on Pollution Control SS593, 2013 • Environmental Protection and Management Act 2020, Part IV on Air Pollution Control • Environmental Protection and Management (Vehicle Emissions) Regulations, 2008 • Environmental Protection and Management (Prohibition on Use of Open Fires) Order, 2008 • Environmental Protection and Management (Air Impurities) Regulations, 2008 • NEA Singapore Ambient Air Quality Targets
Waste Management	• Code of Practice on Pollution Control SS593, 2013 • Environmental Protection and Management Act 2020, Part VII on Hazardous Substances Control • Environmental Protection and Management (Hazardous Substances) Regulations, 2008

Parameter	Legislation, Regulations and Guidelines
	• Environmental Public Health (General Waste Collection) Regulations, 2000 • Environmental Public Health (Toxic Industrial Waste) Regulations, rev. 2000
Vector Control	• Control of Vectors and Pesticides Act, 2020 • Environmental Public Health Act (EPHA), 2020 • NEA Guidelines on Rainwater Collection System and Mosquito Prevention, 2011

4 CONSTRUCTION ENVIRONMENTAL MANAGEMENT & MONITORING PLAN FRAMEWORK

4.1 Objectives

The objectives of this CEMMP are to:

- Ensure compliance with legislation and guidelines.
- Verify environmental performance through information on impacts as they occur.
- Provide feedback for continual improvement in environmental performance.
- Monitor actual impacts of the Project activities on sensitive receptors so that impacts not anticipated in the Environmental Study or long-term impacts which exceed the levels anticipated in the Environmental Study can be identified and appropriate mitigation measures can be adopted in time.

4.2 Organisation Structure and Roles & Responsibilities

The CEMMP organisation structure is as under.

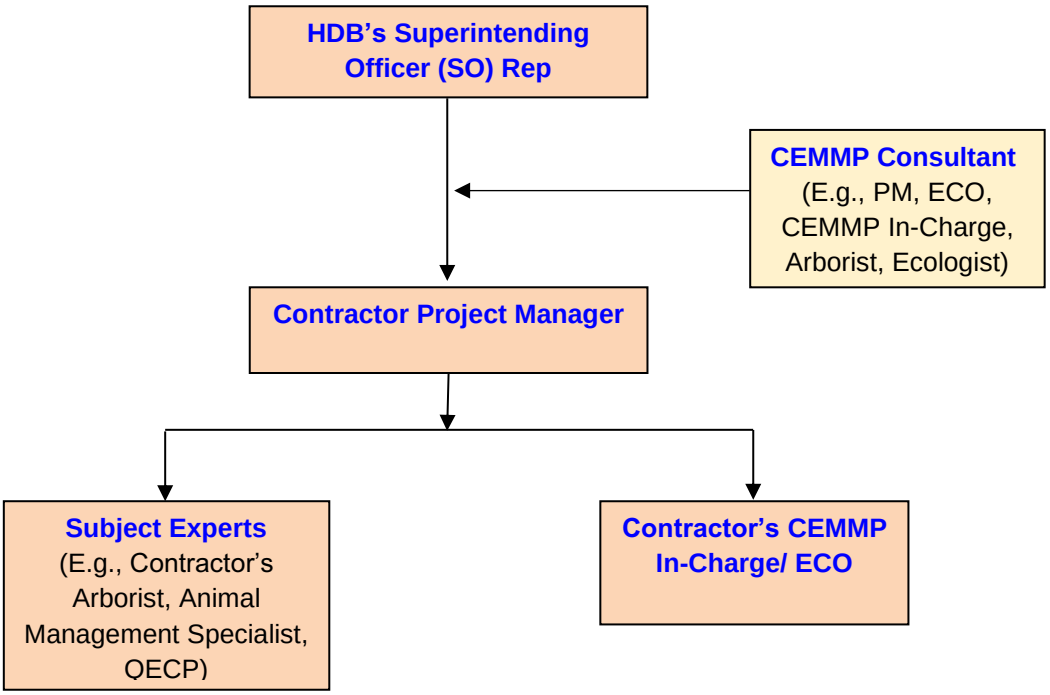


Figure 4.1. CEMMP Organisation Structure

The roles and responsibilities of key stakeholders are as follows.

4.2.1 HDB's Superintending Officer's (SO) Team

- ***HDB's SO Representative***
  - To be the point of contact for HDB.
  - To oversee implementation a CEMMP for the duration of construction phase.
  - To liaise with HDB in mobilising necessary resources to fulfil CEMMP requirements as and when required.
  - To liaise with authorities for CEMMP consultation as and when required.

4.2.2 Contractor's Team

- ***Contractor's Project Manager***
  - To implement a CEMMP for the duration of construction phase.
  - To ensure all necessary CEMMP measures are adhered to.
  - To ensure daily compliance checks on all environmental aspects as per CEMMP requirements are met.
  - To assume ownership of construction activities, including compliance with relevant legislation, guidelines and best practice.
  - To liaise with authorities for CEMMP consultation as and when required.

- ***Contractor's CEMMP In-charge / Environmental Control Officer***
  - To be the point of contact for the Contractor.
  - To act as CEMMP in-charge and lead the implementation of CEMMP during construction phase.
  - To conduct all necessary CEMMP monitoring.
  - To carry out daily compliance checks on all environmental aspects as per CEMMP requirements.
  - To conduct daily toolbox meetings with construction workers including sub-contractors.
  - To monitor ECM performance and coordinate with QECP on specific issues.
  - To coordinate with CEMMP Consultant Team/ CEMMP team members for advice on specific issues related to CEMMP implementation.

- ***Contractor's Arborist***
  - To implement environmental mitigation measures for flora aspect as per CEMMP.
  - To set up Tree Protection Zones (TPZ) for trees to be retained within the site.
  - To conduct fortnightly site visits for flora monitoring to monitor the trees retained within the project site.
  - To monitor all clearance and tree felling activities as and when applicable.
  - To provide monthly reports to the CEMMP Consultant Team.
  - To implement recommendations pertaining to tree protection from the CEMMP Consultant's arborist.
  - To assist in reporting requirements of CEMMP during construction phase.
  - To liaise with NParks on addressing any comments/ requirements related to flora implementation measures.

- ***Contractor's Animal Management Specialist (if needed)***
  - To manage any ad-hoc wildlife encounters during construction phase.
  - To liaise with NParks on appropriate areas for translocation of wildlife within the project site.

- ***Contractor's Qualified Erosion Control Professional (QECP)***
  - To design and endorse the ECM Plan.
  - To verify the implementation of ECM Plan as per the design.
  - Periodic monitoring of the performance of ECM Plan.

4.2.3 Consultant's Team

- ***CEMMP Consultant***
  - To prepare the CEMMP document in consultation with Contractor during pre-construction phase.
  - To assist in obtaining authority approval for CEMMP.
  - During construction phase, review the physical monitoring results (Air, Water, Noise) provided by the Client as per approved CEMMP.
  - To conduct one site visit per fortnight during construction phase to monitor the implementation of mitigation measures for biodiversity.
  - To prepare a monthly monitoring report upon receiving all the data, which includes highlighting and advising on any potential issues regarding the CEMMP implementation.
  - To conduct ad-hoc site visits by ecologist when necessary to advise Client on response protocol in the case of fauna mortality, trapped animals, or human–wildlife conflict.
  - To conduct one training covering CEMMP requirements as well as Biodiversity & Environmental Awareness prior to the commencement of activities on site

- ***Consultant's CEMMP In-charge / Environmental Control Officer***
  - To be the point of contact for the Consultant.
  - To act as CEMMP in-charge and lead the reporting requirements of CEMMP during construction phase.
  - To compile monitoring reports and fulfil reporting requirement.
  - To prepare monthly Site Environmental Performance Reports.
  - To conduct Biodiversity & Environmental Awareness Refresher Briefing every six months during construction phase.
  - To coordinate with CEMMP Consultant Team/ CEMMP team members for advice on specific issues related to CEMMP implementation.

- ***Consultant's Arborist / Flora Specialist***
  - To support Contractor in implementing environmental mitigation measures for flora aspect as per CEMMP.
  - To provide guidance and supervision, to ensure that all the works related to trees are conducted in a safe and professional manner.
  - To conduct fortnightly site visits for flora monitoring to monitor the implementation of flora-related mitigation measures.
  - To provide checks that Tree Protection Zone (TPZ) is not being encroached.
  - To monitor the health of trees located directly outside the project boundary.
  - To assist in reporting requirements of CEMMP during construction phase.
  - To liaise with NParks on addressing any comments/ requirements related to flora implementation measures.

- ***Consultant's Ecologist / Wildlife Specialist***
  - To support Contractor in implementation of environmental mitigation measures for fauna aspect as per CEMMP.

- To conduct pre-clearance wildlife inspection.
- To conduct monthly site inspection to assess implementation of mitigation measures.
- To train and guide the contractor regarding wildlife management.
- To determine if fauna habitats have been degraded beyond authorised working area and to recommend contingency plans if mitigating measures are ineffective.
- To assist in reporting requirements of CEMMP during construction phase.
- To liaise with NParks on addressing any comments/ requirements related to wildlife implementation measures.

4.3 Training and Awareness

To ensure effective implementation of mitigation and monitoring measures, all relevant construction personnel (i.e., Contractor's Project Manager, Construction Manager, Contractor's CEMMP In-charge / ECO, Site Supervisor, Foreman, Construction Worker Team Leader, etc.) will be made aware of the CEMMP requirements prior to commencement of on-site work. The Contractor shall ensure that trainings are conducted before starting the construction work and at a regular interval during construction phase for the site personnel. The recommended training program is provided in Table 4.1.

Table 4.1 Training Programme for Site Personnel.

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

Every training session shall be documented and reported as part of best practices.

4.4 Environmental Incidence Protocol

4.4.1 Response Procedure

The monthly environmental monitoring may result in observations of failed or inadequate mitigation measures. In addition, a public complaint/observation may be received. In the event that a failure is discovered, that failure must be reported to the Contractor's CEMMP In-charge and Contractor's Project Manager within the shortest possible time.

The Contractor's CEMMP In-charge and Contractor's Project Manager will then be responsible for ensuring adequate follow-up activities. This may include:

- Consultation with the CEMMP Consultant Team / Qualified Erosion Control Professional (QECP) / Vector Control Operator (VCO) / Public Relations Officer (PRO).
- Arranging an immediate appropriate response on guidance of the CEMMP Consultant Team / QECP / VCO as necessary.
- Reporting and consultation with the relevant authorities (e.g., NEA, NParks, PUB, etc) if required.

Contact details of the organisation structure shall be provided to the Contractor. In the event of violation of relevant standards/regulations/complaints, the environmental management practices at site are to be reviewed immediately with appropriate mitigation actions taken immediately to reduce impacts to acceptable levels.

4.4.2 Incidence Reporting Flowchart

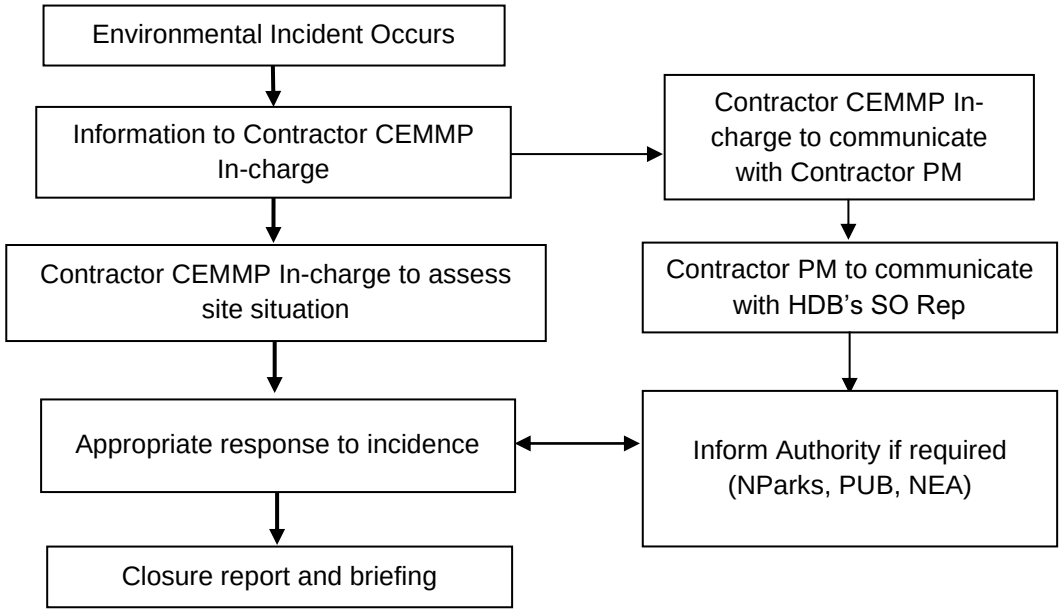


Figure 4.2. Environmental incidence reporting flowchart

Communication Details

Authorities/ Relevant Contacts	Contact Number
NParks Animal Response Centre	1800 476 1600
ACRES Wildlife Rescue	9783 7782
PUB	1800 2255 782
NEA	6225 5632

5 MANAGEMENT PLANS FOR BIODIVERSITY

5.1 Wildlife Management Plan

Given the location of the site within a forest of significant conservation value, it is necessary to minimise impacts to fauna species on the site. The development of a proper Wildlife Response and Rescue Plan will help to reduce impacts to fauna, while also reducing the risk of human-wildlife conflict, which may pose a human health and safety issue if not managed.

Wildlife management should commence prior to construction works. This is to ensure that animals within the site are safely moved outside the working boundaries, either by passive shepherding or capture-and-release. A Wildlife Response and Rescue Plan should then be put in place for the duration of the construction period for animals that may get trapped or injured within the construction site. Regular inspections should be conducted throughout the construction phase to ensure no fauna is trapped or injured at the worksite.

All construction personnel are to be sufficiently trained on biodiversity issues on the site and how to respond to sightings of fauna.

5.1.1 Applicable Legislations

- Animals and Birds Act, 2020
- Endangered Species (Import and Export) Act, 2020
- Fisheries Act, 2020
- Parks & Trees Act, 2020
- Parks & Trees Regulations, 2006
- Parks & Trees Preservation Order, 1998
- Parks & Trees (Composition of Offences) Regulations, 2006
- Parks & Trees (Heritage Road Green Buffers) Order, 2006
- Parks & Trees (Planning Areas) Notifications, 2006
- Wildlife Act, 2020
- NParks Biodiversity Impact Assessment (BIA) Guidelines, 2021
- CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as the Washington Convention), 1983
- IUCN Red List of Threatened Species, 2023
- Singapore Red Data Book, Third Edition (online), 2023

5.1.2 Recommended Mitigation Measures

- Avoid heavy construction activities at night (i.e., limit heavy work activities to the period between 8 am – 6 pm)
- Ensure project layout avoids targeted sensitive receptors and habitats, including Stream 1
- Identify plants of high conservation significance to be transplanted
- Establish Tree Protection Zones (TPZ) for trees to be retained
- Hoard up entire work site. Permanent hoarding is to be embedded along the

perimeter of the working boundaries.

- As far as practicable, avoid the commencement of tree felling during the peak bird nesting period (February to July)
- Visually inspect trees and holes for nesting birds and species of conservation value prior to felling
- Replant new planting verges with native plant species
- Conduct phased /directional clearance of vegetation in the direction away from Ghim Moh Link as well as fauna translocation where required
- Conduct daily checks of ECM blankets and pits to rescue any entrapped fauna
- Implement proper ECMs to prevent impact to adjacent habitats
- Utilise inert construction material
- Ensure equipment, vehicles, and footwear are clean prior to commencing works
- Establish designated areas for food and waste disposal
- During the construction phase, conduct information sessions for workers on what to do upon encountering wildlife
- Conduct regular monitoring of trees and vegetation health during construction phase within project site.

5.1.3 Monitoring Requirements

HDB's Superintending Officer (SO) Representative is to oversee the implementation of the CEMMP throughout the entire construction phase.

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
Biodiversity Monitoring • Avoiding clearance of vegetation outside working boundaries • Minimisation of disturbance to sensitive species	<u>On-site Visual and Compliance Monitoring</u>							
	Habitat Loss and Degradation	• Hoarding to be erected prior to vegetation clearance to demarcate working boundaries • Successful reinstatement of habitats upon work completion where possible • Retain vegetated buffer between construction areas and Stream 1	• Visual monitoring • Compliance check • Water quality monitoring	Entire project site (near / within forested area)	• Proper installation of temporary hoarding/ barriers • Absence of vegetation clearance outside working boundaries	• Weekly during construction phase	• Monthly Environmental Performance Report	• Contractor PM • ECO / CEMMP In-charge • Ecologist • Arborist
• Minimisation of disturbance to sensitive habitats • Avoiding human wildlife conflict	Species Mortality	• Properly designated Tree Protection Zones (TPZ) prior to construction • Visual inspection of trees and holes for nesting birds prior to felling • Directional clearance of vegetation • Translocation of identified plant species • Translocation of targeted animal species • Daily checks of ECM nets for entrapped fauna	• Visual monitoring • Compliance check	Entire project site (near / within forested area)	• Proper TPZ installation • Retention of tree health • Absence of mechanical damage on trees • Absence of nesting birds • Absence of large mammal species • Absence of entrapped fauna	• Prior to vegetation clearance (for wildlife translocation and fauna inspection) • Monthly during construction phase • Daily for fauna entrapment	• Monthly Environmental Performance Report	• Contractor PM • ECO/ CEMMP In-charge • Ecologist • Arborist

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
	Human-wildlife Conflict	• Briefing to on-site workers on dos and don'ts, as well as notes on safety. • Areas are to be demarcated for food consumption and storage.	• Visual monitoring • Compliance check	Entire project site (near forested area)	• No injuries due to wild animals	• Weekly during construction phase	• Monthly Environmental Performance Report	• Contractor PM • ECO/ CEMMP In-charge • Ecologist

5.1.4 Biodiversity Awareness Training

Prior to any construction activities, all construction personnel are to attend a biodiversity awareness training by the CEMMP consultant. This training should impart important information on the ecological importance of the site, and the importance of minimising impacts on the natural environment. Also, they should be trained in the common fauna species they may encounter, and what to do should they have any wildlife encounters.

After the initial training, refresher training and toolbox briefings are to be conducted with the details specified in the following Table 5.1.

Table 5.1. Details of refresher training and daily toolbox briefings

Training Schedule	Training Topics	Conducted by	Target Audience	Frequency
Refresher training	Biodiversity & Environmental Awareness Briefing	Consultant's CEMMP In-charge / ECO	Site personnel, including sub-contractors	Every six months during construction phase
Toolbox briefings	Briefing to include reminders on wildlife encounters and environmental protection	Contractor's CEMMP In-charge / ECO	Construction workers, including sub-contractors	Daily

5.1.5 Lighting Management Plan (LMP)

A Lighting Management Plan (LMP) shall be further developed in consultation with the Contractor prior to the start of any work activities. The LMP will be submitted to NParks for their approval before any nightworks may commence.

5.1.6 Wildlife Management during Site Clearance

Wildlife management during tree clearance is a requirement for the project site. Directional clearance will allow for the passive shepherding of mobile fauna species, while capture-and-release of animals found within the project site may be required for other species. Examples of target species that may require capture-and-release are listed in Table 5.2. Directional clearance is done in order to:

- Minimise the risk of road hazards and kills from the terrestrial fauna that are displaced from the project site onto adjacent roads.
- Minimise the risk of human-wildlife conflict from animals remaining within the project boundaries
- Encourage wildlife movement into designated forested areas located outside of the project site's boundary.

Site clearance to be conducted in the following steps:

- Permanent hoarding along proposed working boundary along Commonwealth Avenue West and Ghim Moh Link, as well as temporary hoarding along the Ulu Pandan Park Connector to prevent entrance of fauna species into construction area and prevent animals from running onto the road

- Manual clearing of undergrowth in phases
- 3 days of rest between the clearance of undergrowth/ shrubs and the clearance of trees
- Phased relocation of temporary hoarding to prevent return of wildlife
- Inspection of trees and tree holes for arboreal fauna, and relocation by qualified agencies and/or specialists
- Felling of remaining trees

Upon completion of the tree felling in the project area, the permanent hoarding will cover the full perimeter of the project worksite.

Due to the topography of the project site, the middle and eastern segments (Figure 2.13) will have to be cleared concurrently. The soil in the middle segment will be used to backfill the eastern segment, which will shorten the time required for soil in the eastern segment to be exposed. By reinstating the eastern segment quickly, the risk of soil erosion in this area, and thus impact into the retained stream, will be minimised.

A portion of the western segment shall also be cleared in the initial stage to create space for the site office and drainage works. The Contractor shall take note of the direction of clearance so as to encourage fauna to move towards Ulu Pandan West.

Target Species

A list of target fauna species has been developed based on the findings of the Environmental Study. Besides species encountered during the baseline surveys, other probable species that exist on the site were also included. This list was developed with the following considerations:

- probable presence of species in the Project area prior to construction;
- risks to species from being in close proximity to construction activities;
- practicality of relocating species from the construction site;
- conservation significance of species; and
- risk of road kills, road hazards, and/or human-wildlife conflict arising from uncontrolled species displacement from the project area.

The target species in the list in Table 5.2 have been categorised into two groups depending on their habits, and thus the approach required for wildlife shepherding. Fauna species in the first category are in general highly mobile species in which a passive approach is recommended, while fauna species in the second category are less mobile and would require a more active approach to shepherding.

Table 5.2. List of identified target species

Category	Species	Active Hours
Category 1 – Passive Shepherding	Long-tailed macaque Common palm civet	Diurnal Nocturnal
Category 2 – Capture-and-release	Smooth-coated otter Black spitting cobra Reticulated python	Diurnal Diurnal Nocturnal

Category	Species	Active Hours
	Clouded monitor Malayan water monitor Other snake species	Diurnal Diurnal Diurnal and nocturnal

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

Methodology and Approach

Directional tree clearance should only be scheduled during daylight hours (8 am to 6 pm). It may include a combination of the following activities:

- Installation of hoarding along project boundaries, which would help to guide target terrestrial fauna in the intended direction of movement and as a barrier to prevent wildlife displacement onto adjacent roads;
- Installation of hoarding along the perimeter of the cleared areas to prevent wildlife from entering the cleared areas;
- Systematic pattern of tree clearance in the site in order to encourage wildlife to move in an intended direction towards adjacent refuge habitats, and;
- Careful survey to check for the presence of target fauna species and any active nests or dens.

Prior to any tree felling, the site is to be inspected by an ecologist to ensure that no target fauna and active nests or dens remain. After clearance of undergrowth, cleared areas should be hoarded up to prevent target terrestrial fauna from entering the site.

The wildlife inspection prior to tree felling and vegetation clearance will also check for any entrapped animals within the hoarded area to be cleared. This inspection will be valid for 14 days only, during which the trapped animals have to be secured away from the site and clearance must be conducted. If more than 14 days has passed and site clearance is not done yet, the inspection should be carried out again.

In the event that any target fauna listed in Table 5.2 are encountered during this process, the following actions which have been developed with the consideration of reducing stress to fauna while ensuring the effectiveness of the exercise shall be taken:

i) Passive Shepherding: These are highly mobile species where passive shepherding is likely to be effective. When species in this category are encountered, personnel should allow the animal to move on its own accord. If necessary, personnel may talk loudly or make some noise by clapping their hands together to encourage the animal to move. If any individual fauna does not move on its own after sufficient time (i.e., up to one hour) has passed, the CEMMP team is to decide on whether to call NParks Animal Response Centre or ACRES for the appropriate removal of the animal.

Should the team encounter a visibly injured animal, NParks Animal Response Centre or ACRES should be called immediately for the next course of action.

No attempt should be made by the CEMMP team, workers, or other unqualified personnel at any point to handle animals on site. Handling animals without appropriate certification is illegal under the recent Wildlife Act of June 2020.

ii) Capture-and-release: Species in this group are less mobile and/or venomous, and a passive shepherding approach is deemed to be ineffective and/or unsafe. A capture-and-release approach will be needed to ensure safe relocation of these fauna from the site prior to construction. In the event that these species are encountered, NParks Animal Response Centre or ACRES should be called immediately for the next course of action. Capture-and release of animals encountered should be conducted by an NParks' licensed Animal Management Specialist.

Before each individual tree is felled, the Wildlife Specialist shall inspect the tree for the presence of fauna, including birds, bats, arboreal mammals, and arboreal herpetofauna. The ecologist should do the following:

- Check the crown of the tree for bird nests
- Check along the trunk from the bottom up for holes in which animals could be nesting
- Scan the trunk and all the branches for animals using the tree
- Scan the ground for potential nests, eggs, or burrows

Photographs of all nests, tree holes, and burrows should be taken for record purposes. In the event that the presence of birds, bats, arboreal mammals and herpetofauna, are found on the tree, tree felling, or transplanting must be postponed until the animal has left the tree on its own accord.

Tree felling or transplanting should not commence during the prime breeding season for birds in Singapore, between the months of February to July. Outside these months, if active nests are detected on the tree, nests shall be left undisturbed until the young birds have fledged. Inactive nests should be removed to minimise the possibility of a new nesting attempt. Tree felling or transplanting shall occur only when no active nests are present on the tree.

Once tree felling is completed, the tree should be inspected again for any animals that were not detected earlier. Should an animal be detected after felling, NParks Animal Response Centre or ACRES should be contacted immediately, especially since the animal might be injured.

Through the undertaking of general approach, a register shall be maintained to record:

- the activities that were carried out,
- the species, numbers, GPS locations, dates, timings, and actions taken (if any) for each target fauna which was identified, and
- the description, GPS location, and actions taken (if any) for each burrow, inhabited tree hole and nest that was identified.

Spatial Visualisation of Directional Clearance

The figures below illustrate the overall scheduled phasing for directional clearance. These activities should take place during daylight hours only (i.e., 8 am to 6 pm) and a minimum of one rest day (i.e., Sunday) per week shall be provided to reduce disturbance to wildlife. Tree felling may commence three days after the understorey vegetation has been cleared.



Figure 5.1. Hoarding before directional clearance commences

Clearance is to commence at the site access areas before other earth and infrastructure works can commence. There are three site access areas as indicated by the white areas – two of which are 20 m by 10 m, and one of which is a route 10 m in width leading to the indicative site office. During clearance of the site access areas, an NParks-approved Animal Management Specialist is to be present at all times in the event of any wildlife encounter.

After the site access areas have been established, permanent hoarding[1] of height 2.4 m is to be erected along the contract boundary, starting with the southern and eastern boundaries. As per NParks' requirements, all permanent hoarding is to be embedded 30 cm underground. The Contractor is to discuss with the QECP on methods to ensure that ponding does not occur adjacent to the embedded hoarding through appropriate

[1] Permanent hoarding shall be of height 2.4 m prior to land clearance. After land clearance, permanent hoarding shall be erected to 6 m along the stream buffer, as well as the western and northern boundaries.

drainage design, the creation of drainage holes, or other suitable methods. Permanent hoarding plans are to be approved by NParks.

Temporary hoarding should be erected along the orange dashed lines shown in each stage of directional clearance (from Figure 5.1 to Figure 5.8). The purpose of the temporary hoarding is to prevent any fauna from entering areas that have been cleared. This means that with each 50 m interval of undergrowth cleared, the location of the temporary hoarding should also move to surround those areas. Temporary hoarding shall be erected three days after undergrowth clearance and before tree felling of each area. Upon completion of directional clearance, the entire contract boundary should be permanently hoarded up and any remaining temporary hoarding can be removed.

Temporary hoarding is also to be erected along the northern boundary and the east segment along Commonwealth Avenue West at the initial stage. This is due to the difficulty of erecting a permanent hoarding within a forested area prior to clearance. A partial hoarding should be erected along the eastern boundary of the pedestrian walkway as indicated by the red dashed line. This partial hoarding should extend to the same height as a permanent hoarding but is specially designed to allow fauna to pass through at the bottom while deterring pedestrians from entering the site. Along the bottom of the hoarding, there should be rectangular openings measuring 1 m in width by 0.8 m in height, spaced 10 m apart. An example of the partial hoarding is illustrated below. Partial hoarding is to remain open at all times of the day.



Figure 5.2. Example of the partial hoarding

Prior to any vegetation clearance in the first 50 m interval, all tree holes, nests, and burrows should also be inspected for wildlife. Directional clearance should be conducted in 50 m intervals as demarcated by the dashed blue lines.

The order of directional clearance should follow the numbering in Figure 5.1. It should commence in three zones simultaneously – (1) the temporary site office zone in the western segment, (2) a 50 m zone in the southeastern corner of the middle segment, and (3) another 50 m zone on the eastern edge of the eastern segment.

Clearance is proposed in the latter two areas simultaneously as the soil from the cleared area west of the retained forested area will be used to backfill the eastern part of the project site, which has lower elevation. Backfilling the area as soon as possible after tree clearance takes place will allow for turfing to be done earlier, so as to reduce the impacts of sediment runoff into adjacent areas.

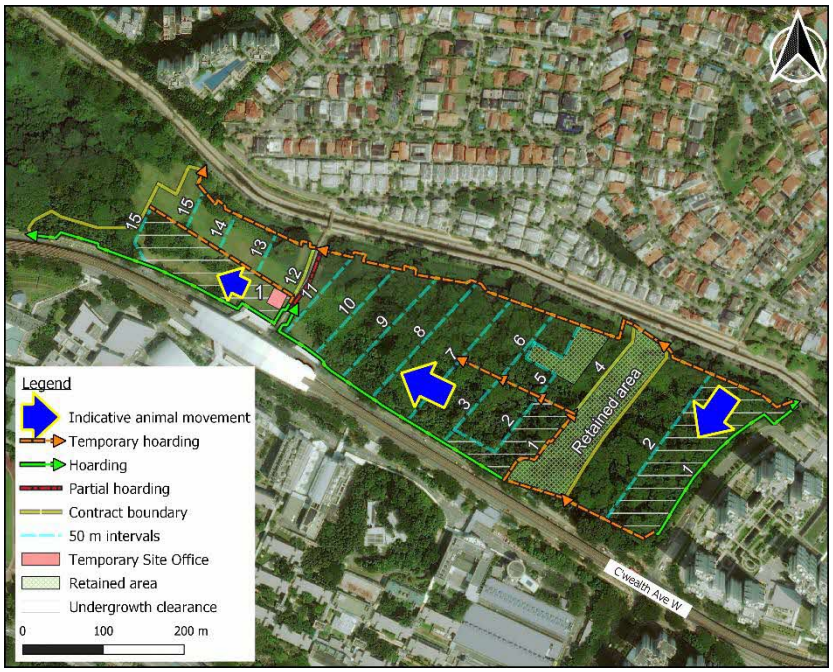


Figure 5.3. Directional Clearance 1

The first 50 m intervals should have their undergrowth layer manually cleared, which would then be followed by a three-day rest period to allow fauna to move out of those areas. All tree holes, nests, and burrows should also be inspected for wildlife. The Contractor should take note of all the trees to be retained.



Figure 5.4. Directional Clearance 2

Following which, these areas should be temporarily hoarded up to prevent fauna from re-entering the site. Tree felling may then commence in those intervals. Directional clearance should take place in the direction of the blue arrow, to encourage fauna to move to the forested areas west of the cleared section.

After the undergrowth in the eastern segment has been cleared, permanent hoarding should be erected around the entire eastern segment along the green lines. There should be no gaps between hoarding to prevent fauna species from entering the site. Permanent hoarding should be erected along the west of Stream 1 as well. Temporary hoarding on the northern and southern boundaries of Stream 1 may now be removed.



Figure 5.5. Directional Clearance 3

On the west of the stream, upon completion of the first three 50 m intervals, directional clearance should continue in the northeast corner. It should continue in 50 m intervals as demarcated by the dashed blue lines. Directional clearance should also take place in the direction of the blue arrows to encourage fauna to move to the forested areas west of the cleared section.

The Contractor should take note that there is an area to be retained, indicated by the green shaded area. Temporary hoarding should be erected around the retained area prior to vegetation clearance surrounding this area. In addition, all tree holes, nests, and burrows should be inspected for wildlife prior to vegetation clearance. In the event of any wildlife encounter, an NParks-approved Animal Management Specialist is to be engaged.

After the undergrowth in each 50 m interval has been cleared, the area should be temporary hoarded along the orange yellow lines. Tree felling may commence after the hoarding has been erected.



Figure 5.6 Directional Clearance 4

At the 100 m interval adjacent to the pedestrian linkway, there should be an Animal Management Specialist on standby to supervise the clearance works and to ensure the safety and survival of crossing fauna.

Upon completion of felling in the middle segment, the partial hoarding should be replaced by permanent hoarding. At this point, the boundaries of the middle area should be completely hoarded up by permanent hoarding along the green lines. There should be no gaps between hoarding to prevent fauna species from entering the site. There should be permanent hoarding on the western boundary of the pedestrian linkway as well.



Figure 5.7. Directional Clearance 5

On the western segment, all tree holes, nests, and burrows should be inspected for wildlife prior to any vegetation clearance. Directional clearance should take place in the direction of the blue arrow, to encourage fauna to move to the forested areas west of the cleared section. This should also be conducted in 50 m intervals following the dashed blue lines.



Figure 5.8. Directional Clearance 6

Once directional clearance has been completed, the full working area should be hoarded up following the contract boundary. Permanent hoarding along the yellow lines, which are on both sides of the stream buffer, the western boundary (facing Ulu Pandan West), and northern boundary (along the PCN), shall be extended to 6 m. Permanent hoarding along the green lines, which are on the eastern boundary (along Ghim Moh link), the southern boundary (along Commonwealth Ave West), and along both sides of the pedestrian linkway, are to maintain its height of at least 2.4 m. The hoarding shall also serve as a noise barrier. There should be no gaps between hoarding to prevent fauna species from entering the site.

5.1.7 Wildlife Response and Rescue Plan

Even upon the completion of wildlife shepherding works, it is highly probable that animals might be able to enter the site and get trapped, particularly burrowing or climbing animals. Whenever fauna is encountered within the working areas, all construction activities should be stopped immediately, and the Wildlife Response and Rescue Plan should be followed. Workers are to notify their supervisor, who will in turn contact the designated ecologist. The ecologist will then decide the next appropriate course of action.

All documentations of wildlife are to be captured in photographs, and a Wildlife Incident Form provided in **Appendix E** is to be filled.

Table 5.3. Wildlife response and rescue plan

Particular	**Within the project site**					**Outside project site**
Timeframe	During working hours					Any time
Animal type	Highly mobile animals (e.g., wild boar, feral dog, smooth-coated otters, and long-tailed macaques)		Non-large animals			Any
			Venomous / poisonous (e.g., king cobra, black spitting cobra)		Non-venomous / -poisonous (e.g., Malayan water monitor)	
Animal condition	Alive / Moving / Resting	Dead	Alive / Moving / Resting	Dead	Any	–
Risk To human	High	Low	High	Low	Low	–
Response	a. Stop work on work site b. Report to Contractor's PM c. Contractor's PM to report to Contractor's and Consultant's CEMMP In-charge d. Contractor's CEMMP In-charge to inform Wildlife Specialist who	a. Barricade affected area b. Report to Contractor's PM c. Contractor's PM to report to Contractor's and Consultant's CEMMP In-charge d. Contractor's CEMMP In-charge	a. Stop work at affected area; if possible, barricade affected area b. Report to Contractor's PM c. Contractor's PM to report to Contractor's and Consultant's CEMMP In-charge	a. Barricade affected area b. Report to Contractor's PM c. Contractor's PM to report to Contractor's and Consultant's CEMMP In-charge d. Contractor's CEMMP In-charge	a. Stop work at affected area; if possible, barricade affected area b. Report to Contractor's PM c. Contractor's PM to report to Contractor's and Consultant's CEMMP In-charge	a. Notify NParks Animal Response Centre/ ACRES hotline if necessary

Particular	Within the project site					Outside project site
	will contact NParks/ ACRES for next steps if necessary	to inform Wildlife Specialist. e. If required, Contractor to assist with transporting of the Wild Animal to Disposal Location	d. Contractor's CEMMP In-charge to inform Wildlife Specialist who will contact NParks/ ACRES for next steps if necessary	to inform Wildlife Specialist. e. If required, Contractor to assist with transporting of Wild Animal to Disposal Location	d. Contractor's CEMMP In-charge to inform Wildlife Specialist who will contact NParks/ ACRES for next steps if necessary	
Remarks	• No attempts shall be made by Contractors to handle the animal • Contractor to take photograph of the animal if possible. • Contractors shall allow the animal to leave the site without harassment / handling • If animal is trapped, notify NParks Animal Response Centre or ACRES hotline • For wild boars found at or around the site, NParks is to be informed as soon as possible for advice and subsequent action. An approved wild boar removal contractor must also be engaged to trap and remove the animal.	• Contractor to take photograph of the animal	• No attempts shall be made by Contractors to handle the animal • Contractor to take photograph of the animal if possible. • Contractors shall allow the animal to leave the site without harassment / handling • If animal is trapped, notify NParks Animal Response Centre or ACRES hotline	• Contractor to take photograph of the animal.	• No attempts shall be made by contractors to handle the animal • Contractor to take photographs of the animal if possible. • Contractors shall allow the animal to leave the site without harassment / handling • If animal is trapped, notify NParks Animal Response Centre or ACRES hotline	• Contractor is encouraged to report • Reports could be from Public and/or Contractor's Staff • If required, CEMMP In-charge to contact PM for assistance of transferring animal carcass to Disposal Location

5.2 Flora Management Plan

The following Flora Management Plan lays out the details on how to select an external nursery, how to carry out native-plant salvaging, how to maintain salvaged saplings, how to carry out tree protection works, the required components of tree assessments and monthly monitoring, etc. The responsibility of native plant salvaging process and management from this project should come under the Nursery Manager. The tree protection and assessment duties should come under the Arborist.

Protection of retained trees should be done though establishment of appropriate Tree Protection Zones (TPZ). Additionally, hoarding to be implemented around the project site to prevent unnecessary vegetation damage outside the project area. Any native flora species found within cleared land should be salvaged whenever possible.

5.2.1 Flora Management During Erection of Hoarding

It is important to ensure that trees outside the worksite boundaries are not impacted when hoarding is erected to demarcate working boundaries.

- Prior to hoarding project site, boundary is to be pegged up to indicate clearly where hoarding is designated to be erected.
- Once the worksite boundary is clearly outlined, the Arborist should walk along the hoarding to assess the potential impacts to trees along the boundary line and advise on the exact placement of the hoarding so as to protect the trees.
- Once the hoarding is in place, the Arborist should monitor the health of the trees along the hoarding line on a monthly basis.

5.2.2 Salvaging of Native Plants

NParks had led plant salvaging activities for the project site. Salvaged native plants and saplings are currently being housed in NParks' Pasir Panjang Nursery as well as the nursery in Singapore Polytechnic.

NParks is working with members of Nature Groups to ensure that the salvaged plants are maintained. NParks plans for the salvaged plants to be used to reforest Ulu Pandan West.

5.2.3 Assessment and Monitoring of Trees to be Protected

Several trees have been identified for potential retention within the project area (Figure 5.9).

In addition, there were seven large trees recommended by members of Friends of Clementi-Ulu Pandan Nature Corridor (CUPNC) to be retained (Table 5.4). Four of the trees were measured during the baseline flora surveys. The Consultant's Arborist shall review the proposed development plan from the Architect to ascertain if these trees can be retained safely at their location.

Table 5.4. List of trees recommended to be retained, provided by Friends of CUPNC

No.	Latitude	Longitude	Description
1	1.31129	103.7824	*Ficus benjamina*. Very large and old banyan tree.
2	1.31044	103.7823	*Ficus macrocarpa*. Moderately large banyan tree
3	1.3111	103.7822	*Ficus variegata.* Three moderately large fig trees.
4	1.3116	103.7808	*Ficus virens*. Nationally critically endangered banyan tree.
5	1.30947	103.7824	*Khaya senegalensis*. Very large African mahogany tree, near to the sidewalk on the border of the forest.
6	1.30919	103.783	*Pterocarpus indicus*. Very large angsana tree, near to the sidewalk on the border of the forest.
7	1.30972	103.7818	*Samanea saman*. Very large rain tree, near to the sidewalk on the border of the forest.

Before any construction activity begins (including both planned and ad-hoc site clearance), the Arborist shall perform pre-construction tree assessment for trees at proposed development site. The Arborist should utilise the Site Layout Plan and Topography Plan to determine the extent of tree roots and tree crown affected by the development. Based on site observation, construction drawing and design, estimated work area boundary, the Arborist shall produce tree assessment report recording tree information such as site and tree photos, species, height, girth, crown spread, tree health, form, structure, site observations and assessment on whether the tree will be affected by proposed development footprint, and if so, what are the recommended mitigation measure to construction impact on trees. This tree assessment report will then serve as a record of the pre-development tree condition, and the Arborist will have to refer to this report as benchmark when performing monthly monitoring for trees.



Figure 5.9 Trees to be retained within and around the project site

Tree pruning such as crown cleaning, formative pruning, structural pruning, or crown thinning should be the first line of mitigation measures. Tree Support Systems such as Tree Guying and Root Anchoring must be considered if the tree is deemed to be

susceptible to wind throw.

5.2.4 Tree Protection Zones

While the design of new residential area doesn't allow retention of large trees within most of the construction footprint, it is possible to retain large trees that fall either (i) inside a footprint that can afford flexibility in location or (ii) outside of construction footprint but within areas with other construction needs. In particular, the trees previously identified for retention (Figure 5.9) should be assessed for retention potential. A TPZ is an area demarcated to protect individual trees, so as to minimise the impacts of construction activities (including root damage, mechanical trunk damage, damage due to soil compaction, etc.) on the tree. NParks (2018) has included some guidelines on Tree Protection Zones in their Guidelines on Greenery Provision and Tree Conservation for Developments.

TPZ size varies depending on tree size (Table 5.5). In general, the remaining space should be sufficient for implementation of design and required infrastructure. Shall the Contractor require ad-hoc space in the midst of construction, the area should be surveyed for native trees to be retained on site and native saplings to be salvaged to on-site nursery before any clearance. If any materials spill into TPZ, the spillage should be cleaned up immediately and the Arborist must be informed. The Contractor shall notify Arborist immediately if trees to be retained are damaged. If the tree suffers from substantial damage as determined by the Arborist, the Contractor should replace the tree of the same species and size.

Table 5.5. TPZ size required for different girth range

Girth	Recommended TPZ (radius)
<0.5m	1 m
>0.5m but less than 1m	2 m
>1m but less than 1.5m	3 m
>1.5m but less than 2m	4 m
>2m	5 m
Fig trees and Trees with Critically Endangered status	Prescribed individually by Arborist on a case-by-case basis

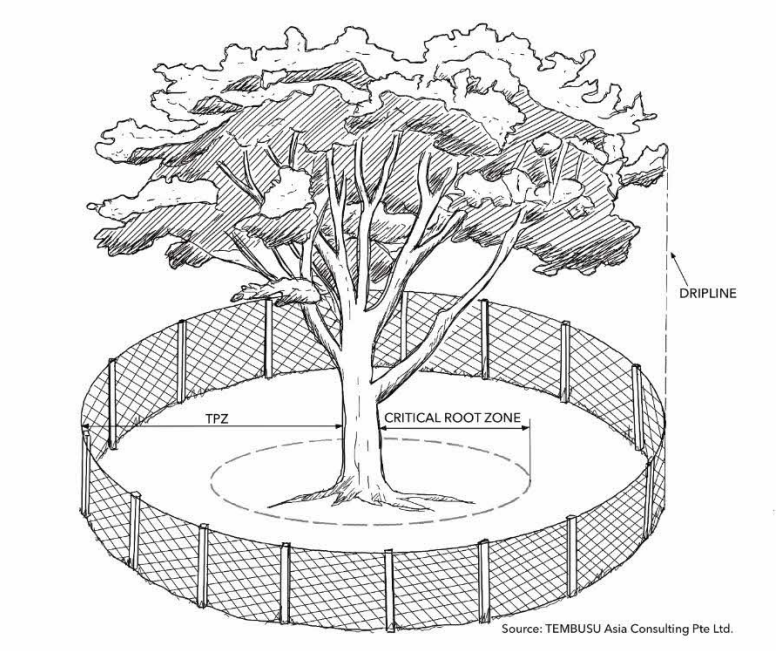


Figure 5.10. Tree Protection Zone Diagram

The following specifies guidelines for construction activities within and outside the TPZ, extracted from NParks (2018).

Inside TPZ

- There must be no excavation, raising or lowering of soil level, compaction or any form of construction activities including temporary works within the hoarded area.
- Dumping of debris, excavated materials and/or storage of construction materials and equipment are not allowed within the TPZ.
- The demolition of drains, structures within the TPZ should be carried out manually and backfilled with Approved Soil Mixture (ASM) immediately.
- Trees are to be watered regularly if rainfall is inadequate.
- Trees are to be 49ertilized if soil tests or deficiency symptoms indicate they are nutrient stressed.

Outside TPZ

- If major roots are encountered during excavation, the main contractor and landscape contractor should consult the Arborist, as cutting of major roots may affect the stability of the tree. Where possible, alternative proposals should be explored to avoid the need to cut the roots.
- In cases where the trees are managed by NParks (e.g., trees within the park connector planting verge), or are required by NParks to be conserved (e.g., trees with girth >1.0 m within Tree Conservation Areas or vacant land), approval from NParks must be obtained before the major root can be cut. If approval is granted by NParks to cut the roots, this must be done with a clean cut using a chainsaw. All building debris and chemical wastes should not be burned or buried within green verges on the site.

Several trees within the project site identified for retention fall close to planned works.

This may affect the feasibility of retaining the tree. This includes at least three trees near the proposed site access in Zone 1 (Figure 5.11) and several trees where drain developments (Zone 2) and 2 shaft placements (Zone 3) have been planned.

During the Arborist assessment, particular attention should be placed in this area. Where possible, shaft locations should be shifted to protect the trees identified for retention. Given the close proximity of the works to the retained trees, the Arborist should pay particular attention to these trees for structural integrity during regular inspections.

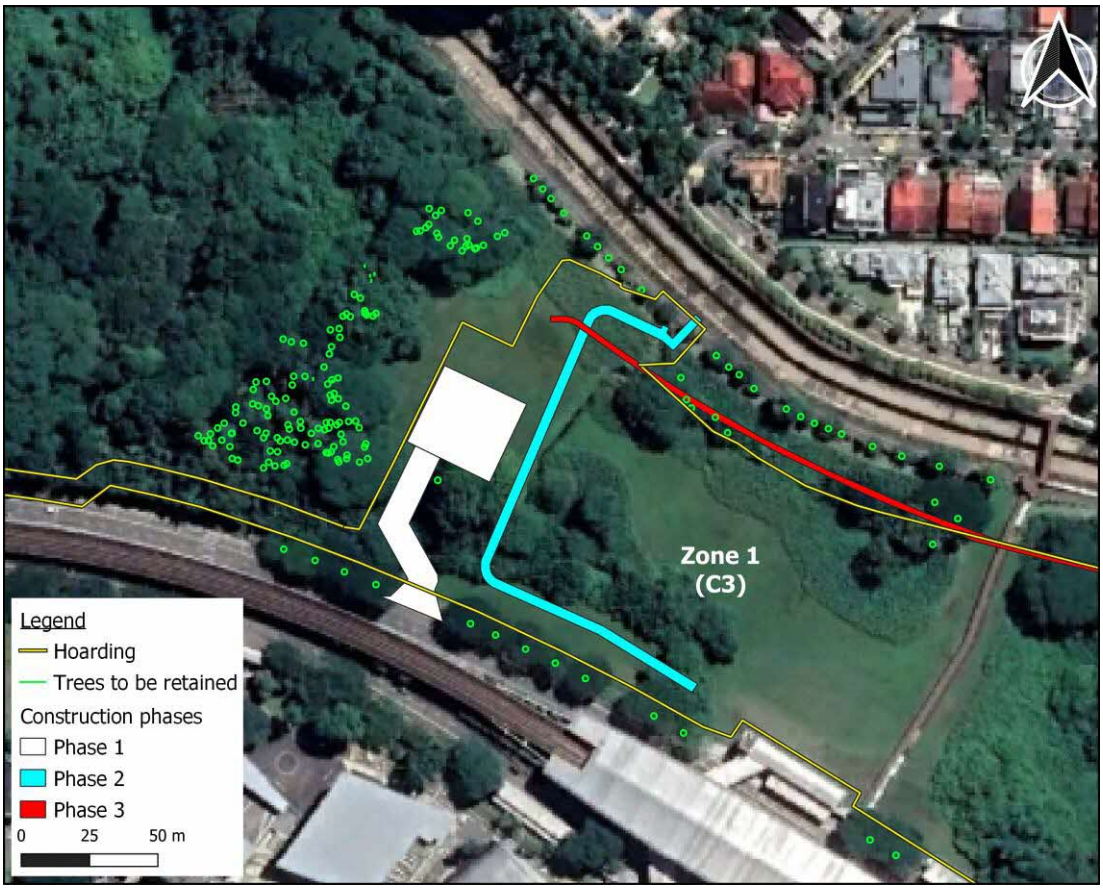


Figure 5.11 Trees to be retained within and around Zone 1 (C3)

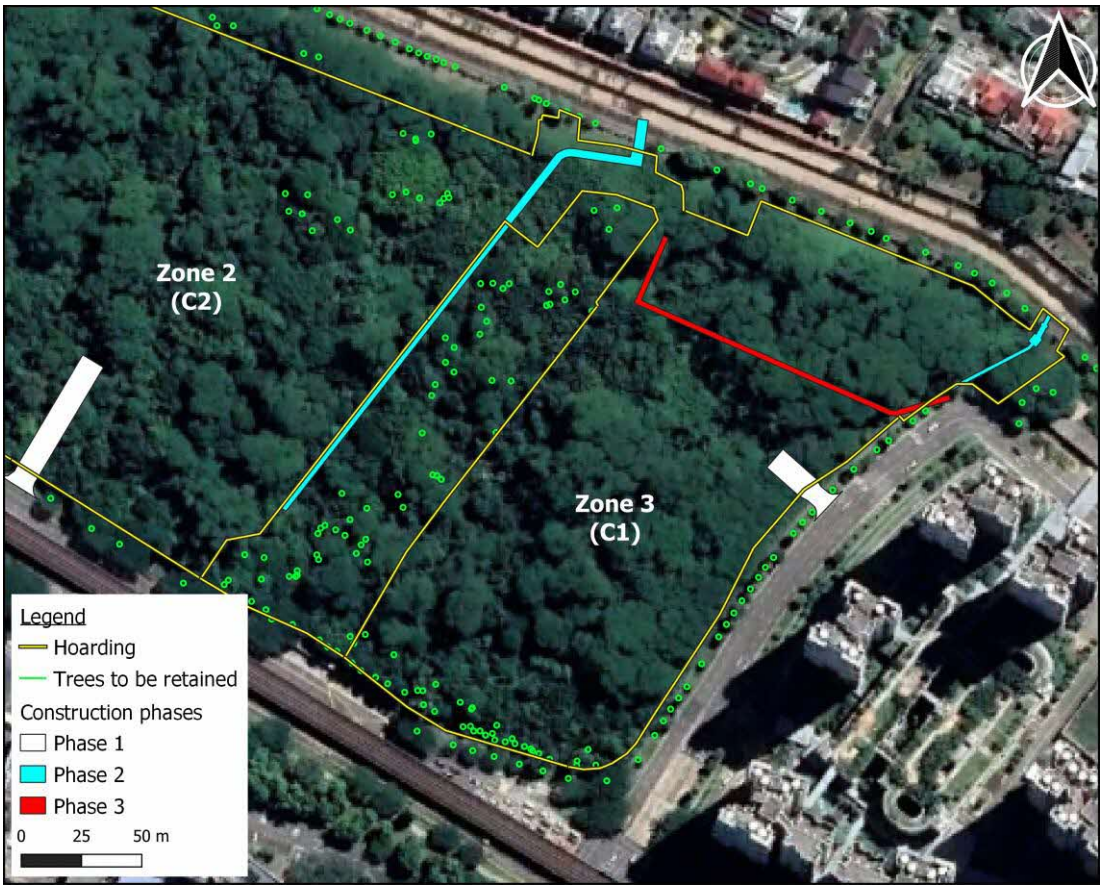


Figure 5.12 Trees to be retained within and around Zones 2 and 3 (C2 and C1)

Additionally, during drain works to connect the drain north of the project site to an existing sump, undergrowth vegetation will have to be cleared within the proposed linear park for construction access (Figure 5.13). Prior to vegetation clearance, the Contractor's Arborist is to do an inspection of the route to ensure that no trees are affected by the works. The Contractor is to erect hoarding along the working boundary and set up Tree Protection Zones for the trees located outside and adjacent to the hoarding.



Figure 5.13 Connection of drain to existing sump, with area of undergrowth clearance between the hoarding lines

5.2.5 Tree Felling Within Forested Areas

Before felling trees, the Arborist must ensure native saplings have already been tagged, identified, and transplanted into on-site nursery. The Arborist must also survey, identify, and confirm the trees to be protected in the surrounding area and establish a tree felling protection distance based on site condition and tree crown spread.

The trees to be felled shall be inspected for any fauna as per guidelines provided in wildlife management plan (Section 5.1). Such trees will be marked with red & white tape and no tree felling operation shall be carried out within 5 m from the said tree until further instruction.

Before commencing tree felling works, the supervisor, banksman, and foreman shall scout the area a final time to ensure that the tree felling protection zone is clear of human activities, while fauna specialist will inspect the tree felling protection zone if the site is free of wildlife activities. Once the areas are cleared, the banksman should signal the excavator operator to commence work for trees felling. The excavator operator should first clear off the shrubs and small trees (<5 m height) to create a clear line of sight for the whole area and to keep away blind spot areas which are blocked by small trees or tall shrubs. The excavator operator shall operate cautiously and fell all small trees and shrubs in a controlled manner, aware of the location of the other trees to be protected.

When opening is completed, the excavator operator should clear off small trees and shrubs along the path into the site so as to demarcate the area that they are supposed to work within. When the paths are cleared, the operator should then move inward to fell trees within the area. If the operator faces a tree with height between 5 and 7 m, they should clear off shrubs in the surrounding area so that the foreman can move closer to the tree. The recommended tree cutting method should be the notch cut (Figure 5.14). The foreman shall determine the direction of falling and ensure the tree does not land on any property, cause injury, or damage nearby Trees to be Protected. To avoid trees leaning to an unintended direction when performing a third cut, the excavator should assist to prevent fall back and guide the tree to fall into the intended direction. Once the tree has been felled, the tree cutter shall cut the tree trunk into shorter lengths for easier loading during clearing of the debris from site.

If the tree has a height greater than 7 m, the tree height has to be reduced by using a lorry crane to perform crown reduction first. Before the lorry crane can enter the site, the Contractor has to prepare proper access for the lorry crane to enter the site and access the tree location. The Contractor must ensure that the access ground is firm enough to allow the lorry crane to deploy its outrigger. When the access is ready, the Contractor will then mobilise the lorry crane to enter the site to reduce tree height to 7 m in order to adopt the notch cut method for trees less than 7 m in height.

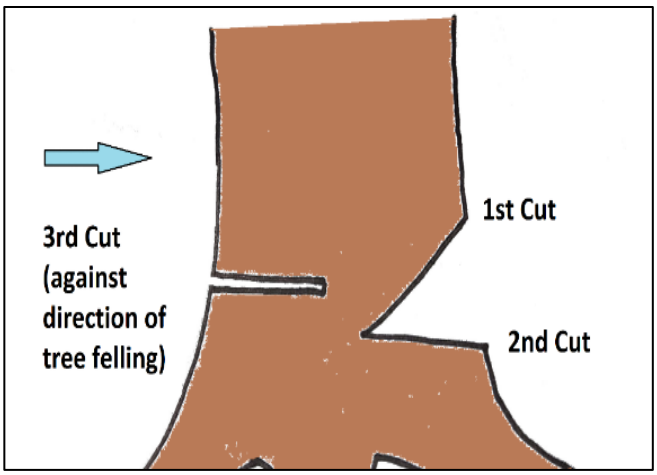


Figure 5.14. Illustration of a notch cut

6 ENVIRONMENTAL MANAGEMENT PLANS

An Environmental Study was carried out for the project site that established baseline conditions within study area, assessed the impacts, and recommended the mitigation measures. The following management plans provide the potential impacts and mitigation measures that are to be implemented during construction phase.

It is recommended to review the whole environmental management plan every quarter to update or adjust the applicable mitigation measures and monitoring requirements based on the various site considerations such as work progress, site utilisation, change in work methods, environmental incident, failure of mitigation measures etc.

6.1 Air Pollution Control Plan

6.1.1 Applicable Legislations and Guidelines

- Environmental Protection and Management Act 1999, Part IV on Air Pollution Control
- Environmental Protection and Management (Vehicle Emissions) Regulations 2008
- Environmental Protection and Management (Prohibition on Use of Open Fires) Order 2008
- Environmental Protection and Management (Air Impurities) Regulations 2008
- Singapore Ambient Air Quality Targets (Long Term Targets)

6.1.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
• Impact to biodiversity due to generation of fugitive dust • Impact on construction workers due to generation of fugitive dust and exhaust emissions from construction machineries	• To implement dust suppression plan • Use of hoarding at project boundary to minimise dust generation by attenuating wind forces. • To avoid stockpiles of soil and dusty materials at project site within forested area as far as possible. • Personal protective equipment i.e., face mask to be worn during dust exposure • Stockpiles of dusty material to be properly stored, covered entirely with impervious sheeting, or dampened with water • Stockpiles to be located away from sensitive receptors • Use of regular watering to reduce dust emissions from exposed site surfaces • Proper maintenance of construction vehicles and fuel burning equipment • Intermittently-used vehicles and machinery are to be shut down between work periods • Provide dust screen at project boundary near residential community

Identified Impacts	Recommended Mitigation Measures
• Impact on ASR (i.e., nearby residents) due to generation of fugitive dust • Impact due to generation of odour	**Site Management Guidelines** • Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken. • Undertake regular on-site and off-site inspections and record results. • Increase the frequency of site inspections during prolonged dry or windy conditions. • Implement a stakeholder communications plan that includes community engagement before work commences on site. • Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable). • Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit. **Measures Specific to PM_{10} and $PM_{2.5}$** • Plan site layout so that machinery and dust causing activities are located away from receptors, where possible. • Keep site fencing, barriers and scaffolding clean by cleaning regularly using wet methods. • Remove materials that have potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site, stockpiled material should be covered, seeded, fenced or enclosed to prevent fugitive dust formation. • Ensure all vehicles and equipment switch off their engines when stationary – i.e. no idling vehicles or engines. Clear signs shall be erected at site entrance to inform all visitors. • No burning of waste or other materials. • Avoid dusty works on windy days; if wind speed reaches more than 5 m/s for over 1 hour, activities should be reduced. • Water and sweeping of roadways often to ensure the vehicles are not picking up dust.

6.1.3 Monitoring Requirements

Technique	Monitoring Parameter	Monitoring Method	Monitoring Location	Standards / Criteria	Duration / Frequency	Reporting	Implementation
On-site Visual and Compliance Monitoring	• Verify implementation of dust suppression plan • Watering to reduce dust emission from exposed areas • Washing bays at exit/entrance points • Implementation of vehicular speed limit within site	• Visual monitoring • Compliance check	Entire project site	Approved Dust suppression plan	• During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO / CEMMP in-charge

Technique	Monitoring Parameter	Monitoring Method	Monitoring Location	Standards / Criteria	Duration / Frequency	Reporting	Implementation
	• Covered stockpiles • Use of PPE (face mask) by construction personnel						
	Maintenance frequency of vehicles and machineries	• Visual monitoring • Compliance check	Entire project site	No visible exhaust plume, dark smoke etc.	• During entire construction phase	Monthly Environmental Performance Report	
Physical Monitoring	CO, NO_2, SO_2, O_3, $PM_{2.5}$, and PM_{10}	Air monitoring equipment (e.g., USEPA FRM/FEM equipment[2])	2 points, see Figure 7.1. None during GIW[3]	Singapore Ambient Air Quality Targets.	• One day (24 hr) continuous monitoring • Once a month (when most of the dust-generating activities are conducted)	Monthly Environmental Performance Report (using calibrated/ corrected PM measurements)	

[2] It is recommended for air quality monitoring to be conducted using a USEPA FRM/FEM equipment. The list of designated reference and equivalent methods can be found at https://www.epa.gov/system/files/documents/2022-06/designated_reference_and_equivalent_methods_-_06152022.pdf. If a non-USEPA FRM/FEM equipment is used, the Monthly Environmental Performance Report is to include information on the co-location or calibration carried out with a USEPA FRM/FEM equipment to ensure the equipment's performance prior to deployment at the project site.

[3] Air monitoring is not included for Ground Improvement Works (GIW) as any generation of dust is expected to be local after implementation of the mitigation measures (e.g., regular watering of exposed site surfaces). If necessary, additional measures shall be proposed to suppress the dust.

6.2 Noise Management Plan

This noise management plan provides the overall management framework for mitigation measures and monitoring requirements. A detailed Noise Management Plan (NMP) in accordance with NEA requirement is to be prepared incorporating below information as well as additional information such as baseline noise levels, and corrected noise standard limits.

6.2.1 Applicable Legislations

- Environmental Protection and Management Act 2002, Part VIII Noise Control
- Environmental Protection and Management (Control of Noise at Construction Sites) Regulations 2008
- NEA Code of Practice on Pollution Control SS 593 (2013)
- LTA Best Environmental Practices: Noise Control at LTA Sites (2013)
- Code of Practice for Noise Control on Construction and Demolition Sites SS602 (2014)

6.2.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
• Disturbance to fauna species in and around the project site • Impact to construction workers due to exposure to high noise levels of construction activities • Impact to NSR due to noise pollution from construction activities	• No heavy nightworks (i.e., limit heavy construction activities to 8 am – 6 pm), • Noise barrier with 6 m height as hoarding along the stream buffer, PCN, and western edge • Noise barrier with 2.4 m height as hoarding along Commonwealth Avenue West, Ghim Moh Link, and pedestrian linkway (Hoarding plans are detailed in **Appendix B** for Infra works**, Appendix C** for GIW, and **Appendix D** for the revised drain alignment) • Quieter equipment and vehicles with low noise levels to be used • For piling work, to consider the use of quieter piling methods • Acoustic enclosures to be considered for compressors, generators, drilling tools etc. • Noise level monitoring throughout all phases to ensure that the construction noises remain within acceptable limits • Personnel are to wear appropriate Personal Protective Equipment (PPE) at all times while on the construction site • All noise barriers and acoustic enclosures to utilse material with a theoretical capability of at least 10 dB(A) noise reduction so as to reduce source noise levels • To consider erection of temporary acoustic barriers around piling equipment • To utilise GIW techniques that have low noise levels such as MSM and DCM and avoid methods such as rigid inclusions, rapid impact compaction, and dynamic compaction • To utilise machinery that are relatively quieter such as mechanical augers instead of power drills

6.2.3 Monitoring Requirements

Technique	Monitoring Parameter	Monitoring Method	Monitoring Location	Standards / Criteria	Duration / Frequency	Reporting	Implementation
On-site Visual and Compliance Monitoring	• Noise barriers around construction work areas • Utilisation of quieter equipment and vehicles with low noise levels • PPE use by construction personnel at all times while on the construction site	• Visual monitoring • Compliance check	Entire project site	Environmental Protection and Management (Control of Noise at Construction Sites) 2008	• Monthly during entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge
Physical Monitoring	• Leq 12 hrs • Leq 1 hr • Leq 5 mins	• Sound level meter • Compliance check	6 points, see Figure 7.1 See Figure 7.2 and Figure 7.3 for revised points	Environmental Protection and Management (Control of Noise at Construction Sites) 2008	• Continuous (24x7) boundary noise monitoring • During entire construction phase • During GIW	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge

6.3 Water Pollution Management Plan

6.3.1 Applicable Legislations

- Sewerage and Drainage Act 2001
- Sewerage and Drainage (Surface Water Drainage) Regulations 2007
- Sewerage and Drainage (Trade Effluent) Regulations revised 2007
- LTA Best Environmental Practices: Earth Control Measures (2014)
- Environmental Protection and Management Act 2002, Part V on water pollution
- Environmental Protection and Management Act (Trade Effluent) Regulations 2008
- PUB Code of Practice on Surface Water Drainage (2018)
- LTA, Best Environmental Practices: Water Resource Management at LTA Sites (2011)
- PUB Handbook on Managing Urban Runoff (2013)
- PUB Guidebook on Erosion and Sediment Control at Construction Sites (2018)

6.3.2 Identified Impacts and Recommended Mitigation Measures

Surface Water Quality

Identified Impacts	Recommended Mitigation Measures
• Degradation and loss of stream habitats • Impact to water quality due to sediment runoff and trade effluent • Impact to water quality due to accidental spillage of construction materials, fuel, and solvents • Impact to water quality due to accidental spillage of construction materials, fuel, and solvents	• Implement ECM plan approved by PUB (**Appendix F** for the entire site area, **Appendix G** for GIW, and **Appendix H** for drainage works) • The minimum dry weather flow to be maintained in the natural stream for sustainability • Design and incorporate open sump • Sump should be designed such that it is able to divert away any additional water during heavy rainfall, and still able to maintain the baseline flow in Stream 1 • Ensure that none of the site investigation (SI) boreholes are located within 10 m of the natural streams • Mobilisation of SI machinery within retained stream area should be done to minimise vegetation clearance. If vegetation clearance is required, this should be kept to a minimum and conducted manually • Temporary hoarding is to be erected at the northern and southern ends of Stream 1 for the construction of the drains (e.g., drain C7) • Regular water quality monitoring is to be conducted according to the proposed Environmental Monitoring Plan during construction and post-construction stage • Design appropriately to ensure that stormwater flow can be controlled during heavy rain period • Hoarding to be erected around the retained stream area • Construction vehicles to use the main road and avoid cutting through the retained stream area • Contractor to provide sufficient storage tanks of adequate size to temporarily store trade effluent before treatment and disposal • Area where trade effluent is being transported out to be kerbed to minimise spills • Contractor to provide sampling point and inspection for collection of trade effluent to be tested for parameters stipulated in the Regulations, depending on the discharge point (i.e., sewer, watercourse) • Contractor should install and maintain trade effluent treatment facilities (e.g., slurry treatment plant, grease trap and suspended solid settling tank) as per NEA's requirements • Appropriate concrete wash bays should be provided and should not be performed in or near any water body • To ensure that slurry is contained within the working area and does not enter any watercourses or surface water drains. • Slurry storage tanks should have secondary containment

Identified Impacts	Recommended Mitigation Measures
	• Foreign material should not be illegally disposed at the water bodies but removed from site by a licensed waste collector • Waste bins to be provided within the construction work area for proper disposal of construction debris and rubbish • Vehicle fueling and major maintenance to be minimised within the project area/ No vehicle fueling and maintenance to be allowed within the project area • Excess loose soil and rock to be contained prior to the commencement of the works • Diesel/ fuel tanks are to be located away from water bodies • To ensure that diesel has stopped leaking from the hose before removing it • To ensure that the inside of the hose is cleared after refuelling • Emergency spill kits should be provided by contractor on site in the event of any chemical spillages Emergency response team should also be trained in the use of these spill kits • Temporary bund walls shall be built prior to the commencement of GIW. The bunds shall be used to contain slurry from GIW activities • Slurry shall be collected and loaded into dump trucks for disposal off-site regularly. No slurry shall be disposed of in the stream or Ulu Pandan Canal • No discharge of silty water into any public drains • Inspect Ulu Pandan Canal regularly for the presence of silty water • Real-time continuous CCTV and TSS monitoring at two GIW discharge points (for exposed areas) following the ECM plan approved by PUB • Visual inspection of TSS at two GIW discharge points (for drainage) following the ECM plan approved by PUB. Visual inspection shall involve taking a picture of the discharge and comparing it to the TSS colour chart. This shall be conducted on every day that has discharge. • Continuous TSS monitoring to be conducted at three discharge points (for drainage works) following ECM plan approved by PUB • Contractor to ensure TSS systems are functioning properly. Should TSS system fail, no discharge is allowed into the storm water drainage system until TSS system is repaired. • Visual inspection of TSS at three discharge points (for drainage works) following ECM plan approved by PUB. Visual inspection shall involve taking a picture of the discharge and comparing it to the TSS colour chart. This shall be conducted on every day that has discharge.

Identified Impacts	Recommended Mitigation Measures
	• Surface water quality monitoring should be conducted at three ECM discharge points with ex-situ testing following NEA Trade Effluent parameters and allowable threshold • All storm water shall be treated within 10 hours to ensure sufficient storage is available for the next storm • Silt fences shall be installed with a minimum exposed height of 600 mm above ground level and are embedded into the ground • Any exposed earth surfaces are to be covered in earth control blankets made of wildlife-friendly, biodegradable material • Along the drains being constructed, concrete berms are to be erected on both sides of the drain to prevent runoff into the drainage construction area. Concrete berms are to be of height 300 mm above ground level following the ECM plan approved by PUB

6.3.3 Monitoring Requirements

Technique	Monitoring Parameter	Monitoring Method	Monitoring Location	Standards / Criteria	Duration / Frequency	Reporting	Implementation
Surface Water Quality							
On-site Visual and Compliance Monitoring	• Verify implementation of ECM Plan • Perimeter cut-off drains, perimeter silt fence, silt traps, sedimentation basin and silt treatment system • No silty discharge	• Visual monitoring • Compliance check • ECM checklist	• Construction area with earthworks • Ulu Pandan Canal	ECM Plan designed by a Qualified Erosion Control Professional (QECP)	• Daily compliance monitoring • During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge • QECP
Physical Monitoring	• Total Suspended Solids (TSS)	• Implementation of TSS monitor and CCTV including a Silty Imagery Detection System (SIDS) • Visual comparison to TSS colour chart at drainage discharge points	Final ECM discharge points, see Figure 7.1 See Figure 7.2 and Figure 7.3 for revised points	• Less than 50 mg/L for TSS • Sewerage and Drainage (Surface Water Drainage) Regulation 2007	• Real-time continuous during entire construction phase • Daily at drainage discharge points, when there is discharge	• TSS report • Visual inspection findings • Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge • QECP

Technique	Monitoring Parameter	Monitoring Method	Monitoring Location	Standards / Criteria	Duration / Frequency	Reporting	Implementation
	• All parameters identified in EPM (Trade Effluent) Regulations for Controlled Watercourse • Additional parameters: • Aluminium, Conductivity, Turbidity, Total nitrogen, Total phosphorous, Total organic carbon, Ammonia, Enterococcus	Ex-situ monitoring	At every discharge outlet, see Figure 7.1 See Figure 7.2 and Figure 7.3 for revised points	• EPM (Trade Effluent) Regulations for Controlled Watercourse	• Once a month • During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge
Water Quality in Stream 1							
Physical Monitoring	• All parameters identified in EPM (Trade Effluent) Regulations for Controlled Watercourse • Flow velocity	In-situ and ex-situ monitoring	3 points in Stream 1, see Figure 7.1 None during GIW[4]	• EPM (Trade Effluent) Regulations for Controlled Watercourse • Baseline results	Monthly during construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge

6.4 Vibration Management Plan

6.4.1 Applicable Legislations

- Environmental Protection and Management Act 2002, Part VIII Noise Control
- NEA Code of Practice on Pollution Control SS 593 (2013)
- Code of Practice for Noise Control on Construction and Demolition Sites SS602 (2014)

6.4.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
• Disturbance to the	• Use of heavy equipment to be restricted to daylight hours only

[4] Water quality monitoring of the stream will be handed over to the scope of the Building Contractor.

Identified Impacts	Recommended Mitigation Measures
fauna due to vibration from construction activities • Disturbance/ annoyance to the VSR due vibration from construction activities	• Use of equipment or method which generate lower vibration levels • Route heavily loaded trucks away from the VSRs as far away as possible. • To plan and phase excavation, earth-moving, and ground pilling activities in staggered manner • Control speed of vehicle movement at the worksite • Keep access roads within project work site in good condition • To develop the vibration monitoring plan in consultation QP & to monitor throughout construction period • Notify nearby VSRs (residences) in advance of the construction activities • To utilise GIW techniques that are less vibrationally intensive such as MSM and DCM and avoid methods such as rigid inclusions, rapid impact compaction, and dynamic compaction • To utilise machinery that are less vibrationally intensive such as mechanical augers instead of power drills

6.4.3 Monitoring Requirements

Technique	Monitoring Parameter	Monitoring Method	Monitoring Location	Standards / Criteria	Duration / Frequency	Reporting	Implementation
Physical Monitoring	Vibrations (mm/s)	Vibration meter	• One location based on Contractor's Instrumentation Plan • See Figure 7.2 and Figure 7.3 for revised points	Refer to instrumentation monitoring plan as advised by QP	• Refer to instrumentation monitoring plan as advised by QP • During GIW	• Vibration monitoring report • Monthly Environmental Performance Report	• QP • Contractor's ECO/ CEMMP in-charge

6.5 Waste Management Plan

6.5.1 Applicable Legislations

- Environmental Protection and Management Act 2002, Part VII on Hazardous Substances
- Environmental Protection and Management (Hazardous Substances) Regulations 2008
- Environmental Public Health (General Waste Collection) Regulations 2000
- Environmental Public Health (Toxic Industrial Waste) Regulations 2000
- Best Environmental Practices: Construction Waste Management at LTA Sites (2009)

6.5.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
• Disposal of general waste material • Disposal of hazardous waste material • Disposal of contaminated excavated soil	• All wastes and debris will be disposed only in designated waste disposal facilities and appropriately separated, i.e. by training workers to properly sort and label the different types of waste (reusable and recyclable waste, toxic and non-toxic waste, etc.). • Timber/wood from cut vegetation can be recovered for use in the wood industry as far as possible. • Scrap metals to be recovered and sent for recycling as scrap • Inert general waste to be collected and disposed through licensed waste collector • All non-hazardous wastes to be handled and disposed of in accordance with EPH (General Waste Collection) Regulations **Hazardous Waste** • All hazardous wastes to be handled and disposed of in accordance with EPH (Toxic Industrial Wastes) Regulations • Disposal of hazardous waste to be conducted by a licensed waste collector for hazardous waste. • Provision of secondary containment for all toxic waste stored in bulk as per the requirements. • Preparing emergency response plan, training the ERT to be competent in the response mechanism and ensuring availability of response kits for any spillages. • Any hazardous wastes that are generated must be handled and disposed of in accordance with the requirements of the EPHA and the EPH (Toxic Industrial Wastes) Regulations. **Contaminated Excavated Soil** • To develop solid waste management plan • Surplus excavated material to be reused within project site as fill, landscaping, erosion control and restoration wherever practicable

6.5.3 Monitoring Requirements

Technique	Monitoring Parameter	Monitoring Method	Monitoring Location	Standards / Criteria	Duration / Frequency	Reporting	Implementation
On-site Visual and Compliance Monitoring	• Engagement of NEA licensed general waste collector for hazardous waste • Record of waste disposal	• Visual monitoring • Compliance check	Entire project site	Environmental Public Health (Toxic Industrial Wastes) Regulation, 2000	During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge
	• Verify implementation of solid waste management plan • Engagement of NEA licensed general waste collector • Record of waste disposal	• Visual monitoring • Compliance check	• Construction waste storage location • General waste storage location	Environmental Public Health (General Waste Collection) Regulation, 2000	During entire construction phase		• Contractor's PM • Contractor's ECO/ CEMMP In-charge

6.6 Vector Control Plan

6.6.1 Applicable Legislations

- Control of Vectors and Pesticides Act 2002
- NEA guidelines on “Rainwater Collection System and Mosquito Prevention
- LTA Best Environmental Practices: Vector Control at LTA Sites (2019)

6.6.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
• Increase in mosquito breeding and dengue cases due to work activities • Increase in other vectors breeding due to work activities	• Contractor to engage an NEA-registered Vector Control Operator (VCO) to prepare and implement vector management plan • A vector control team to check construction sites for breeding of mosquitoes • Construction worksite to be kept free of litter; construction wastes shall be disposed promptly into bulk waste containers and the containers shall be emptied daily • Worksite shall be kept litter-free and waste bins shall always be covered tightly. • Construction workers’ food provisions shall be stored in rodent-proof rooms or cabinets • Vector Control Operator to check for rodent burrows every week • To implement mitigation measures to control mosquito numbers and other vectors • To aid the authorities to investigate outbreaks of vector-borne diseases if required • Thermal fogging shall not be carried out due to location of project site adjacent to a forested area.

6.6.3 Monitoring Requirements

Technique	Monitoring Parameter	Monitoring Method	Monitoring Location	Standards / Criteria	Duration / Frequency	Reporting	Implementation
On-site Visual and Compliance Monitoring	• Verify implementation of vector control management plan • Engagement of NEA-registered Vector Control Operator (VCO)	• Visual monitoring • Compliance check	Entire project site	• Vector control management plan • Control of Vectors and Pesticides Act, 2002 • Best Environmental Practices: Vector Control at LTA Sites (2019)	• Daily during entire construction phase • Weekly VCO visit	Monthly Environmental Performance Report	• Contractor’s PM • Contractor’s ECO/ CEMMP in-charge

7 ENVIRONMENTAL MONITORING PLAN

The summary of the proposed Environmental Monitoring Plan is presented in this chapter. Environmental monitoring parameters are to follow the locations identified in Figure 7.1. While both infrastructure and building works are conducted simultaneously, the monitoring locations for the infrastructure works are to follow Figure 7.2 and Figure 7.3.

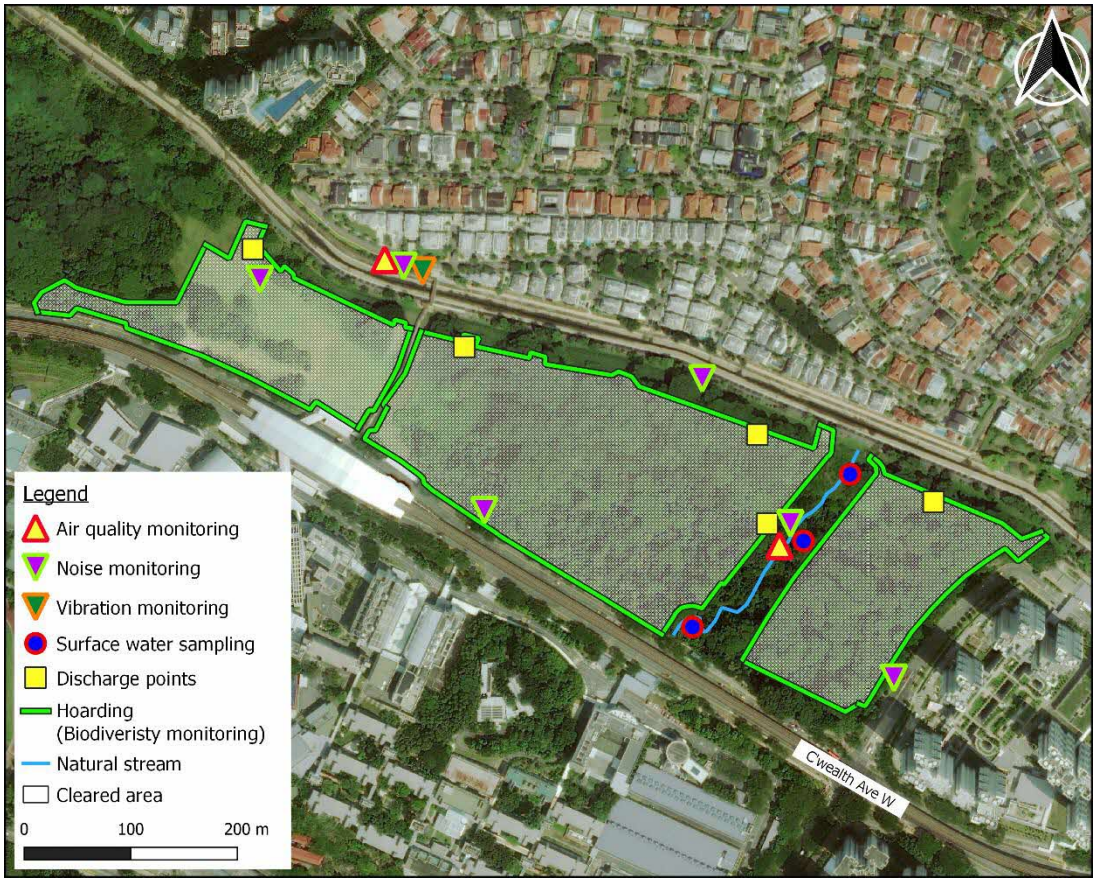


Figure 7.1 Monitoring locations during construction phase

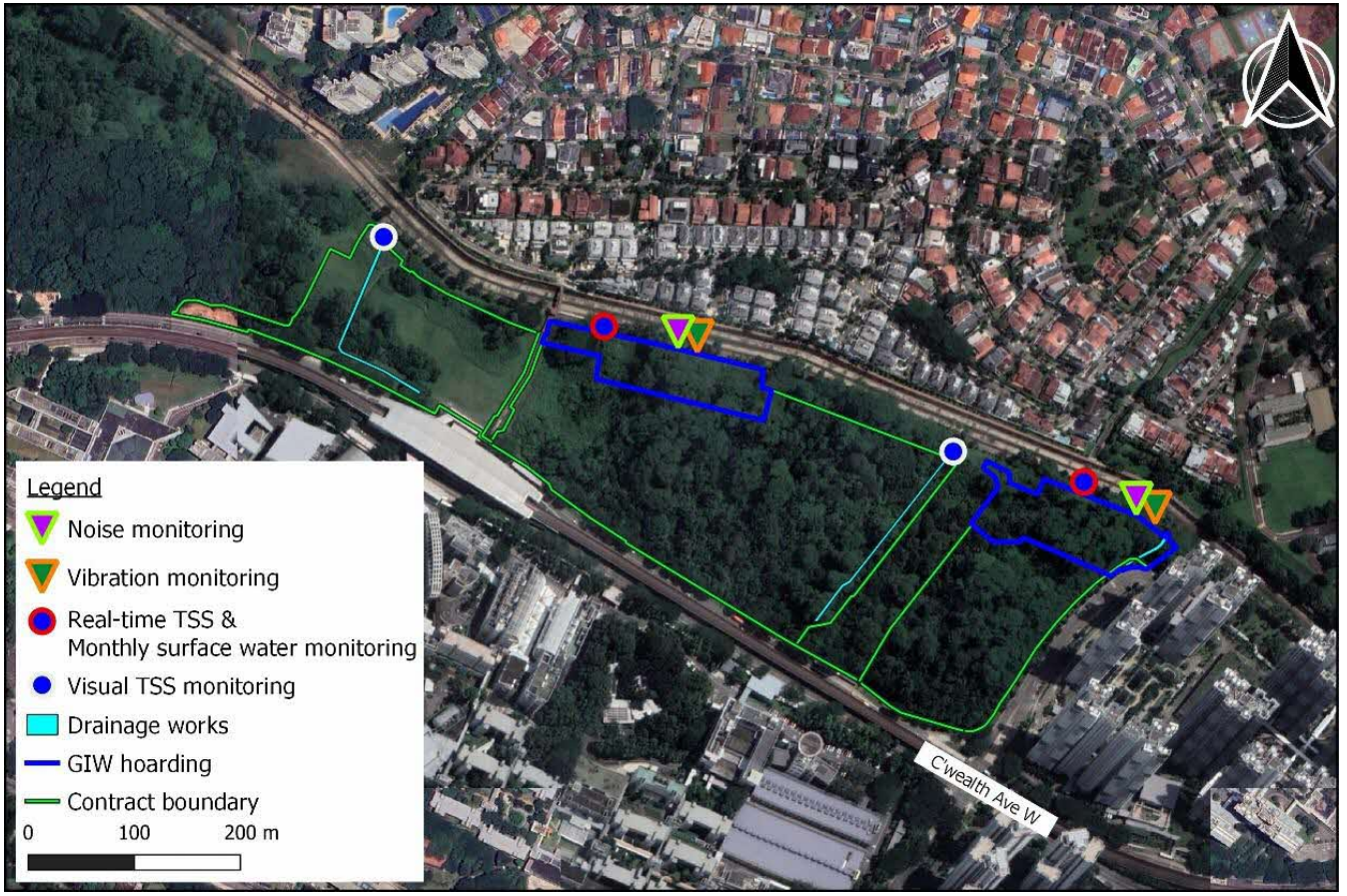


Figure 7.2. Monitoring locations for Infrastructure Contractor during overlap with Building Contractor, during GIW phase



Figure 7.3. Monitoring locations for Infrastructure Contractor during overlap with Building Contractor, during drainage works

HDB's Superintending Officer (SO) Representative is to oversee the implementation of the CEMMP throughout the entire construction phase. It is recommended to review the monitoring plan and locations regularly to update or adjust the monitoring requirements based on the various site considerations such as work progress, site utilisation, change in work methods, environmental incident, failure of measures etc.

Table 7.1. Environmental monitoring plan for construction phase

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
Biodiversity Monitoring • Avoiding clearance of vegetation outside working boundaries • Minimisation of disturbance to sensitive species • Minimisation of disturbance to sensitive habitats • Avoiding human wildlife conflict	<u>On-site Visual and Compliance Monitoring</u>							
	Habitat Loss and Degradation	• Hoarding to be erected prior to vegetation clearance to demarcate working boundaries • Successful reinstatement of habitats upon work completion where possible • Retain vegetated buffer between construction areas and Stream 1	• Visual monitoring • Compliance check • Water quality monitoring	Entire project site (near / within forested area)	• Proper installation of temporary hoarding/ barriers • Absence of vegetation clearance outside working boundaries	Fortnightly during construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge • Contractor's Arborist • Consultant's Arborist • Consultant's Ecologist
	Species Mortality	• Properly designated Tree Protection Zones (TPZ) prior to construction • Visual inspection of trees and holes for nesting birds prior to felling • Directional clearance of vegetation • Translocation of identified plant species • Translocation of targeted animal species • Daily checks of ECM nets for entrapped fauna	• Visual monitoring • Compliance check	Entire project site (near / within forested area)	• Proper TPZ installation • Retention of tree health • Absence of mechanical damage on trees • Absence of nesting birds • Absence of large mammal species • Absence of entrapped fauna	• Prior to vegetation clearance (for wildlife translocation and fauna inspection) • Monthly during construction phase • Daily for fauna entrapment	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge • Contractor's Arborist • Consultant's Arborist • Consultant's Ecologist

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
	Human-wildlife Conflict	• Briefing to on-site workers on dos and don'ts, as well as notes on safety. • Areas are to be demarcated for food consumption and storage.	• Visual monitoring • Compliance check	Entire project site (near forested area)	• No injuries due to wild animals	Weekly during construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge • Consultant's Ecologist
Noise Monitoring • Minimisation of biodiversity disturbance due to construction noise • Minimisation of nuisances to human due to construction noise	<u>On-site Visual and Compliance Monitoring</u>							
	Disturbance to biodiversity and human due to construction noise	• Noise barriers around construction work areas • Utilisation of quieter equipment and vehicles with low noise levels • PPE use by construction personnel at all times while on the construction site	• Visual monitoring • Compliance check	Entire project site	Environmental Protection and Management (Control of Noise at Construction Sites) 2008	Monthly during entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge
	<u>On-site Noise Monitoring</u>							
	Noise generated from construction work	• Leq 12 hrs • Leq 1 hr • Leq 5 mins	Sound level meter	• 6 points, see Figure 7.1 • See Figure 7.2 and Figure 7.3 for revised points	Environmental Protection and Management (Control of Noise at Construction Sites) 2008	• Continuous (24x7) noise monitoring • During entire construction phase • During GIW	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge
Water Quality Monitoring • Minimisation of impact to	<u>On-site Visual and Compliance Monitoring</u>							
	ECM non-compliance	• Verify implementation of ECM Plan • Perimeter cut-off drains, perimeter silt fence, silt traps,	• Visual monitoring • Compliance check	• Construction area with earthwork • Ulu Pandan	ECM Plan designed by a Qualified Erosion Control	• Daily compliance monitoring • During	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
waterbodies due to contaminated site run-off • Minimisation of impact to terrestrial habitats due to erosion of topsoil		sedimentation basin and silt treatment system • No silty discharge	• ECM checklist	Canal	Professional (QECP)	entire construction phase		• QECP
	<u>On-site Water Quality Monitoring</u>							
	ECM discharge (sediment runoff)	• Total Suspended Solids (TSS)	• TSS monitor and CCTV with Silty Imagery Detection System (SIDS) • Visual comparison to TSS colour chart	• Final ECM discharge points • See Figure 7.2 and Figure 7.3 for revised points.	• Less than 50 mg/L for TSS • Sewerage and Drainage (Surface Water Drainage) Regulation 2007	• Real-time continuous during entire construction phase • Daily, when there is discharge	• TSS report • Visual inspection findings • Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge • QECP
	Contamination of water resources through trade effluent discharge	• All parameters identified in EPM (Trade Effluent) Regulations for Controlled Watercourse • Additional parameters: Aluminium, Conductivity, Turbidity, Total nitrogen, Total phosphorous, Total organic carbon, Ammonia, Enterococcus	Ex-situ monitoring	Final ECM discharge points See Figure 7.3 for revised points.	EPM (Trade Effluent) Regulations for Controlled Watercourse	• Once a month • During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge
	Degradation of stream habitat (Construction stage monitoring)	• All parameters identified in EPM (Trade Effluent) Regulations for Controlled Watercourse	In-situ and ex-situ monitoring	Stream 1 None during GIW[5]	• EPM (Trade Effluent) Regulations for Controlled	Monthly during construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge

[5] Water quality monitoring of the stream will be handed over to the scope of the Building Contractor.

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
		• Flow velocity			Watercourse • Baseline results			
Air Quality Monitoring • Minimisation of human health & biodiversity impacts due to dust pollution • Minimisation of human health impacts due to exhaust emissions	<u>On-site Visual and Compliance Monitoring</u>							
	Fugitive dust emissions	• Verify implementation of dust suppression plan • Watering to reduce dust emissions from exposed areas • Washing bay • Implementation of vehicular speed limit • Covered stockpiles • Use of PPE (face mask) by construction personnel	• Visual monitoring • Compliance check	All construction areas	Approved dust suppression plan	During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge
	Exhaust emission from construction machineries operations	Maintenance frequency of vehicles and machineries	• Visual monitoring • Compliance check	All construction areas	No visible exhaust plume, dark smoke etc.	During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge
	<u>On-site Air Quality Monitoring</u>							
	Particulate matter emission from construction activities	CO, NO_2, SO_2, O_3, $PM_{2.5}$, and PM_{10}	Air monitoring equipment (e.g., USEPA FRM/FEM equipment[6])	2 points, see Figure 7.1. None during GIW[7]	Singapore Ambient Air Quality Targets	• One day continuous monitoring • Monthly	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge

[6] It is recommended for air quality monitoring to be conducted using a USEPA FRM/FEM equipment. The list of designated reference and equivalent methods can be found at https://www.epa.gov/system/files/documents/2022-06/designated_reference_and_equivalent_methods_-_06152022.pdf. If a non-USEPA FRM/FEM equipment is used, the Monthly Environmental Performance Report is to include information on the co-location or calibration carried out with a USEPA FRM/FEM equipment to ensure the equipment's performance prior to deployment at the project site.

[7] Air monitoring is not included for Ground Improvement Works (GIW) as any generation of dust is expected to be local after implementation of the mitigation measures (e.g., regular watering of exposed site surfaces). If necessary, additional measures shall be proposed to suppress the dust.

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
Vibration Monitoring • Minimisation of biodiversity disturbance due to vibration • **Minimisation of nuisances to human due to** vibration	<u>On-site Air Quality Monitoring</u>							
	Disturbance due to vibration generated from construction work	Vibrations (mm/s)	Vibration meter	• One location based on Contractor's Instrumentation Plan • See Figure 7.2 and Figure 7.3 for revised points	Refer to instrumentation monitoring plan as advised by QP	• Refer to instrumentation monitoring plan as advised by QP • During GIW	• Vibration monitoring report • Monthly Environmental Performance Report	• QP • Contractor's ECO/ CEMMP in-charge
Light Impact Monitoring • Minimisation of light pollution impacts on ecological processes	<u>On-site Visual and Compliance Monitoring</u>							
	Light pollution affecting sensitive species	• Appropriate positioning of lights • Scheduling of activity during nightworks • Turn off all unnecessary lights outside working hours	• Visual monitoring • Compliance check	Entire project site (near forested area)	• Absence of heavy nightworks • All artificial lights to be downward facing, turned away from forested areas	During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge • Consultant's Ecologist
Vector Monitoring • Minimising the impacts due to increase in vector related diseases	<u>On-site Visual and Compliance Monitoring</u>							
	Increase in the Incidence of vectors & related diseases	• Verify implementation of vector control management plan • Engagement of NEA registered Vector Control Operator • Appointment of a vector control team	• Visual monitoring • Compliance check	Entire project site	• Vector control management plan • Control of Vectors and Pesticides Act, 2002	During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
Waste Management Monitoring • Minimising the impacts due to improper disposal of hazardous and general waste	<u>On-site Visual and Compliance Monitoring</u>							
	Improper disposal of hazardous waste leading to land pollution	• Engagement of NEA licensed general waste collector for hazardous waste • Record of waste disposal	• Visual monitoring • Compliance check	Entire project site	Environmental Public Health (Toxic Industrial Wastes) Regulation, 2000	During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge • QECP
	Improper disposal of construction waste leading to land pollution	• Verify implementation of solid waste management plan • Engagement of NEA licensed general waste collector • Record of waste disposal	• Visual monitoring • Compliance check	• Construction waste storage location • General waste storage location	Environmental Public Health (General Waste Collection) Regulation, 2000	During entire construction phase	Monthly Environmental Performance Report	• Contractor's PM • Contractor's ECO/ CEMMP In-charge

8 CEMMP REPORTING

8.1 Site Environmental Control Report by Environmental Control Officer

As per Code of Practice for Environmental Control Officers for Construction Sites, the Contractor's ECO shall prepare the Site Environmental Control Programme before work commences at the worksite and submit it to the Consultant's ECO for review. After which, the Contractor's ECO shall submit the Site Environmental Control Report (SECR) to the Contractor's Project Manager covering assessment of the environmental efforts carried out and review the effectiveness of these measures.

The Contractor's ECO shall 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 CEMMP's recommendations. The Contractor's ECO shall record all observations and actions taken for the Consultant's ECO to report them in the SECR. This SECR should form part of CEMMP monthly performance report described in next section.

8.2 Monthly Environmental Performance Report

A monthly Environmental Performance Report is to be prepared by the Consultant's CEMMP In-charge in assistance with CEMMP Team and to be submitted to HDB's SO representative, project management team and relevant authorities. The Performance Report is to include the description of the construction activities being carried out at site during the month and the status of CEMMP implementation including information on environmental incidence if any. Table 8.1 provides the monthly environmental performance reporting framework.

Table 8.1. Monthly Environmental Performance Report framework

No.	Chapter	Input By	Content Reference
1.	Introduction	Contractor's PM, Contractor's CEMMP In-charge, Health, Safety and Environment (HSE) Manager	Description of construction activities within project area
2.	Project Status	Contractor's PM, HSE Manager, Contractor's CEMMP In-charge	Update on construction activities within project area
3.	CEMMP Implementation Status	HSE Manager, Contractor's CEMMP In-charge, Contractor's Arborist, CEMMP Consultant, Consultant's Ecologist/ Wildlife Specialist, Consultant's Arborist / Flora Specialist, QECP, PRO, VCO	Daily observations and actions taken, ECO report, ECM performance checklist, Wildlife Specialist's and Flora Specialist's observations and recommendations, Physical monitoring results (Noise, Air, Surface water quality, ECM discharge) and assessment, Vector control report, Waste disposal record

No.	Chapter	Input By	Content Reference
4.	Environmental Awareness Training	HSE Manager, Consultant CEMMP In-charge, Contractor CEMMP In-charge	Record of periodic biodiversity awareness training, toolbox briefings
5.	Environmental Incidence	HSE Manager, Contractor CEMMP In-charge, PRO	Environmental Incident report and corrective actions, Public feedback & response
6.	Authority Inspection & Findings	HSE Manager, Contractor CEMMP In-charge	Record of authority inspection visits (i.e. NParks, NEA, PUB) and corrective actions

8.3 Environmental Close-off Report

A final environmental close-off report should be prepared after construction work is completed to address all residual impacts where possible and mention the state of the site.

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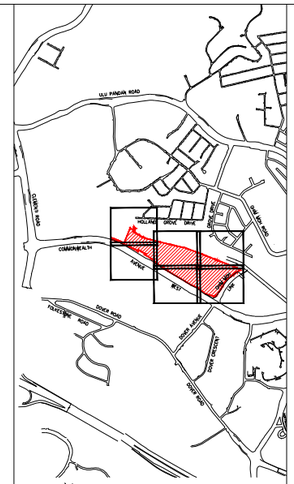
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APPENDIX A – OVERALL SITE PLAN





KEY PLAN
1 : 20000

MAIN CONTRACTOR:

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12 TUAS SOUTH STREET 6
SINGAPORE 636911
Tel : 65659511 Fax : 65659513

SURVEYOR:

CLIENT

HOUSING & DEVELOPMENT BOARD
HDB Hub 480 Lorong 6 Toa Payoh
Singapore 310480
CLIENT SIGNATURE:

DRAWING NO. | REVISION :

PROJECT TITLE
INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT

LOT NO. : 05193M AND 07126K | MUKIM NO. : 03 & 04

JOB TITLE
PROPOSED SITE CLEARANCE AND EARTHWORKS FOR HDB DEVELOPMENT

DRAWING TITLE

SCALE: 1 : 1500 | DATE: NOV 2024

Surbana Jurong Consultants Pte. Ltd.
Surbana Jurong Campus
38 Cleantech Loop #01-31
Singapore 636741
Tel: +65 62481288 Fax: +65 62739090
www.surbanajurong.com
Company Regn No: 200304951Z

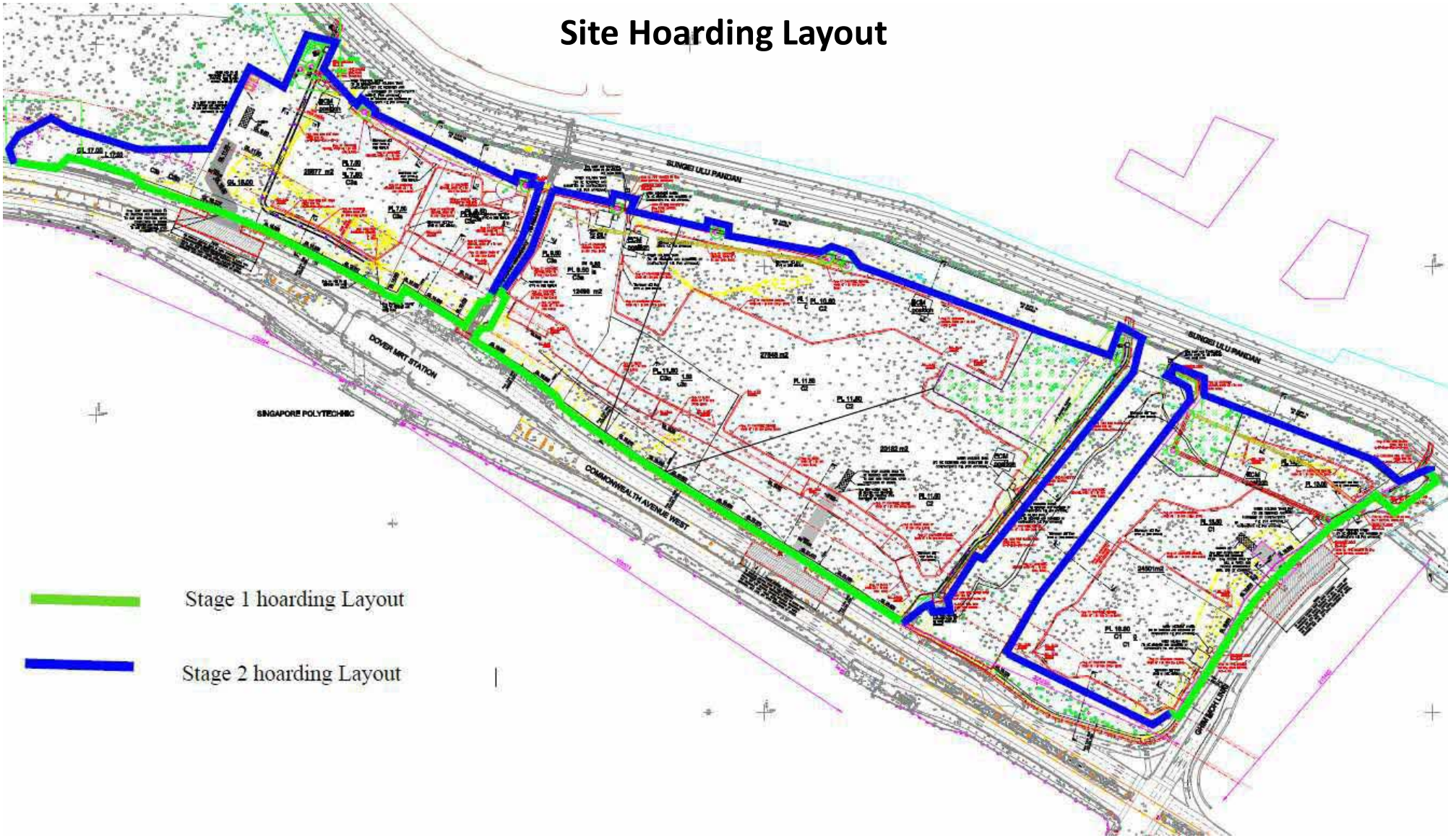
DRAWING NO. SJ-IF-HAQU-F2013-CE-001_GL | REVISION :

DESIGN ENGINEER | QUALIFIED PERSON

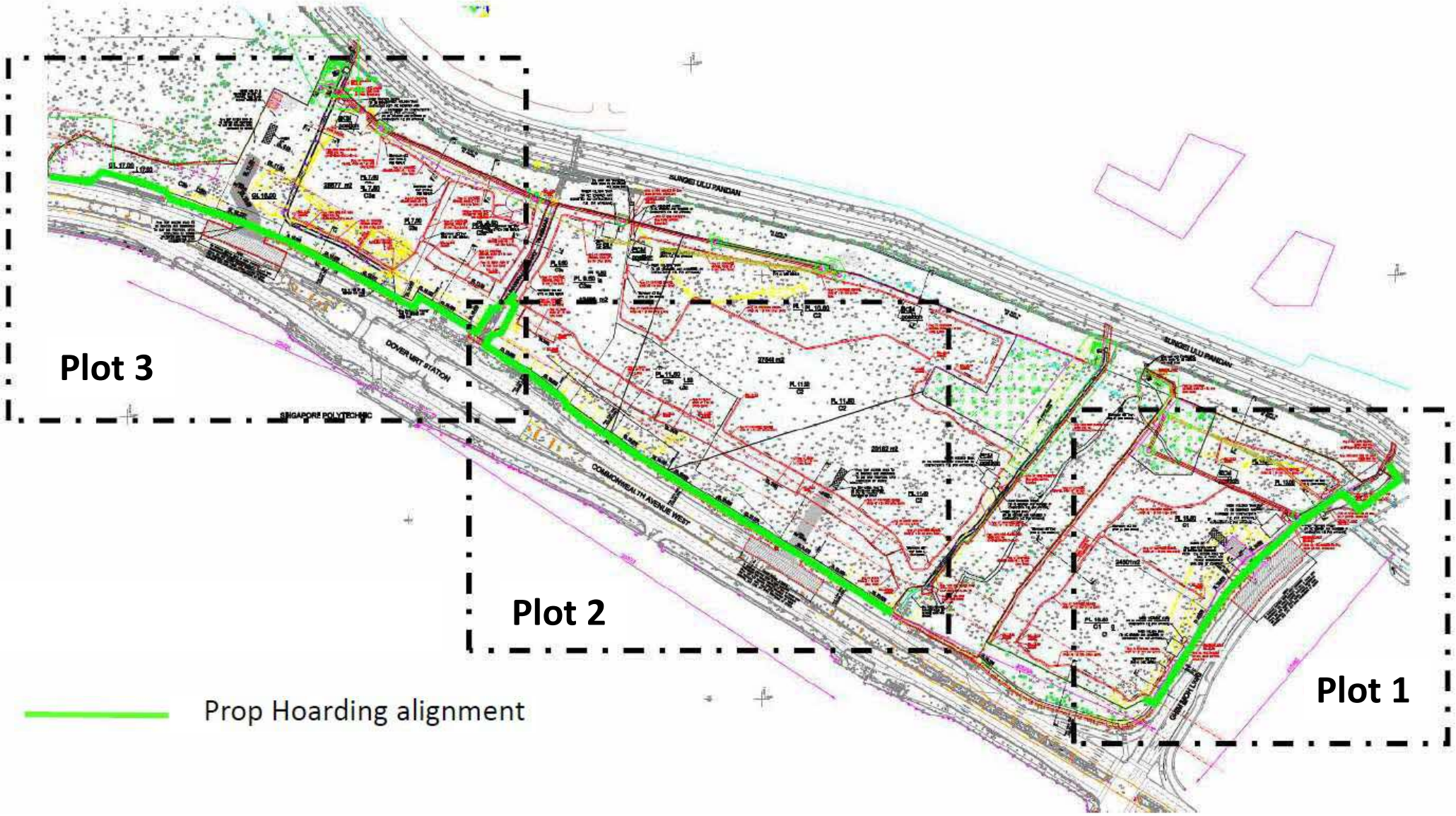
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APPENDIX B – HOARDING PLAN

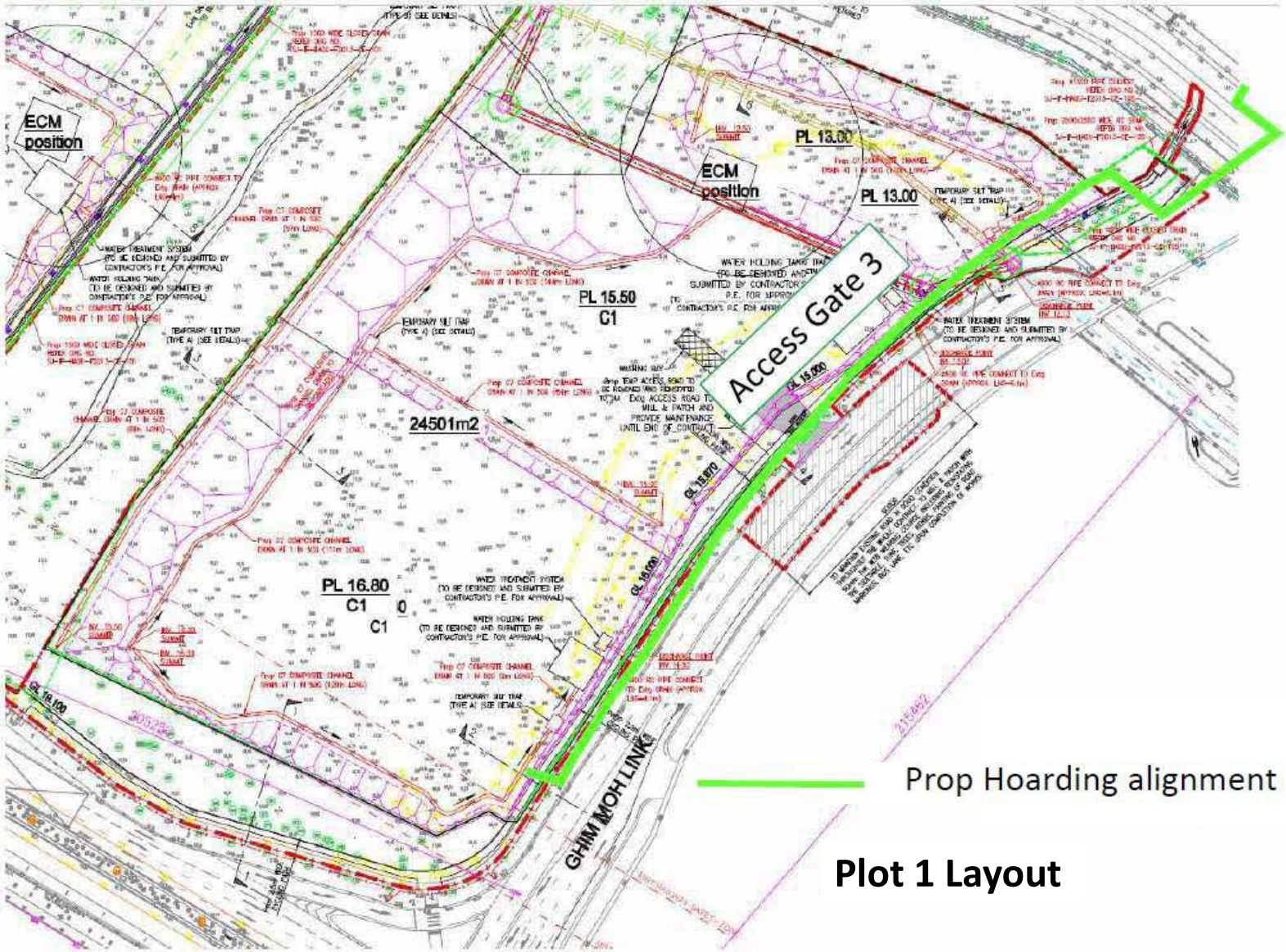
Site Hoarding Layout



Site Hoarding Layout (Stage 1)

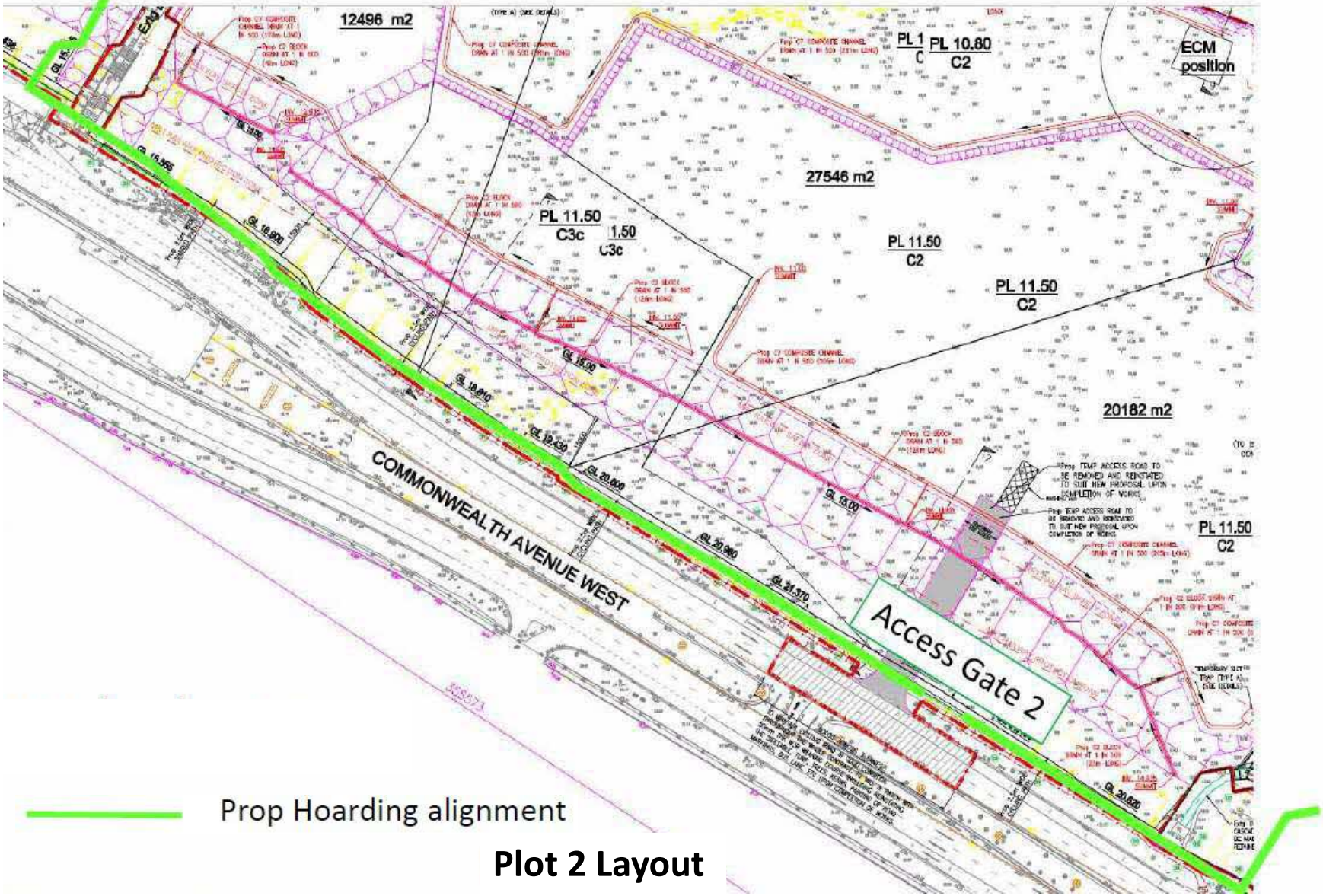


Site Hoarding Layout (Stage 1)



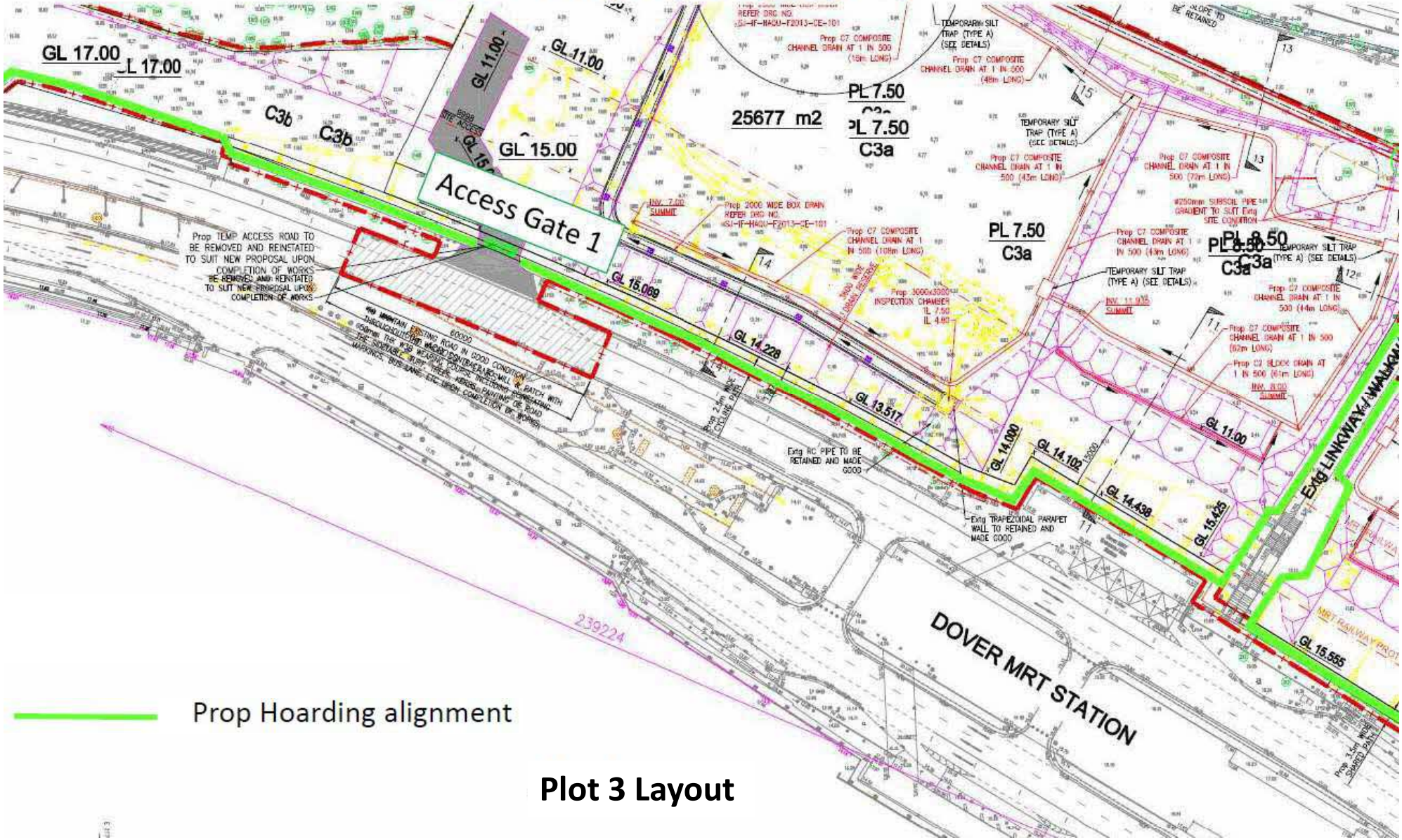
Plot 1 Layout

Site Hoarding Layout (Stage 1)



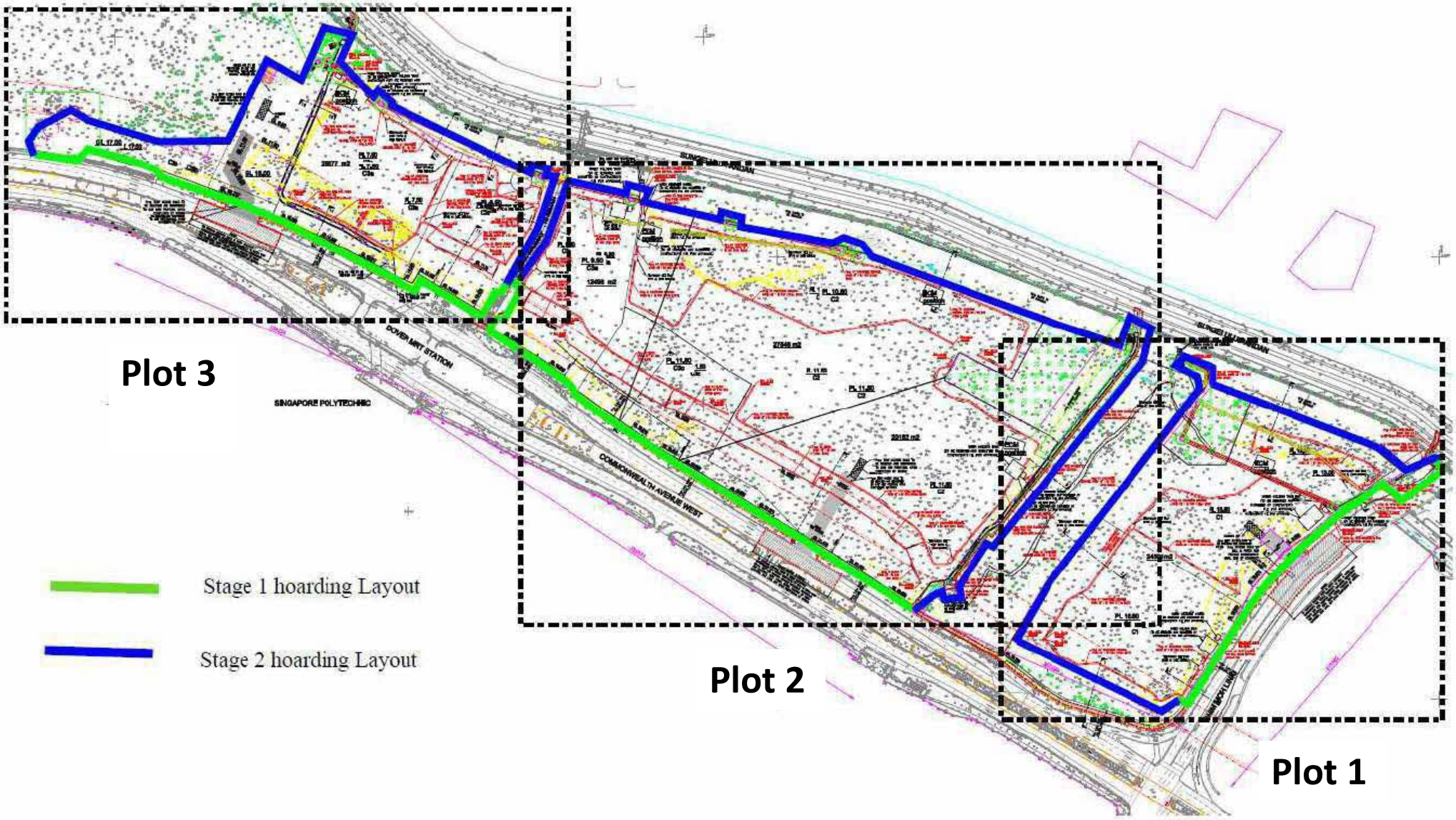
Plot 2 Layout

Site Hoarding Layout (Stage 1)

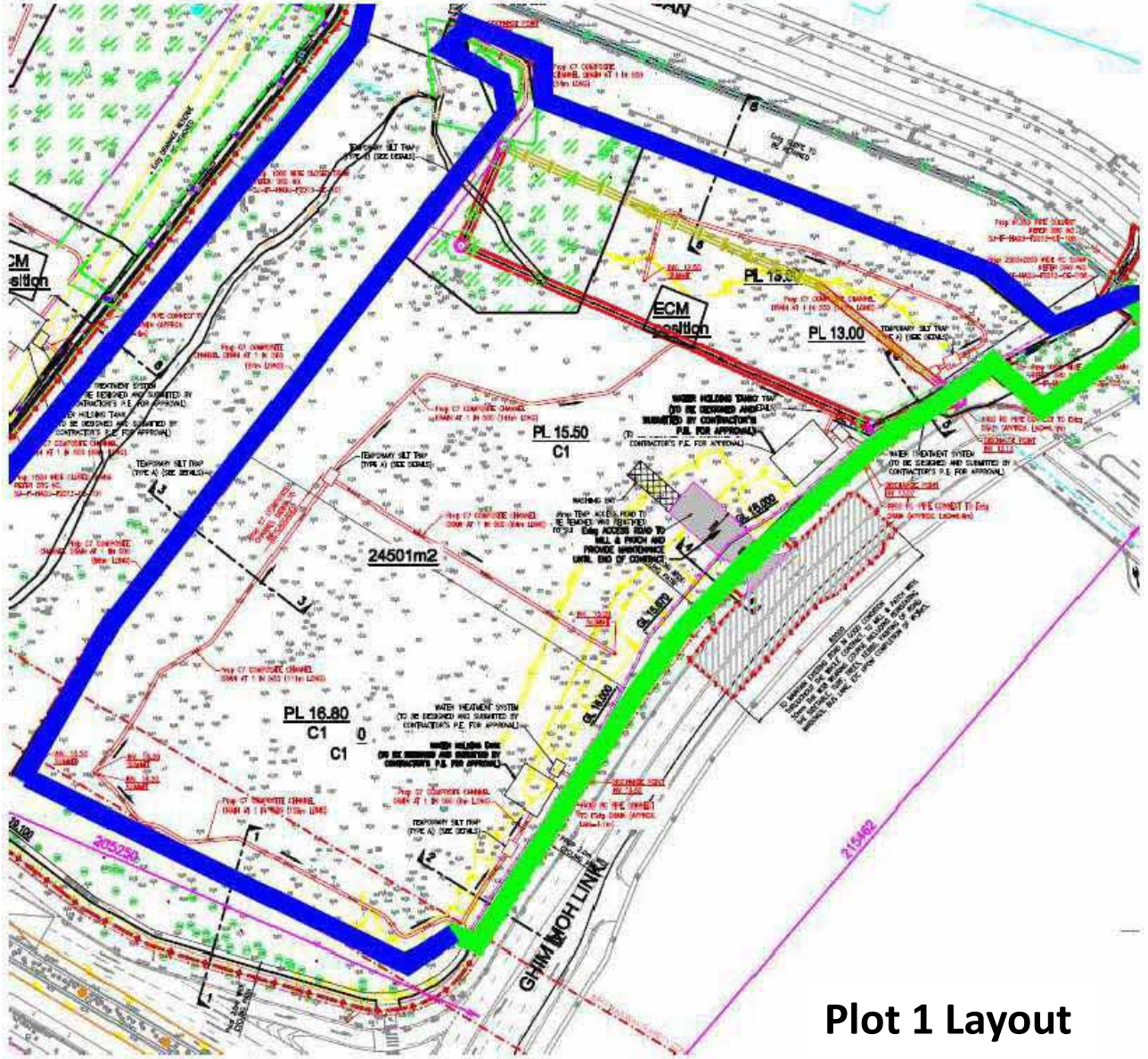


Plot 3 Layout

Site Hoarding Layout (Stage 2)

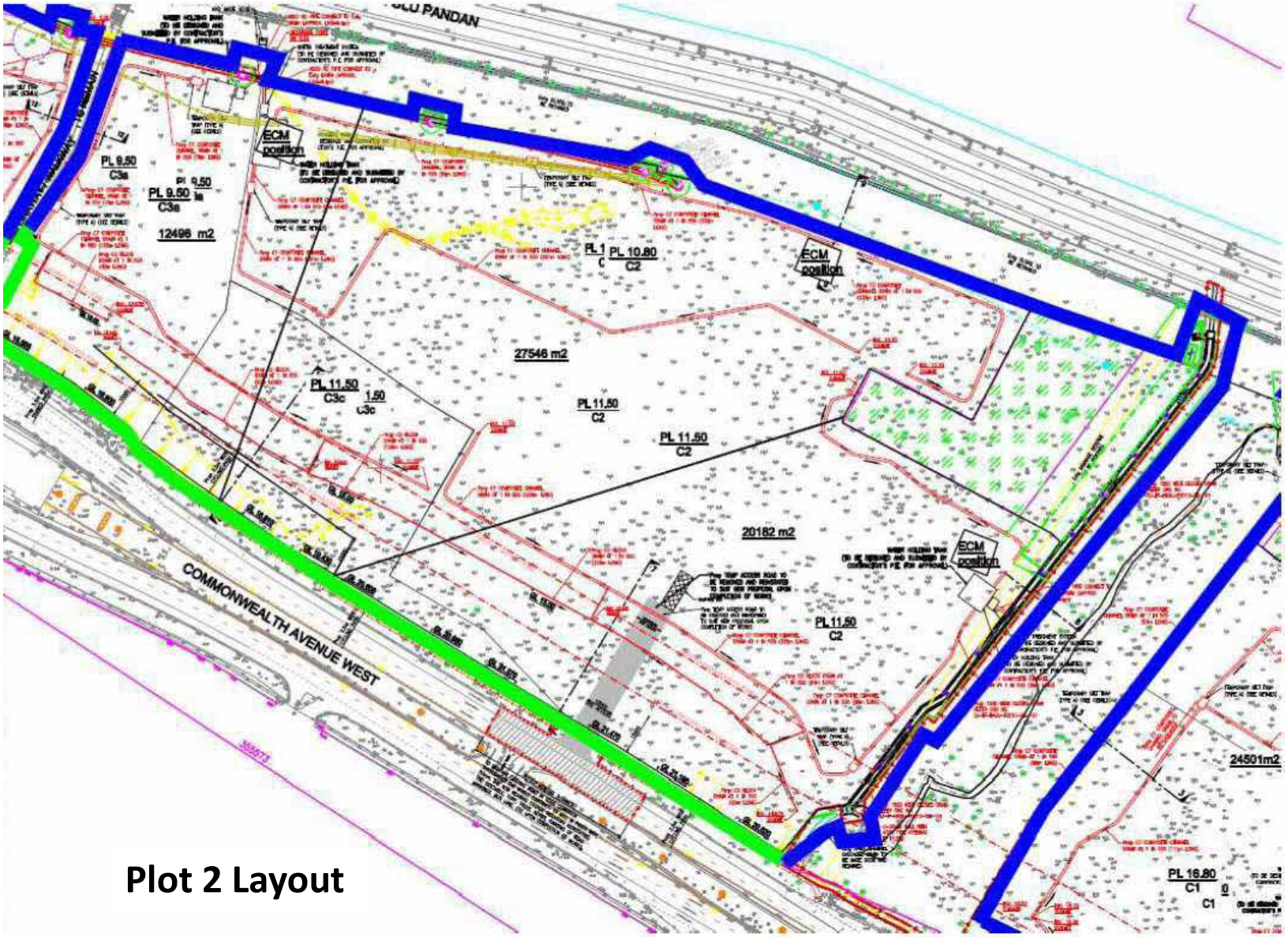


Site Hoarding Layout (Stage 2)



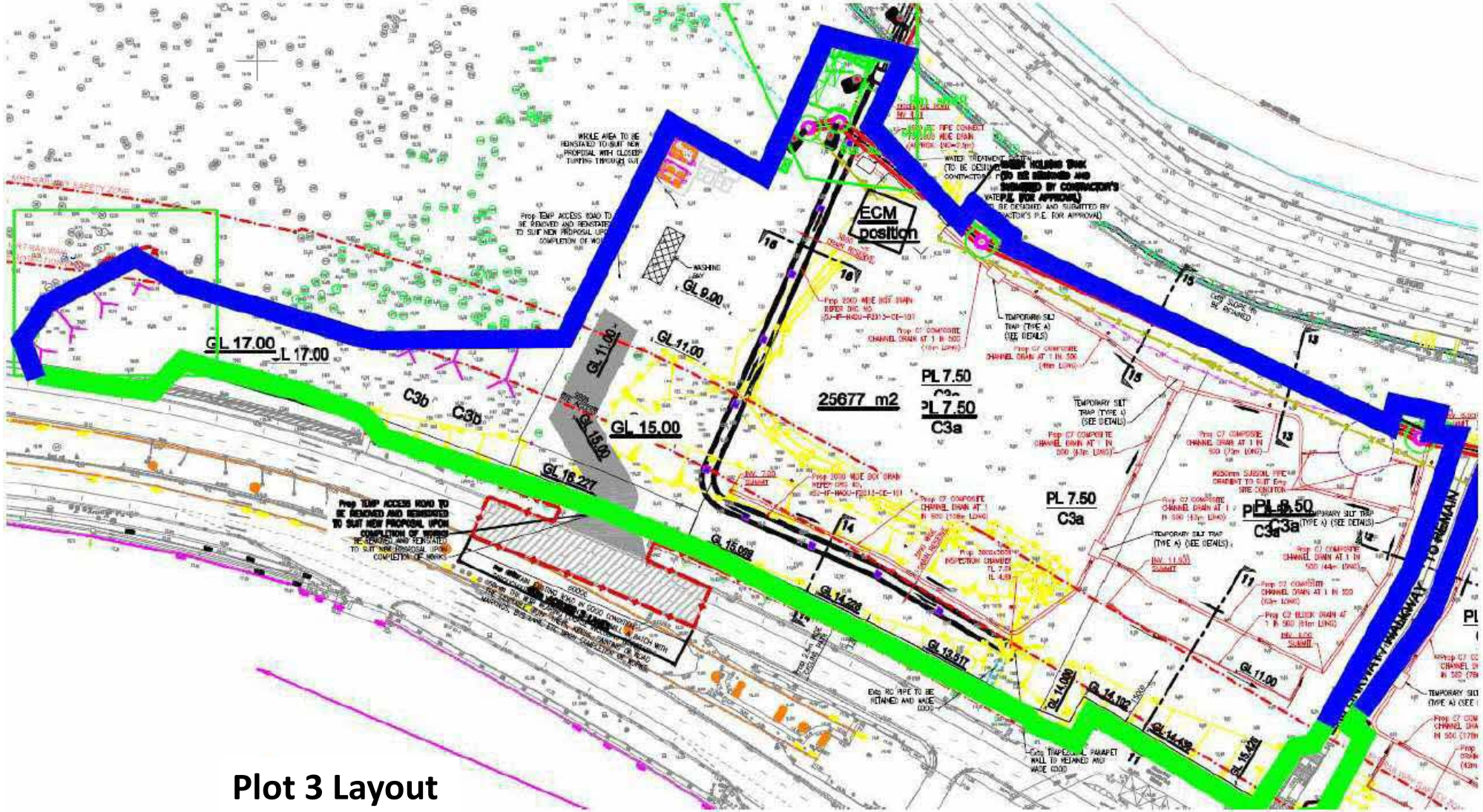
Plot 1 Layout

Site Hoarding Layout (Stage 2)



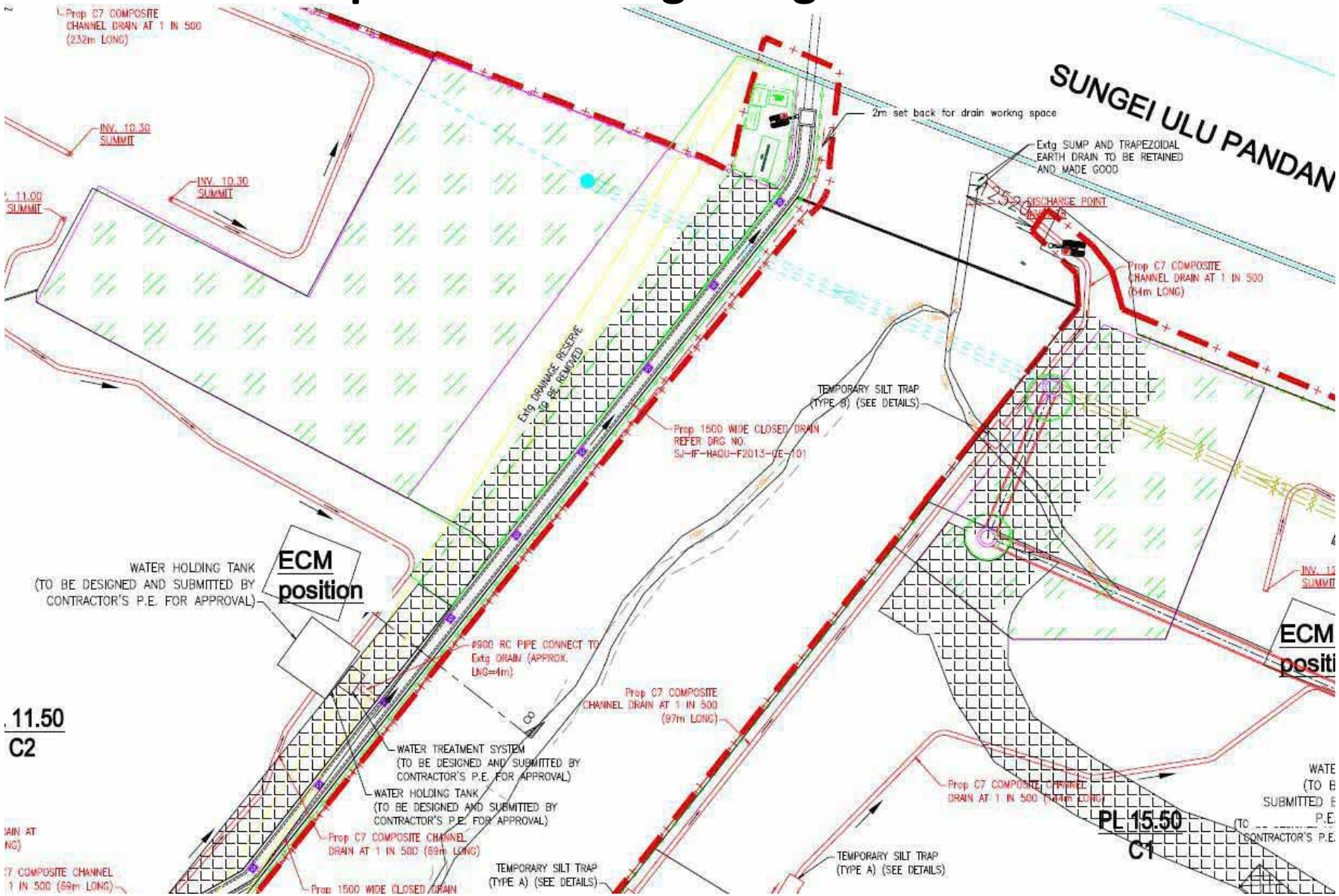
Plot 2 Layout

Site Hoarding Layout (Stage 2)



Plot 3 Layout

Proposed hoarding along Stream 1



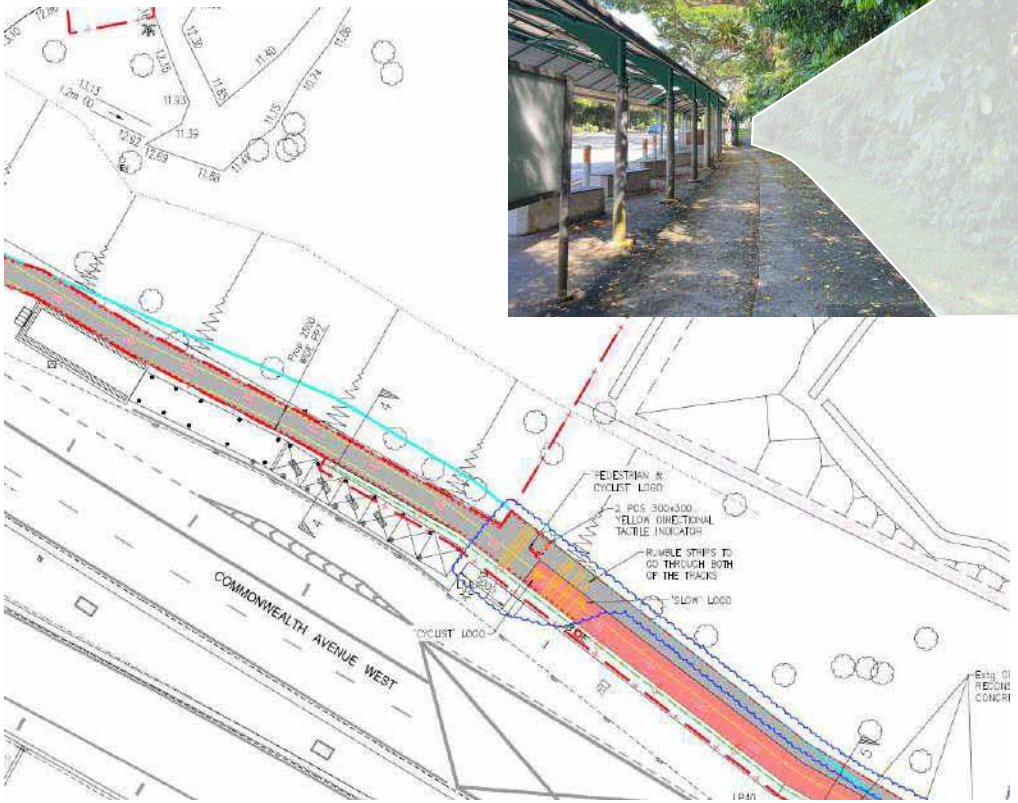
Proposed Hoarding on Footpath



Proposed Hoarding on Footpath



Proposed Hoarding on Footpath









Proposed Hoarding on Footpath





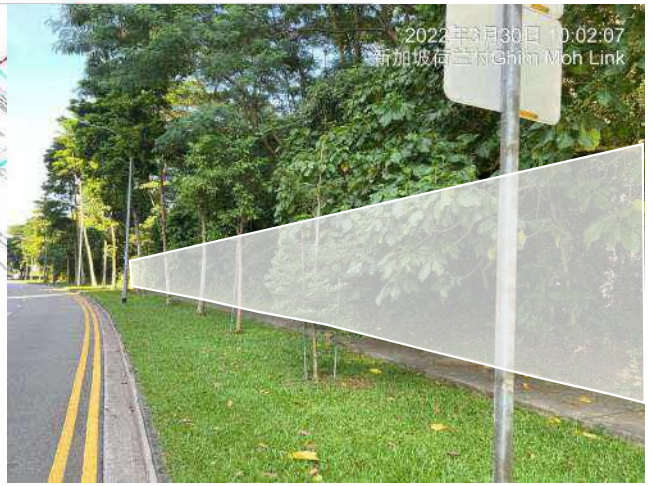




Proposed Hoarding on Footpath

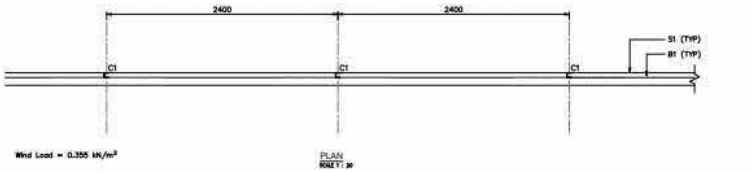






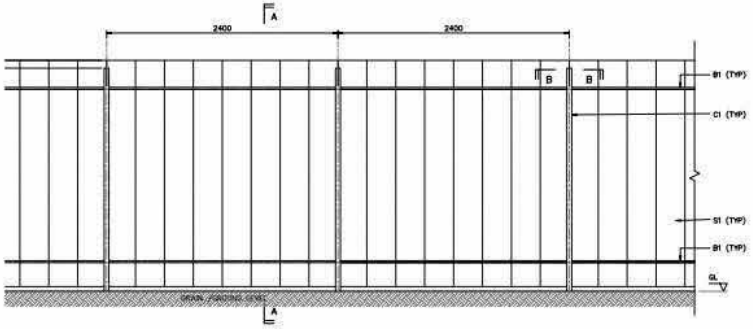


Proposed Hoarding Details

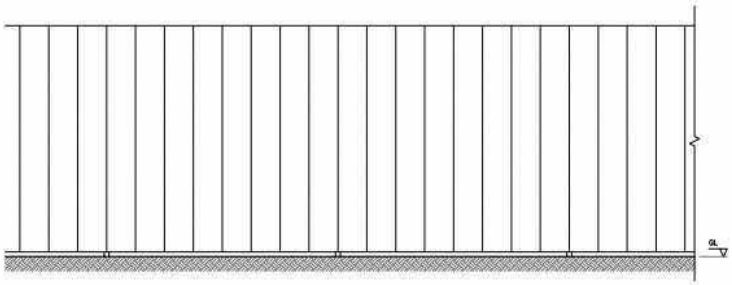


Wind Load = 0.355 kN/m²

PLAN
SCALE 1 : 20



REAR ELEVATION
SCALE 1 : 20

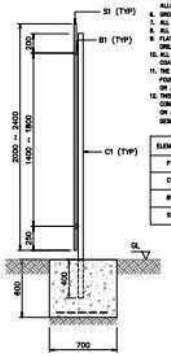


FRONT ELEVATION (DETAILS NOT SHOWN)
SCALE 1 : 20

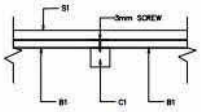
DESIGNED

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE NOTED.
2. BASIC WIND VELOCITY = 16.05 m/s (BASED ON MCWS RETURN PERIOD OF 10 YEARS).
3. ALL CONCRETE SHALL BE GRADE C16/20 WITH 30mm COVER.
4. ALL STEEL REINFORCEMENTS SHALL BE 460N WITH f_{yk}=460 N/mm².
5. EXISTING GROUND SHALL BE WELL COMPACTED BEFORE FOOTING CONSTRUCTION TO ACHIEVE AN ALLOWABLE SOIL BEARING PRESSURE OF 15 kN/m².
6. GROUND SURROUNDING FOOTING SHALL BE COMPACTED AFTER FOOTING CONSTRUCTION.
7. ALL STRUCTURAL STEEL MEMBERS SHALL BE HOT ROLLED GRADE S275.
8. ALL WELDING SHALL BE 5mm THICK FILLET WELD UNLESS OTHERWISE NOTED.
9. FLAT PANELS S1 SHALL BE SECURED TO BEAMS B1 WITH HEX WASHER HEAD (12–14x30mm SELF DRILLING AND TAPPING SCREWS SUITABLE FOR FONCTRATING BY AND C1 FLANGE THICKNESS.
10. ALL STEEL FRAME MEMBER SHALL BE PROVIDED WITH 1 COAT OF ANTI-CORROSION PRIMER AND 2 COATS OF PAINT.
11. THE CONTRACTOR'S PE SHALL CHECK THE ADEQUACY OF THE HOARDING STRUCTURE AND FOUNDATION BASED ON ACTUAL SITE CONDITION, AND PREPOSE ANY NECESSARY MODIFICATION ON ADDITIONAL DETAIL IF REQUIRED TO THE S.O. FOR APPROVAL.
12. THIS DRAWING REPRESENTS A MINIMAL DESIGN THAT THE CONTRACTOR SHALL PROVIDE, THE CONTRACTOR MAY ADOPT THIS DESIGN OR PROVIDE A MORE ROBUST DESIGN AS REQUIRED BASED ON ACTUAL SITE CONDITION. THE CONTRACTOR'S PE SHALL BE RESPONSIBLE FOR WHICHEVER DESIGN ADOPTED ON SITE.

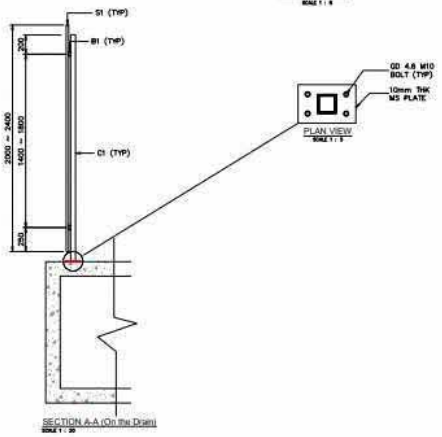
ELEMENT	SECTION/SIZE	COLOUR
F1	700 x 700 x 600 FOOTING WITH M25R D11 BOTTOM	-
C1	50 x 50 x 5.0mm tbk	OFF-WHITE
B1	50 x 30 x 3.0mm tbk	
S1	FLAT PANEL 300 x 20 x 0.55 thk x 6 kg/m²	



SECTION A-A (On the Ground)
SCALE 1 : 20



SECTION B-B
(B1 - C1 SCREW)
SCALE 1 : 5



SECTION A-A (On the Drain)
SCALE 1 : 20

FOR CONSTRUCTION

PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE
(QUALIFIED PERSON FOR STRUCTURAL WORKS
STEP 4 SIGNOFF)

REV	DATE	DESCRIPTION	DESIGNED

DEVELOPER / OWNER
HOUSING & DEVELOPMENT BOARD
HDB Hub (East) Lobby A Tow Floors
Singapore 570300

CONTRACTOR
JIN CHOON CIVIL ENGINEERING PTE. LTD.
12 TUAS SOUTH STREET 9
Singapore 636811

CONSULTANTS
SJ
SurbanJurong Consultants Pte. Ltd.
Singapore 609917

PROJECT TITLE
INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT (DOVER)

DRAWING TITLE
SITE HOARDING DETAILS

PROFESSIONAL ENGINEER (CIVIL)
VASU CHARTERED ENGINEERING LLP
Singapore 607726
Tel: 6336 2360 Fax: 6752 6362

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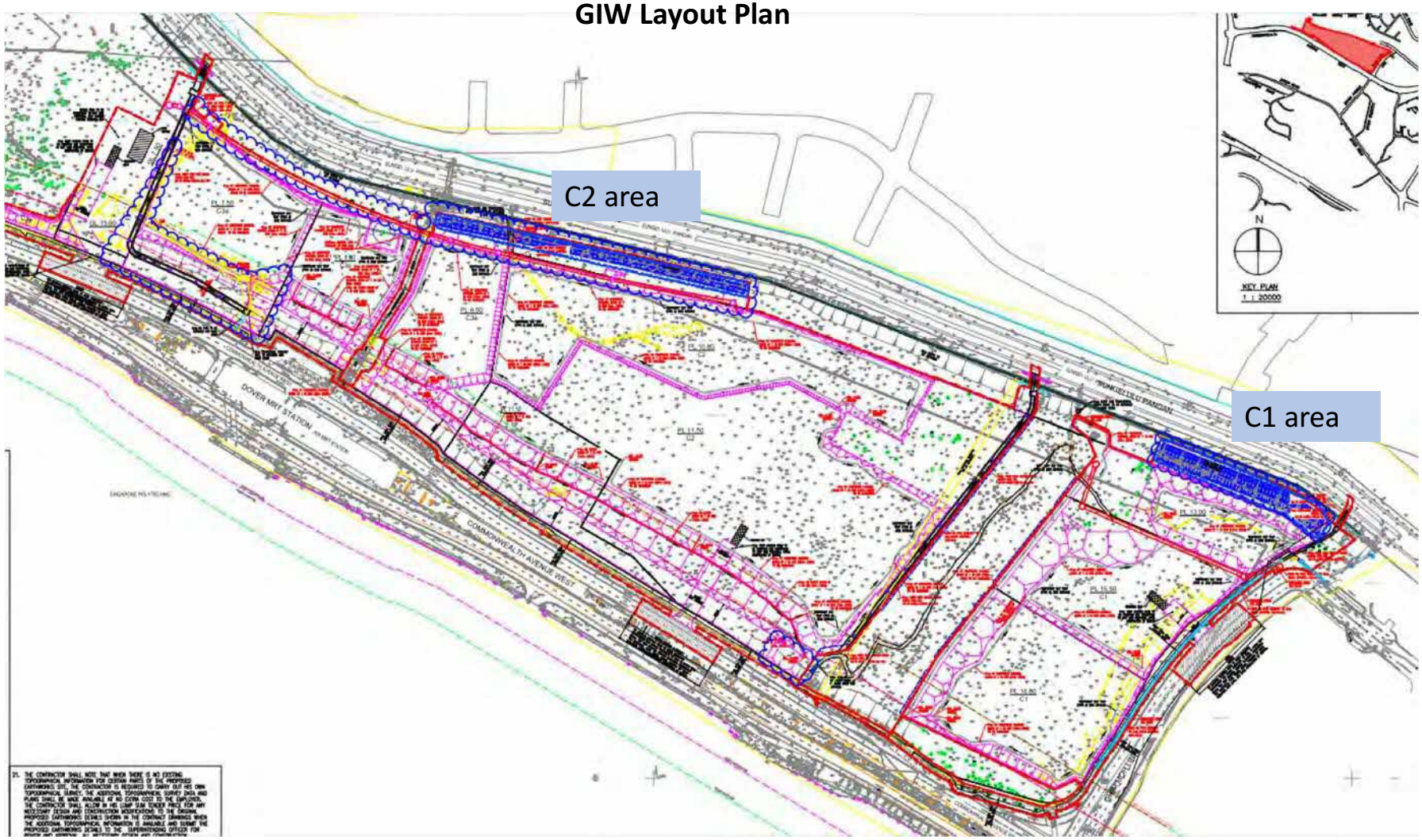
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RG/RC/MM	01.01.2023	HHB	HHB	AS SHOWN

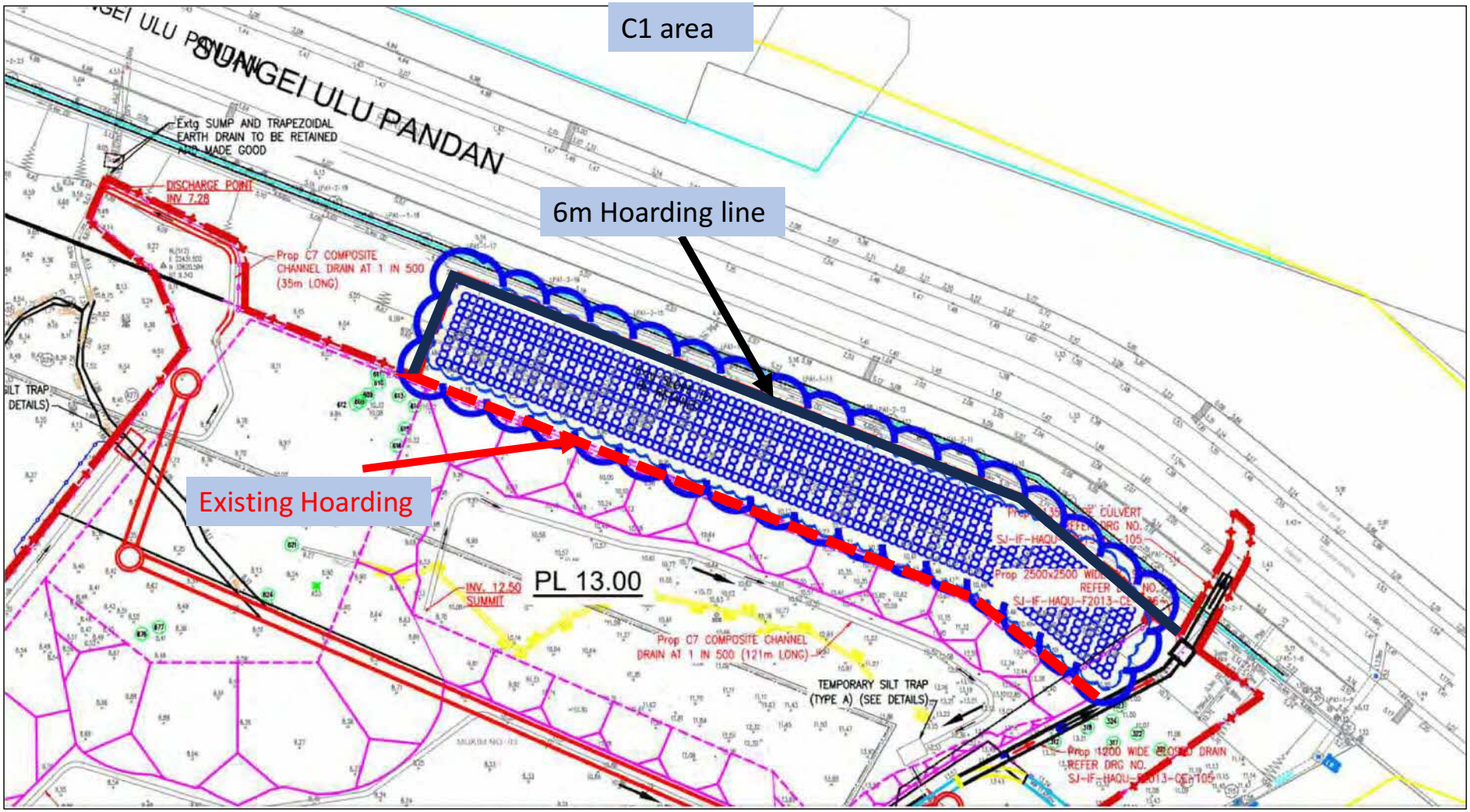
PROJECT NO	AUTHOR	MODEL FILE / DRG. SIZE	DRAWING NO.	REV
E2650-0015-2022	HRD	-	01	-

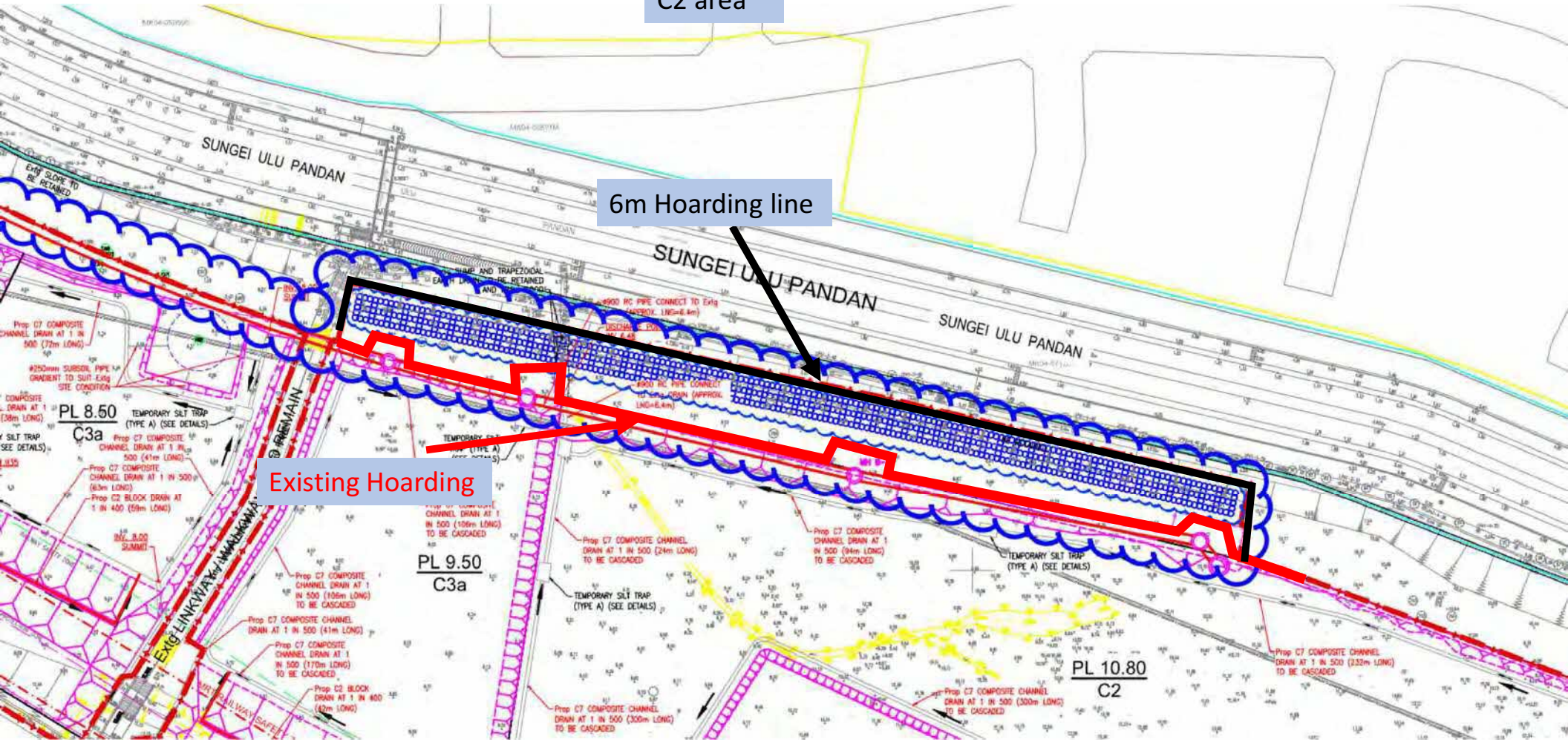
PLOT NAME: DOVER SITE HOARDING

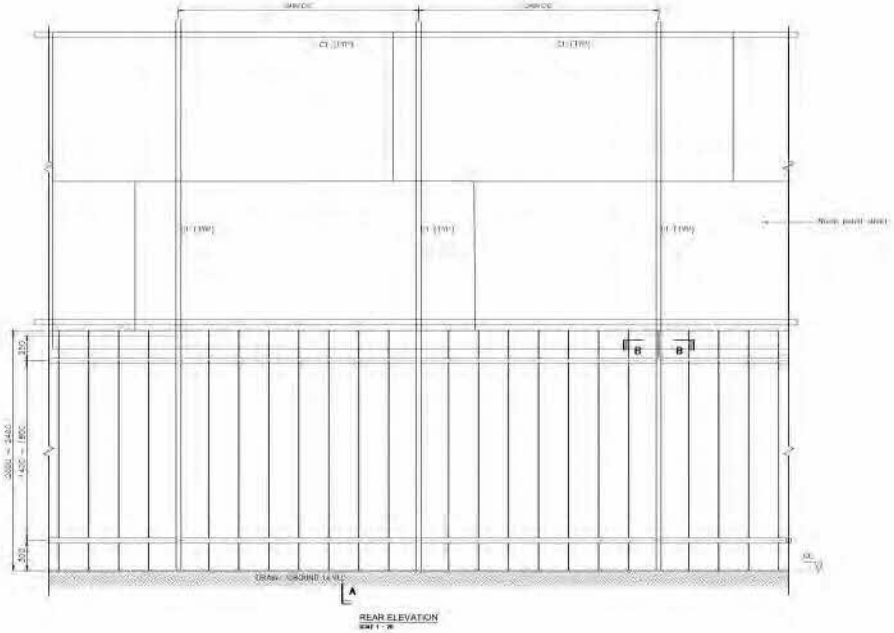
APPENDIX C – HOARDING PLAN (GIW)

GIW Layout Plan

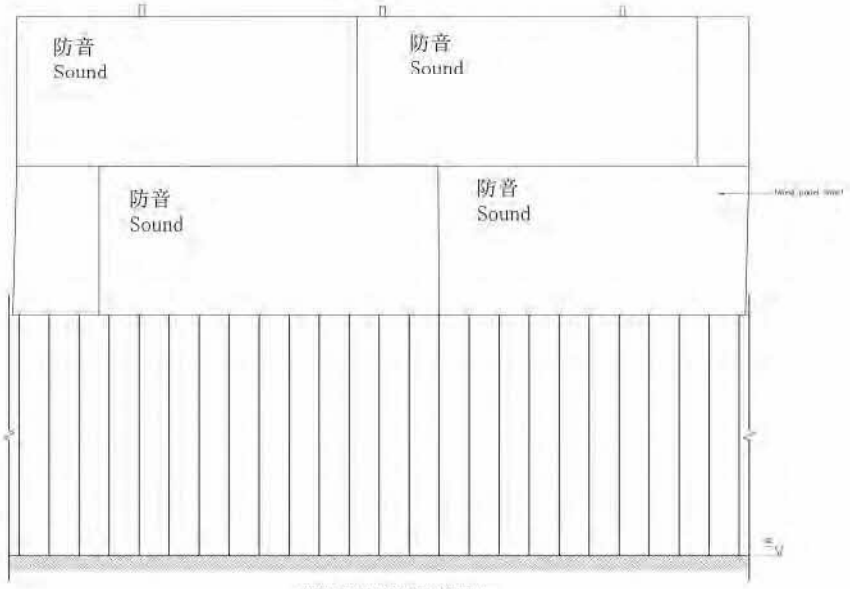



C1 area
6m Hoarding line
Existing Hoarding
SUNGEI ULU PANDAN
Extg SUMP AND TRAPEZOIDAL EARTH DRAIN TO BE RETAINED AND MADE GOOD
DISCHARGE POINT INV. 7.28
Prop C7 COMPOSITE CHANNEL DRAIN AT 1 IN 500 (35m LONG)
PL 13.00
INV. 12.50 SUMMIT
Prop C7 COMPOSITE CHANNEL DRAIN AT 1 IN 500 (121m LONG)
TEMPORARY SILT TRAP (TYPE A) (SEE DETAILS)


C2 area
6m Hoarding line
Existing Hoarding
SUNGEI ULU PANDAN
SUNGEI ULU PANDAN
SUNGEI ULU PANDAN
PL 8.50
C3a
PL 9.50
C3a
PL 10.80
C2
TEMPORARY SILT TRAP (TYPE A) (SEE DETAILS)
EXIST LINKWAY
EXIST SLOPE TO BE RETAINED



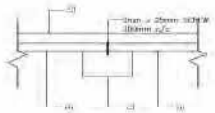
REAR ELEVATION



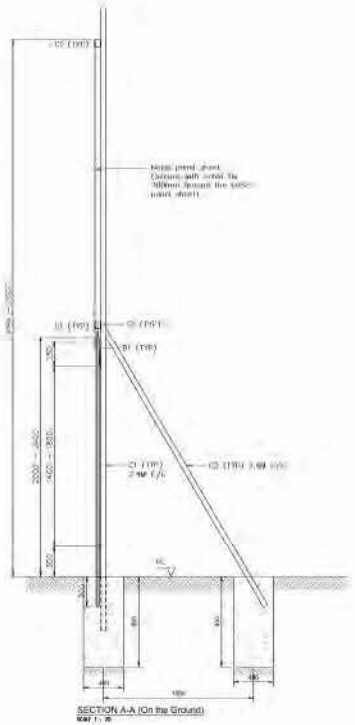
FRONT ELEVATION (DETAILS NOT SHOWN)

NOTES:

ELEMENT	SECTION SIZE	GRADE
C1	400 x 400 x 850 TUSPILE	
C2	100 x 50 x 4mm SS Hollow section	
C3	100 x 50 x 3mm SS Hollow section	
B1	50 x 50 x 3.0mm SHS	
S1	TILE PANEL 400 x 65 x 230 (W) 1.8 kg/m²	

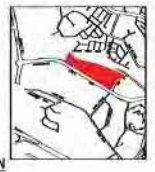


SECTION B-B
(B1 - C1 SCREW)



SECTION A-A (On the Ground)

Sheet Index



KEY PLAN

PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE

REV	DES	DATE	ISSUED	CHKD

Client:
HOUSING & DEVELOPMENT BOARD
HDB HUB 480 LORONG 6 TOA PAYOH
SINGAPORE 310480

Consultant:
SURBANA JURONG CONSULTANTS PTE. LTD.
168 JALAN BUKIT MERAH
#01-01 CONNECTION ONE
SINGAPORE 150168

Contractor:
JIN CHOON CIVIL ENGINEERING PTE. LTD.
12 TUAS SOUTH STREET 8
SINGAPORE 636911
Tel : 65659511 Fax : 65659513

PROFESSIONAL ENGINEER (PEB):
VASU CHARTERED ENGINEERING LLP
No. 6 Uni Street 1, #06-10
Uniwork Centre Singapore 407706
Email: submissions@vce.com.sg
Tel: 6748 0245 Fax: 6743 9252

Project Title :
INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT

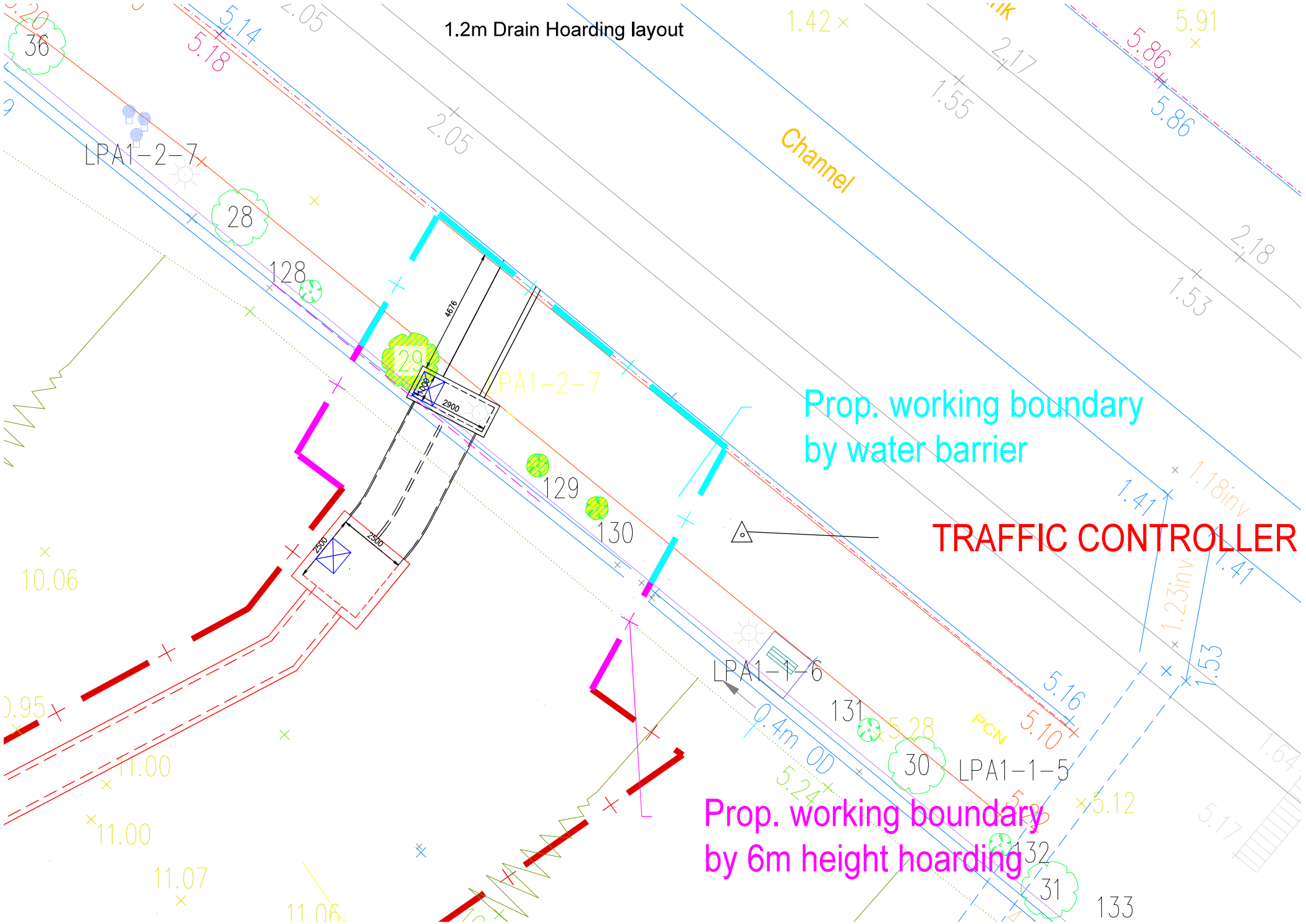
Drawing Title :
SITE HOARDING DESIGN (6.0m H)

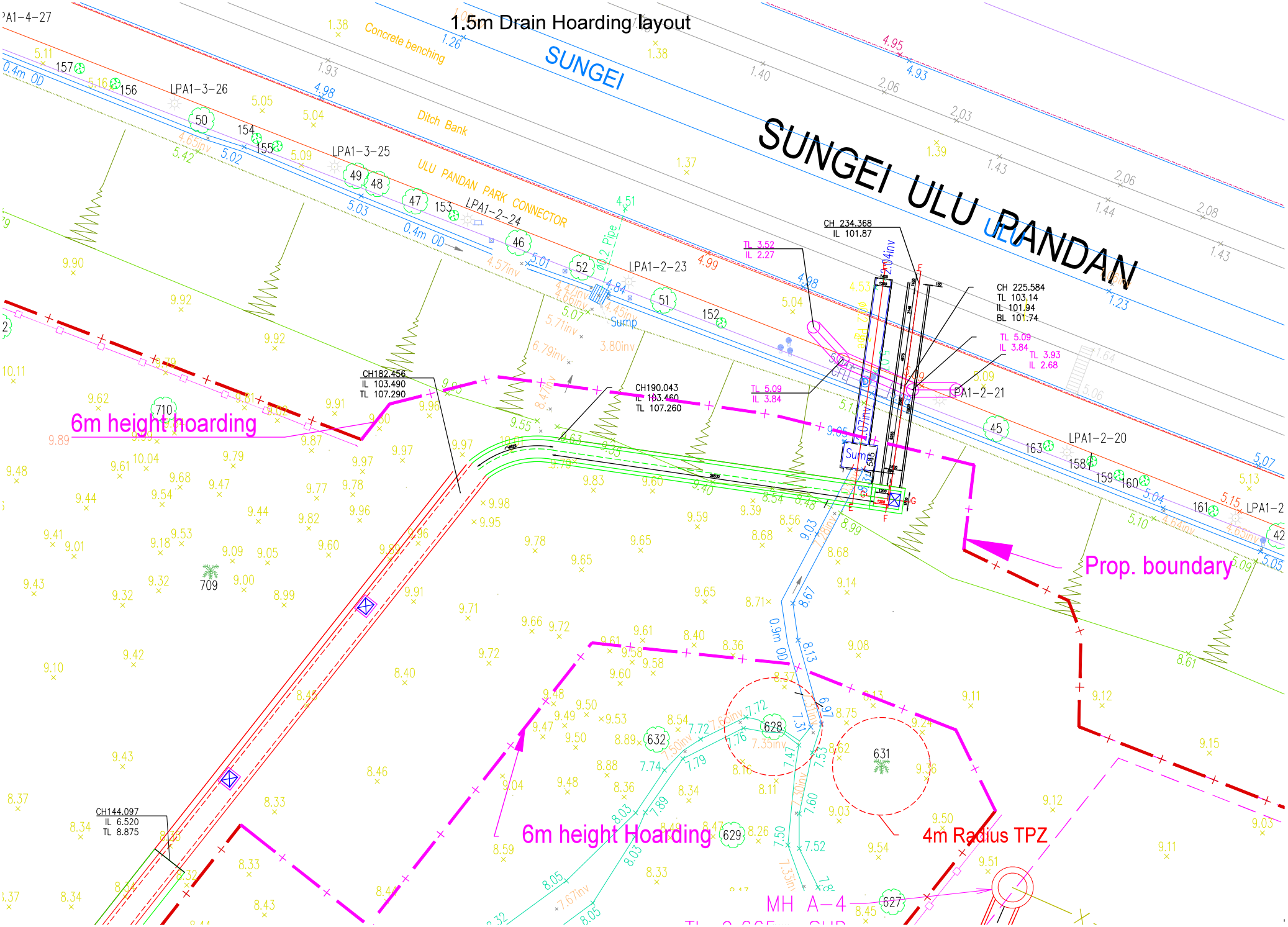
Designed	Checked	Approved
SDD	PEER	HHB
Scale	Drawn	Date
	MMR1	12.9.2022

Drawing No. : Rev.

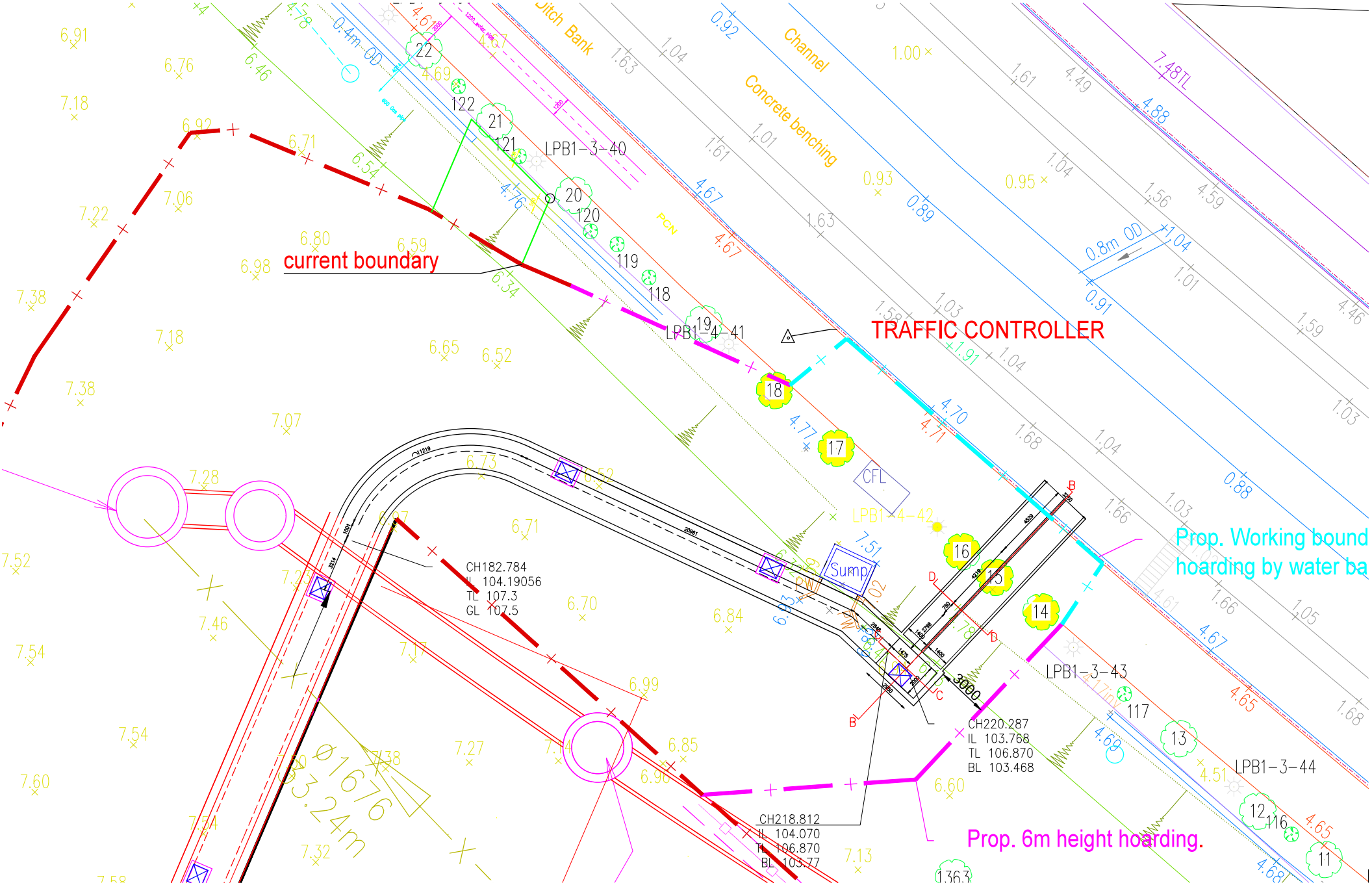
CAD File Name: Sheet of A1

APPENDIX D – HOARDING PLAN (REVISED DRAIN ALIGNMENT)


1.2m Drain Hoarding layout
Channel
Prop. working boundary
by water barrier
TRAFFIC CONTROLLER
Prop. working boundary
by 6m height hoarding
LPA1-2-7
LPA1-2-7
LPA1-1-6
LPA1-1-5
36
28
128
29
129
130
131
30
132
31
133
4676
2900
2500
2500
0.4m OD
PCN
5.14
5.18
2.05
1.42
2.17
1.55
5.86
5.86
5.91
2.18
1.53
1.41
1.18inv
1.23inv
1.41
1.53
5.16
5.10
5.28
5.24
5.12
10.06
11.00
11.00
11.07
11.06


1.5m Drain Hoarding layout
SUNGEI
SUNGEI ULU PANDAN
ULU
Concrete benching
Ditch Bank
ULU PANDAN PARK CONNECTOR
LPA1-3-26
LPA1-3-25
LPA1-2-24
LPA1-2-23
LPA1-2-21
LPA1-2-20
0.4m OD
0.9m OD
Sump
CH182.456
IL 103.490
TL 107.290
CH190.043
IL 103.460
TL 107.260
CH 234.368
IL 101.87
CH 225.584
TL 103.14
IL 101.94
BL 101.74
TL 3.52
IL 2.27
TL 5.09
IL 3.84
TL 3.93
IL 2.68
CH144.097
IL 6.520
TL 8.875
6m height hoarding
6m height Hoarding
Prop. boundary
4m Radius TPZ
MH A-4

2m Drain Hoarding layout



APPENDIX E – WILDLIFE INCIDENT FORM

WILDLIFE INCIDENT FORM

Part A – Wildlife Incident Details

The CEMMP In-charge is to complete the Form and submit to PM within 24 hours of reporting incident.

Reference No. (by CEMMP In-charge)			
Personnel	**Reporting Person**	**Witness**	
Name:			
Contact Number:			
Title / Company:			
Time / Date of Wildlife Encounter	**Date**	**Time**	
Affected Area			
Weather:	☐ Clear	☐ Overcast	☐ Thunderstorm
	☐ Sunny	☐ Others (To Describe):	
Actual Location:			
Description of Area:	☐ Vegetated area	☐ Non-vegetated area	
	☐ Excavated area	☐ Others (to describe):	
Activities Carried Out Nearby at Time of Incident:	If there are no active works near wildlife encountered, please state so.		

Details of Animal			
Animal:	Where identifiable, please provide [Common Name (Scientific Name)] If animal cannot be identified, carcass to be described to the best of ability.		
Animal Condition:	☐ Active	☐ Outwardly injured (e.g. bleeding, limping)	☐ Flattened
	☐ Stationary	☐ Decomposed	☐ Trapped
	☐ Others (to describe):		
Photographs:	1) Close-up of Animal ☐ No Close-up available Please provide reason here if close-up photographs could not be obtained, e.g. unsafe to approach		
	2) Animal with surroundings or showing full width of road (if roadkill), indicating where the animal is.		
	☐ No photographs available. Reason: e.g. animal moved away too quickly		

Incident Details	
Incident Summary: To be filled by reporting party	Briefly describe when, what, who, where and how the incident happened. *Sample incident summary:* *[Personnel] was conducting [activity] on [date/time] when he observed an [animal] at [location]. The animal was observed to be [condition]. [Personnel] reported the incident to [contractor representative] who contacted the WMO. While awaiting wildlife response, [contractor] barricaded the area and continued monitoring for movement of animal.* If EMMP Specialist (Fauna) visited site: Recommended actions
Follow-up Actions: To be filled by CEMMP In-charge	☐ Animal rescued to NParks Shelter ☐ Immediate relocation ☐ Carcass transported to disposal location ☐ Others:_____
	☐ No Action Taken by CEMMP In-charge

Part B – Closure of Incident

Possible Causes What is/are the possible cause/s of the incident? (Man / Machine / Management / Medium / Mission)		
Preventive/Corrective Actions To be filled by CEMMP In-charge	**Close-up** To be filled by reporting party	
1)	Close-up Action.	Close-up Date
2)		Close-up Date
Closure of Incident Report		
Date of Closure of Incident Report:		
Acknowledged by PM (Name/Title):		

APPENDIX F – ECM PLAN



KEY PLAN
N.T.S

I. GENERAL NOTES:

1. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY APPROVAL FROM ALL RELEVANT AUTHORITIES PRIOR TO THE COMMENCEMENT OF THE PROPOSED WORK/S.
2. THE CONTRACTOR SHALL CONSTRUCT ACCORDING TO THE APPROVED DRAWINGS AT ALL TIMES.
3. ALL CONTRACTOR/ECO SHALL REPORT TO THE QECP OF ANY DEVIATION FROM THE APPROVED DRAWINGS AND SHALL NOT ALLOW WORKS TO COMMENCE UNTIL SUCH DEVIATION IS APPROVED BYTHE RELEVANNT AUTHORITIES.
4. IF THERE ARE ANY MATERIAL CHANGES TO THE APPROVED PLANS, APPROVAL MUST BE OBTAINED BEFORE CARRYING OUT THE PROPOSED AMENDMENT ON SITE.
5. ALL MEASUREMENTS SHALL BE IN MILLIMETERS UNLESS OTHERWISE STATED.
6. INSTALLED SILT FENCE SHALL HAVE A MINIMUM EXPOSED HEIGHT OF 300mm ABOVE GROUND LEVEL.

BASELINE ECM GENERAL NOTES:

1. THE BASELINE ECM IS DESIGNED FOR RAINFALL INTENSITY OF A RETURN OF 1 IN 5 YEARS STORM.
2. CONTRACTOR SHALL MINIMISE THE EXTENT AND DURATION OF ANY EXPOSED/BARE/ERODABLE SURFACES AT ALL TIMES.
3. WHERE APPLICABLE, SILT FENCE SHALL BE ERECTED AROUND EARTH STOCKPILES.

EXCAVATION:

1. SILT FENCE SHALL BE INSTALLED AROUND THE PERIMETER OF THE EXCAVATION AREA.
2. THE SITE SHALL BE LAID WITH 200mm HARDCORE, MILLED WASTE, 75mm LEAN CONCRETE WITH 1 LAYER OF BRC A10, ETC AND BARE SURFACE SHALL BE COVERED BY CANVASS OR EROSION CONTROL BLANKET, ETC TO MINIMISE EROSION.
3. EXCESS MATERIAL STOCKPILE SHALL BE REMOVED FROM SITE. SOIL FOR LATER BACKFILL MATERIAL STOCKPILE SHALL BE COVERED BY CANVASS SHEETS, TARPAULIN SHEETING OR OTHER SURFACE MATERIAL DURING RAIN OR BEFORE WORKS START EVERYDAY.

II. MAINTENANCE OF ECM DURING CONSTRUCTION:

1. PERIMETER SILT FENCE SHALL BE EMBEDDED INTO THE GROUND AND MADE FROM AN APPROVED GEOTEXTILE FILTER FABRIC WHICH ALLOWS WATER TO FLOW THROUGH I, BUT NOT SUSPENDED SOIL PARTICLES. THE SEDIMENT BUILT-UP BEHIND THE FENCE MUSTBE REGULARLY REMOVED (MAXIMUM STORAGE HEIGHT - 150mm) AND AT LEAST ONCE A WEEK.
2. SILT FENCE SHALL BE INSPECTED AFTER EACH STORM AND MAKE GOOD IF NECESSARY. IT SHALL BE REPLACED EVERY 4 MONTHS UNLESS OTHERWISE APPROVED BY THE QECP.

III. MONITORING OF DISCHARGE DURING CONSTRUCTION:

1. THE CONTRACTOR SHALL MONITOR THE TSS (MG/L) - APHA PT 2540D AND TURBIDITY (NTU) APHA PT 2130B OF THE DISCHARGE USING METER BEFORE DISCHARGE ENTERS THE STORM WATER DRAINAGE SYSTEM.
2. CONTRACTOR SHALL ENSURE THAT THE LEGAL REQUIREMENT OF TSS DOES NOT EXCEED 50MG/L IN THE SITE DISCHARGE.
3. CCTV INSTALLATION SHALL BE IN ACCORDANCE WITH PUB REQUIREMENT TO MONITOR CONDITIONS OF DISCHARGE BEFORE ENTERING THE STORM WATER DRAINAGE SYSTEM.
4. THE CONTRACTOR SHALL SUBMIT REGULAR REPORT (INCLUDING PHOTOGRAPHIC AND MONITORING RECORDS) OF THE ECM AS WELL AS THOSE FOR DISCHARGE QUALITY TO THE PUBLIC UTILITIES BOARD OVER THE WHOLE DURATION OF THE PROJECT.

III. REMOVAL UPON COMPLETION:

THE CONTRACTOR SHALL INFORM THE PUBLIC UTILITIES BOARD PRIOR TO THE REMOVAL OF THE ECM BASED ON QECP RECOMMENDATION.

PROJECT REF. NO. : E2850-00015-2020

PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHK'D

DEVELOPER/OWNER:

HOUSING & DEVELOPMENT BOARD (HDB)
BLK 480, LORONG 6 TOA PAYOH,
#01-01 HDB HUB
Singapore 310480

TEL: 9797 0089

CONTRACTOR:

JIN CHOON CIVIL ENGINEERING PTE LTD
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QUALIFIED PERSON (QP):

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TEL: 6284 1373

PROJECT TITLE

INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE:

KEY PLAN

PROFESSIONAL ENGINEER:

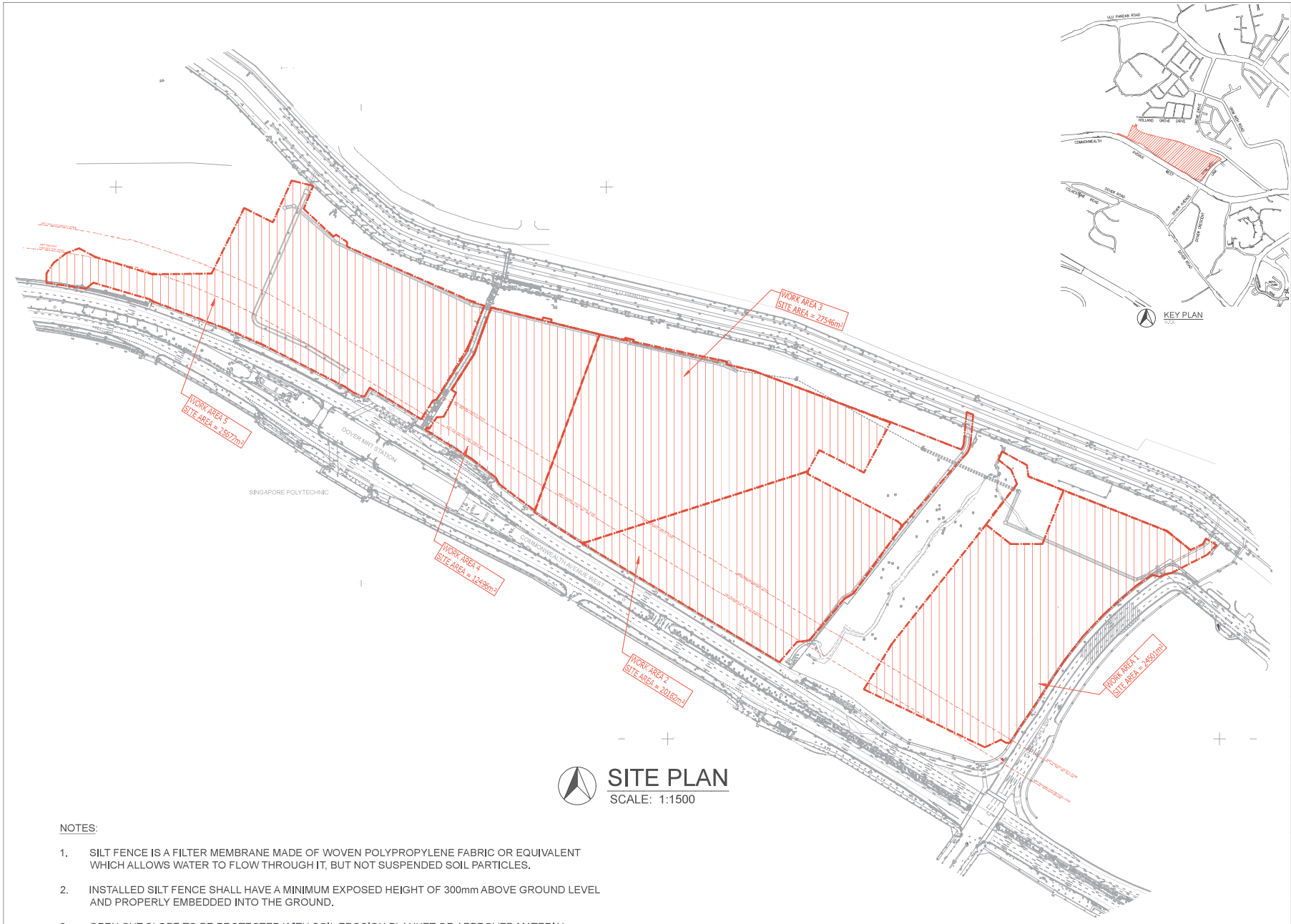
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KT	03.08.22	HHB	HHB	AS SHOWN

PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220xx	ECM	-	1	-

FILE NAME : HDB INFRASTRUCTURE WORKS - ECM



SITE PLAN
SCALE: 1:1500

NOTES:

1. SILT FENCE IS A FILTER MEMBRANE MADE OF WOVEN POLYPROPYLENE FABRIC OR EQUIVALENT WHICH ALLOWS WATER TO FLOW THROUGH IT, BUT NOT SUSPENDED SOIL PARTICLES.
2. INSTALLED SILT FENCE SHALL HAVE A MINIMUM EXPOSED HEIGHT OF 300mm ABOVE GROUND LEVEL AND PROPERLY EMBEDDED INTO THE GROUND.
3. OPEN CUT SLOPE TO BE PROTECTED WITH SOIL EROSION BLANKET OR APPROVED MATERIAL.
4. REGULAR INSPECTION AND REVIEW OF THE EROSION CONTROL SCHEME TO BE CARRIED ON A MONTHLY BASIS OR WHEN THE CONSTRUCTION NEEDS ARISE.
5. LENGTH AND WIDTH OF THE SITE AREA CAN BE ALTERED BUT DO NOT EXCEED MAX. SITE AREA ALLOWED.

PROJECT REF. NO. : E2850-00015-2020

PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHK'D

DEVELOPER/OWNER:
HOUSING & DEVELOPMENT BOARD (HDB)
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PROJECT TITLE:
INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE:
SITE PLAN

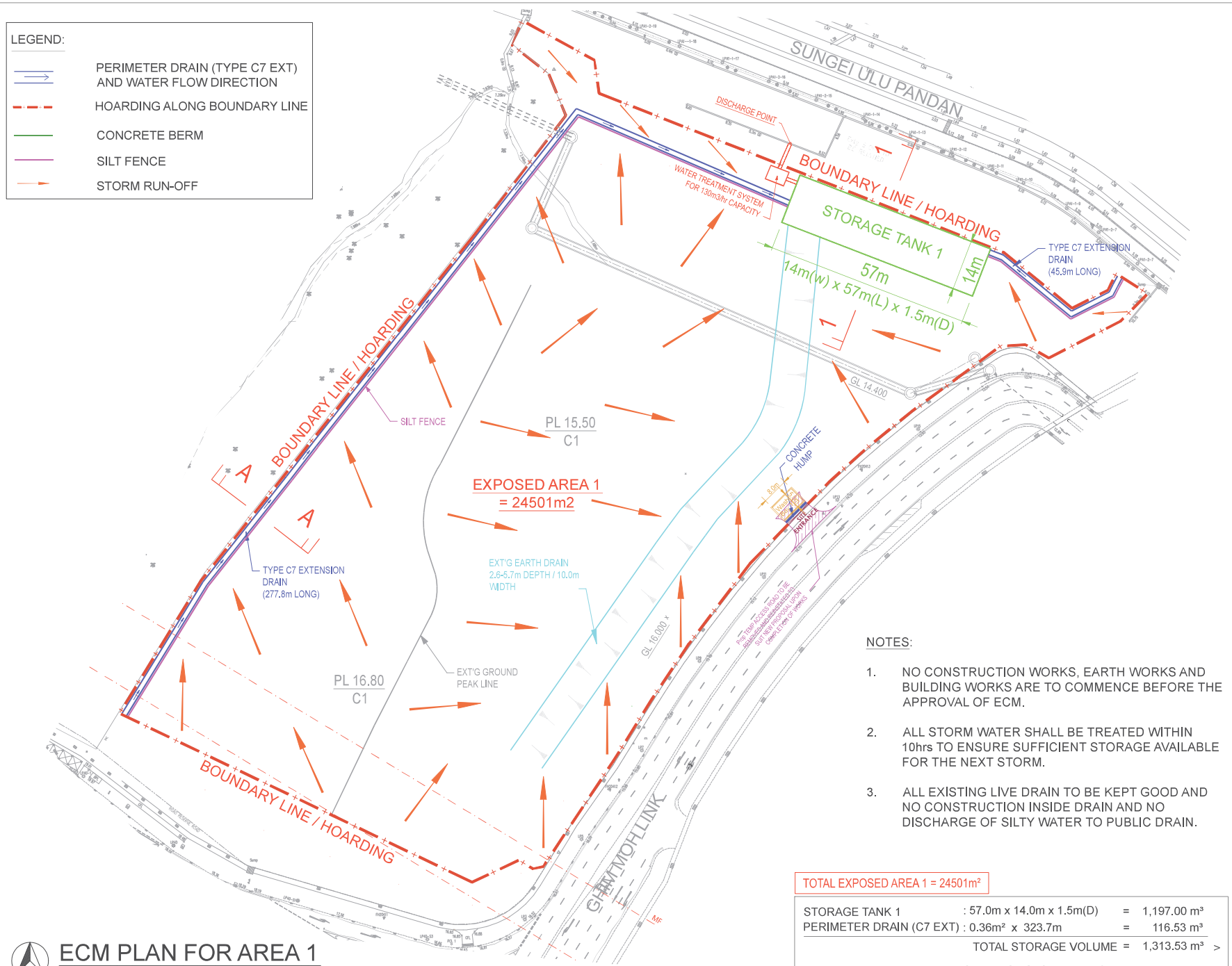
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KT	03.08.22	HHB	HHB	AS SHOWN

PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220xx	ECM	-	2	-

FILE NAME : HDB INFRASTRUCTURE WORKS - ECM



ECM PLAN FOR AREA 1

SCALE: 1:500

NOTES:

1. NO CONSTRUCTION WORKS, EARTH WORKS AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
2. ALL STORM WATER SHALL BE TREATED WITHIN 10hrs TO ENSURE SUFFICIENT STORAGE AVAILABLE FOR THE NEXT STORM.
3. ALL EXISTING LIVE DRAIN TO BE KEPT GOOD AND NO CONSTRUCTION INSIDE DRAIN AND NO DISCHARGE OF SILTY WATER TO PUBLIC DRAIN.

TOTAL EXPOSED AREA 1 = 24501m²

STORAGE TANK 1	: 57.0m x 14.0m x 1.5m(D)	=	1,197.00 m³
PERIMETER DRAIN (C7 EXT)	: 0.36m² x 323.7m	=	116.53 m³
	TOTAL STORAGE VOLUME	=	1,313.53 m³ >
	VOLUME OF STORM RUN-OFF	=	1,274.10 m³

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PROJECT REF. NO. : E2850-00015-2020

PROFESSIONAL ENGINEER CIVIL HE HONGBO 5130 SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHK'D

DEVELOPER/OWNER:

HOUSING & DEVELOPMENT BOARD (HDB)
BLK 480, LORONG 6 TOA PAYOH,
#01-01 HDB HUB
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CONTRACTOR:

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TEL: 6284 1373

PROJECT TITLE

INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE:

EARTH CONTROL MEASURE PLAN FOR AREA 1

PROFESSIONAL ENGINEER:

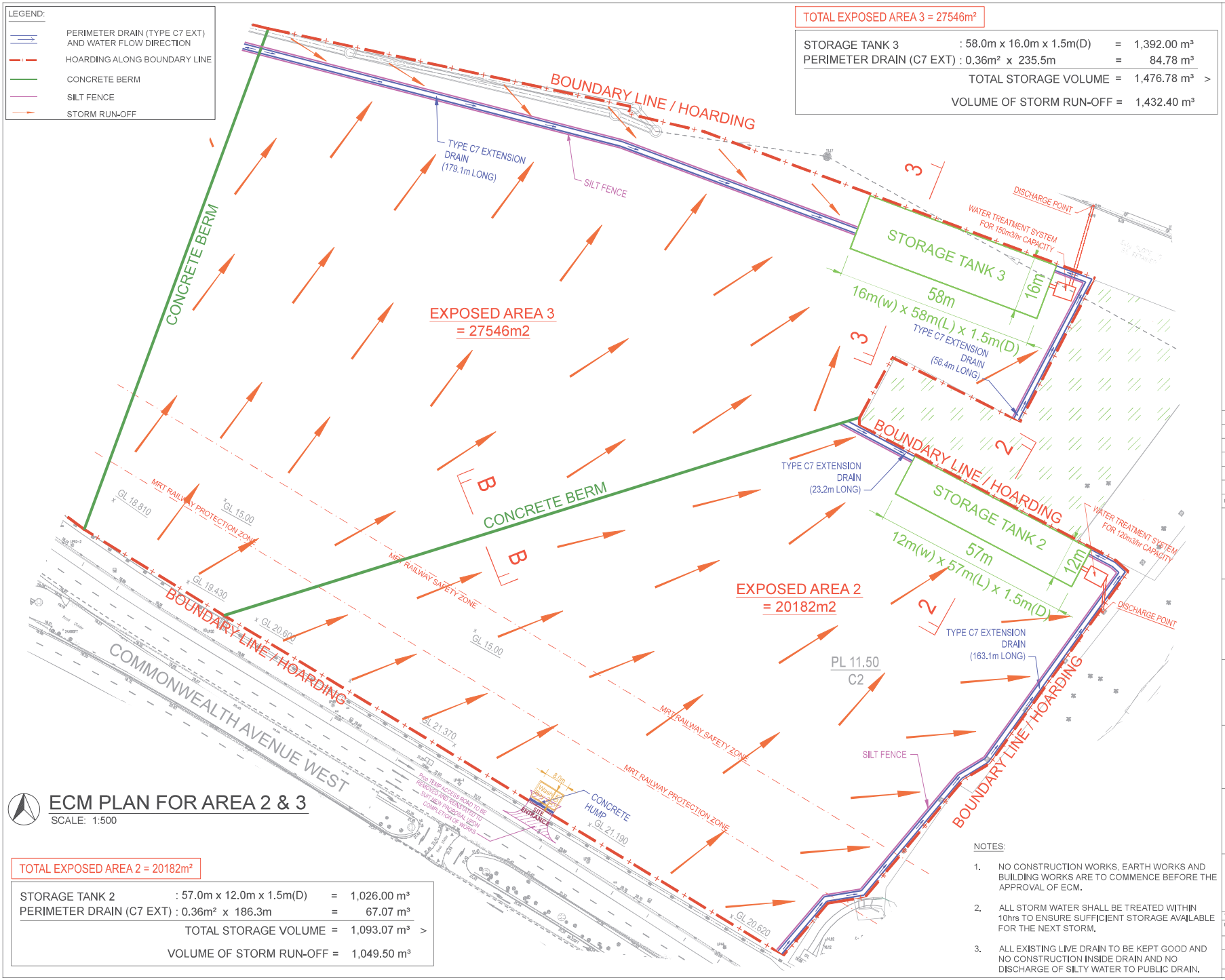
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PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220xx	ECM	-	3	-

FILE NAME : HDB INFRASTRUCTURE WORKS - ECM



ECM PLAN FOR AREA 2 & 3

SCALE: 1:500

TOTAL EXPOSED AREA 3 = 27546m²

STORAGE TANK 3	: 58.0m x 16.0m x 1.5m(D)	=	1,392.00 m³
PERIMETER DRAIN (C7 EXT)	: 0.36m² x 235.5m	=	84.78 m³
	TOTAL STORAGE VOLUME	=	1,476.78 m³ >
	VOLUME OF STORM RUN-OFF	=	1,432.40 m³

TOTAL EXPOSED AREA 2 = 20182m²

STORAGE TANK 2	: 57.0m x 12.0m x 1.5m(D)	=	1,026.00 m³
PERIMETER DRAIN (C7 EXT)	: 0.36m² x 186.3m	=	67.07 m³
	TOTAL STORAGE VOLUME	=	1,093.07 m³ >
	VOLUME OF STORM RUN-OFF	=	1,049.50 m³

NOTES:

1. NO CONSTRUCTION WORKS, EARTH WORKS AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
2. ALL STORM WATER SHALL BE TREATED WITHIN 10hrs TO ENSURE SUFFICIENT STORAGE AVAILABLE FOR THE NEXT STORM.
3. ALL EXISTING LIVE DRAIN TO BE KEPT GOOD AND NO CONSTRUCTION INSIDE DRAIN AND NO DISCHARGE OF SILTY WATER TO PUBLIC DRAIN.

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PROJECT REF. NO. : E2850-00015-2020

PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHK'D

DEVELOPER/OWNER:

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TEL: 6284 1373

PROJECT TITLE:

INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE:

EARTH CONTROL MEASURE PLAN FOR AREA 2 AND 3

PROFESSIONAL ENGINEER:

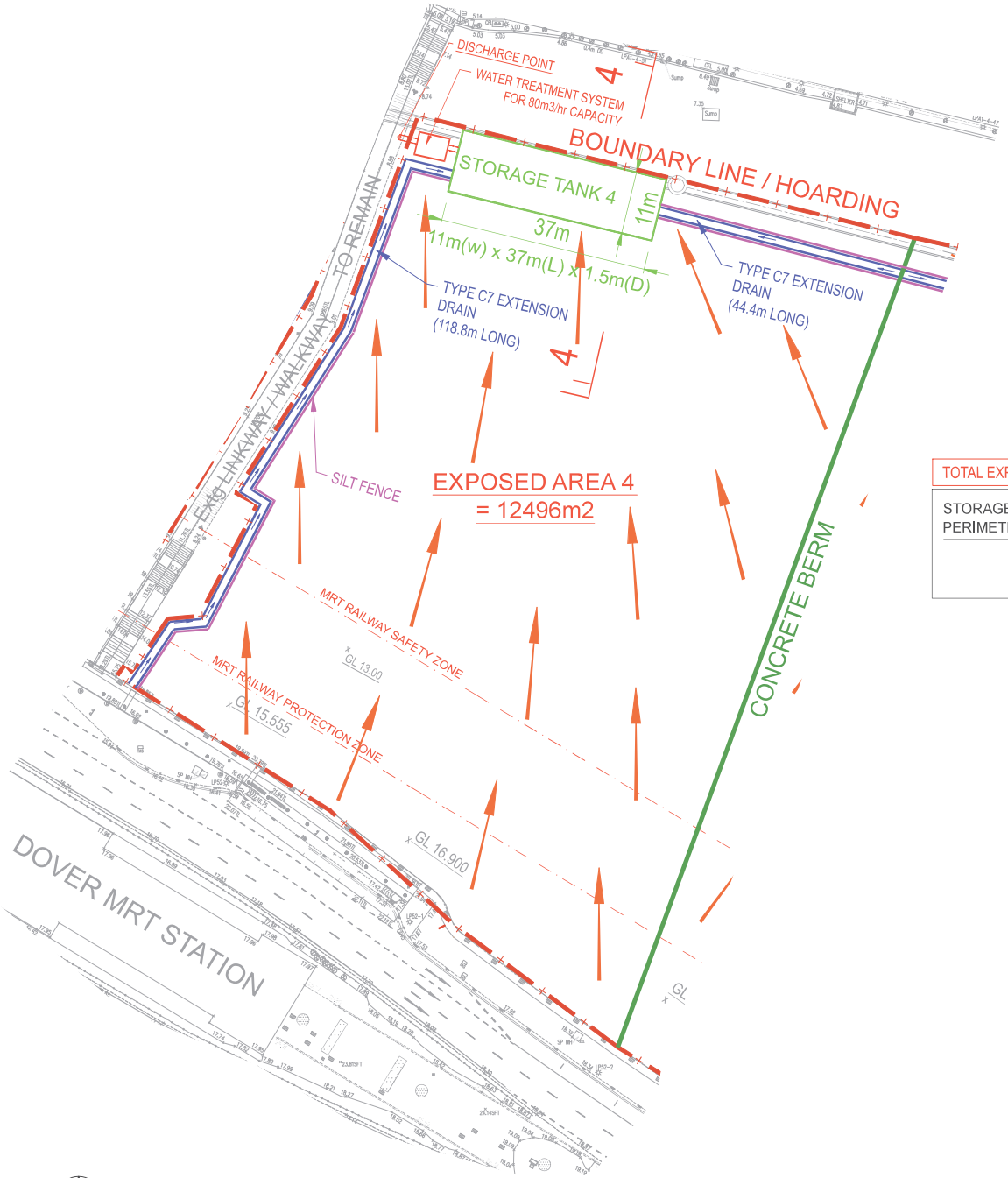
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KT	03.08.22	HHB	HHB	AS SHOWN

PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220xx	ECM	-	4	-

FILE NAME : HDB INFRASTRUCTURE WORKS - ECM



ECM PLAN FOR AREA 4

SCALE: 1:400

LEGEND:

- PERIMETER DRAIN (TYPE C7 EXT) AND WATER FLOW DIRECTION
- HOARDING ALONG BOUNDARY LINE
- CONCRETE BERM
- SILT FENCE
- STORM RUN-OFF

TOTAL EXPOSED AREA 4 = 12496m²

STORAGE TANK 4	: 37.0m x 11.0m x 1.5m(D)	=	610.50 m³
PERIMETER DRAIN (C7 EXT)	: 0.36m² x 163.2m	=	58.75 m³
	TOTAL STORAGE VOLUME	=	669.25 m³ >
	VOLUME OF STORM RUN-OFF	=	649.80 m³

NOTES:

1. NO CONSTRUCTION WORKS, EARTH WORKS AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
2. ALL STORM WATER SHALL BE TREATED WITHIN 10hrs TO ENSURE SUFFICIENT STORAGE AVAILABLE FOR THE NEXT STORM.
3. ALL EXISTING LIVE DRAIN TO BE KEPT GOOD AND NO CONSTRUCTION INSIDE DRAIN AND NO DISCHARGE OF SILTY WATER TO PUBLIC DRAIN.

005 sheet of 008

PROJECT REF. NO. : E2850-00015-2020

PROFESSIONAL ENGINEER CIVIL HE HONGBO 5130 SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHK'D

DEVELOPER/OWNER:

HOUSING & DEVELOPMENT BOARD (HDB)
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CONTRACTOR:

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QUALIFIED PERSON (QP):

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Singapore 150168

TEL: 6284 1373

PROJECT TITLE:

INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE:

EARTH CONTROL MEASURE PLAN FOR AREA 4

PROFESSIONAL ENGINEER:

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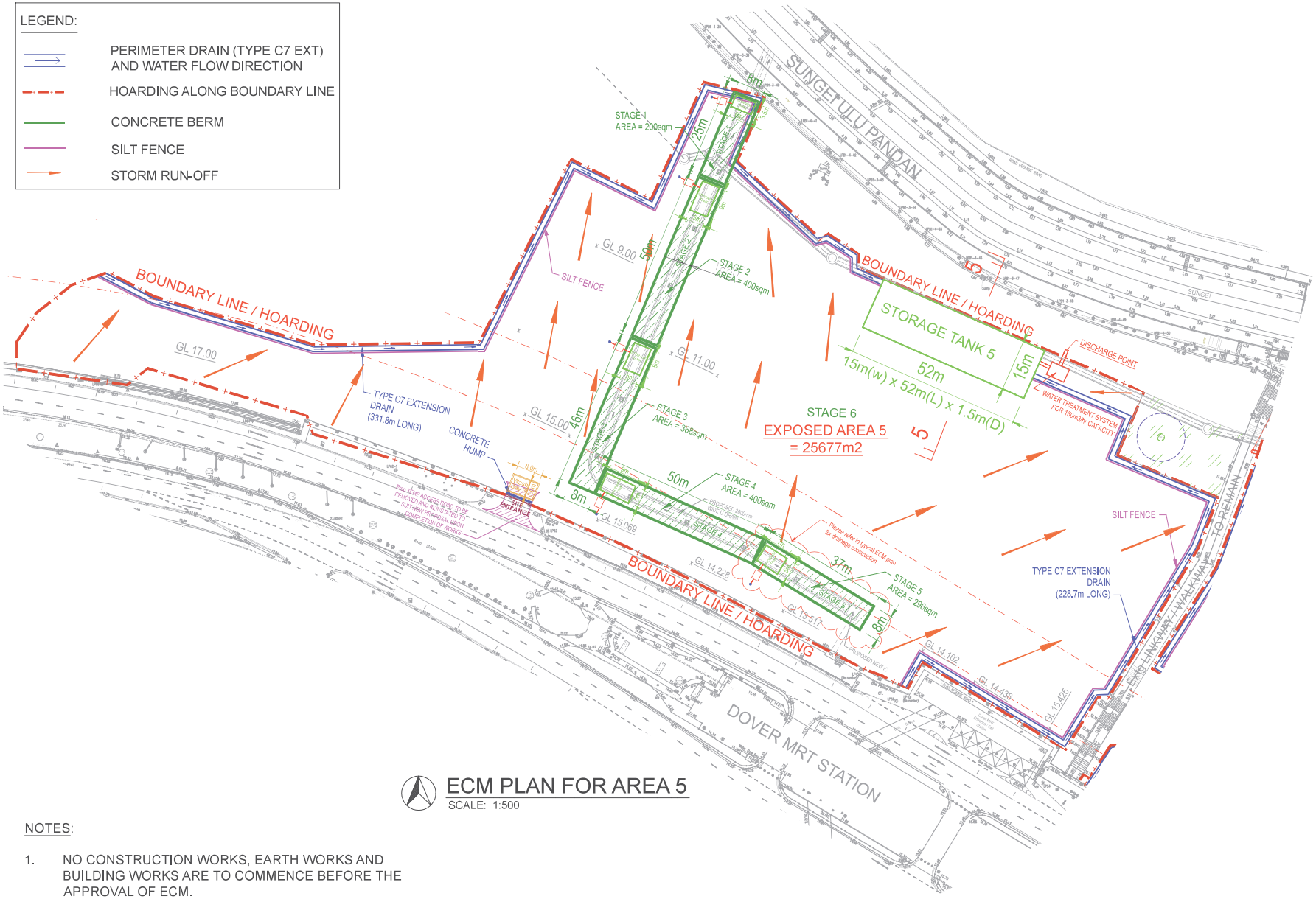
PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220xx	ECM	-	5	-

FILE NAME: HDB INFRASTRUCTURE WORKS - ECM

PROJECT REF. NO. : E2850-00015-2020

LEGEND:

- PERIMETER DRAIN (TYPE C7 EXT) AND WATER FLOW DIRECTION
- HOARDING ALONG BOUNDARY LINE
- CONCRETE BERM
- SILT FENCE
- STORM RUN-OFF



ECM PLAN FOR AREA 5

SCALE: 1:500

NOTES:

1. NO CONSTRUCTION WORKS, EARTH WORKS AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
2. ALL STORM WATER SHALL BE TREATED WITHIN 10hrs TO ENSURE SUFFICIENT STORAGE AVAILABLE FOR THE NEXT STORM.
3. ALL EXISTING LIVE DRAIN TO BE KEPT GOOD AND NO CONSTRUCTION INSIDE DRAIN AND NO DISCHARGE OF SILTY WATER TO PUBLIC DRAIN.

TOTAL EXPOSED AREA 5 = 25677m²

STORAGE TANK 5	: 52.0m x 15.0m x 1.5m(D)	=	1,170.00 m³
PERIMETER DRAIN (C7 EXT)	: 0.36m² x 560.5m	=	201.78 m³
	TOTAL STORAGE VOLUME	=	1,371.78 m³ >
	VOLUME OF STORM RUN-OFF	=	1,335.20 m³

PROFESSIONAL ENGINEER
CIVIL
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SINGAPORE
QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHK'D

DEVELOPER/OWNER:

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TEL: 6284 1373

PROJECT TITLE

INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE:

EARTH CONTROL MEASURE PLAN FOR AREA 5

PROFESSIONAL ENGINEER:

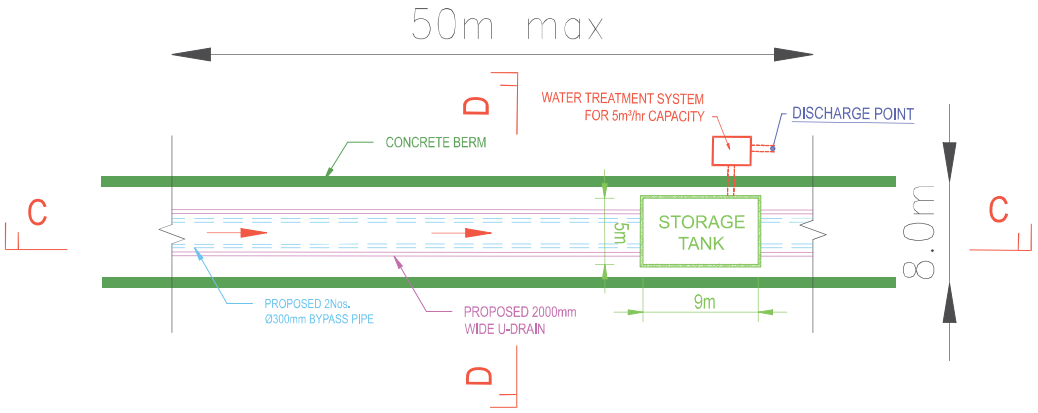
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PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220xx	ECM	-	6	-

FILE NAME : HDB INFRASTRUCTURE WORKS - ECM

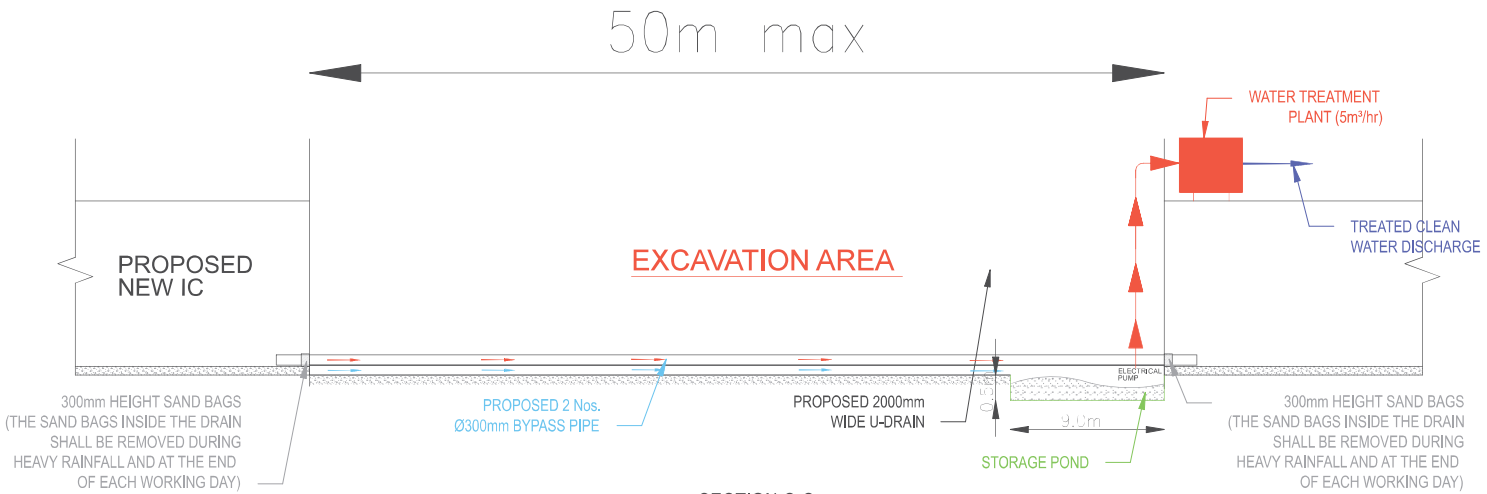


TYPICAL ECM PLAN FOR DRAINAGE CONSTRUCTION (MAX EXPOSED LENGTH 50M)
STAGE 1-5 AT AREA 5

SCALE: 1:200

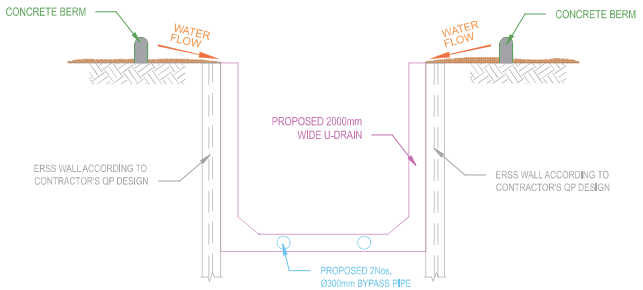
NOTES:

1. NO CONSTRUCTION WORKS, EARTH WORKS AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
2. ALL STORM WATER SHALL BE TREATED WITHIN 10hrs TO ENSURE SUFFICIENT STORAGE AVAILABLE FOR THE NEXT STORM.
3. ALL EXISTING LIVE DRAIN TO BE KEPT GOOD AND NO CONSTRUCTION INSIDE DRAIN AND NO DISCHARGE OF SILTY WATER TO PUBLIC DRAIN.



SECTION C-C

SCALE: 1:150



SECTION D-D

SCALE: 1:30

EXPOSED AREA (m²)	VOLUME OF RUNOFF (m³)	STORAGE POND				REQUIRED CAPACITY FOR TREATMENT PLANT (m³/hr)	PROVIDED CAPACITY FOR TREATMENT PLANT (m³/hr)	SILTY WATER TREATMENT SYSTEM
		L(m)	W(m)	D(m)	V(m³)			
400m²	20.80m³	9.0	5.0	0.5	22.50	2.10m³/hr	5m³/hr	FLEXI

LEGEND:

- SILTY WATER FLOW
- TREATED CLEAN WATER DISCHARGE
- WATER TREATMENT PLANT
- EXISTING DRAIN WATER
- STORAGE TANK

PROJECT REF. NO. : E2850-00015-2020

PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHK'D

DEVELOPER/OWNER:

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QUALIFIED PERSON (QP):

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TEL: 6284 1373

PROJECT TITLE:

INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE:

ECM PLAN FOR TYPICAL EXPOSED LENGTH 50m (STAGE 1-5 AT AREA 5)
SECTION C-C
SECTION D-D

PROFESSIONAL ENGINEER:

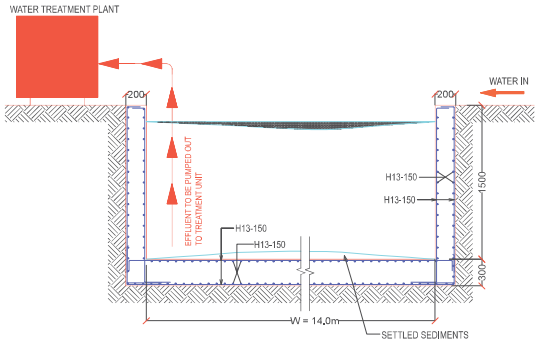
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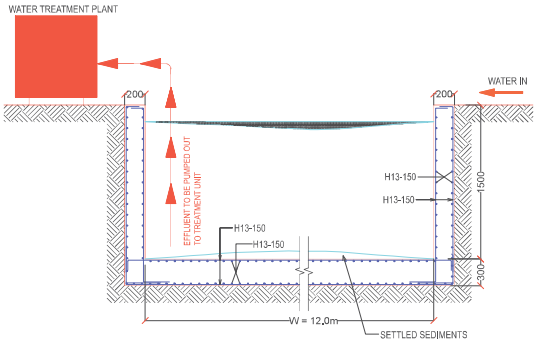
PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220xx	ECM	-	7	-

FILE NAME : HDB INFRASTRUCTURE WORKS - ECM



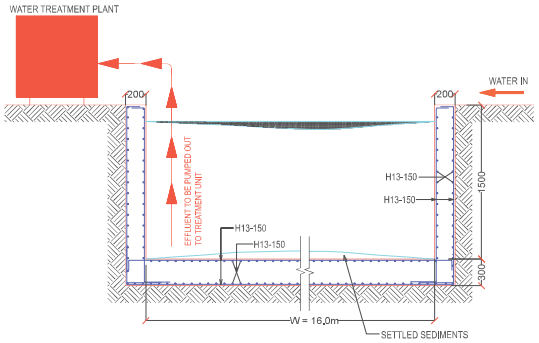
STORAGE TANK 1 (SECTION 1-1)

SCALE: 1:25



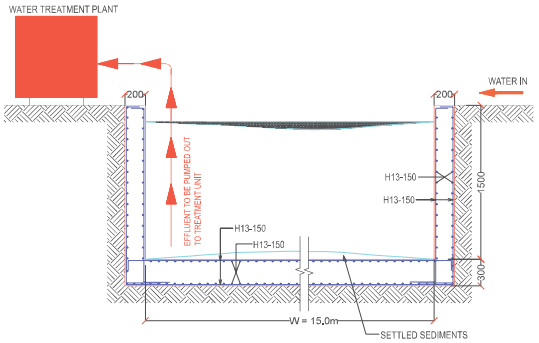
STORAGE TANK 2 (SECTION 2-2)

SCALE: 1:25



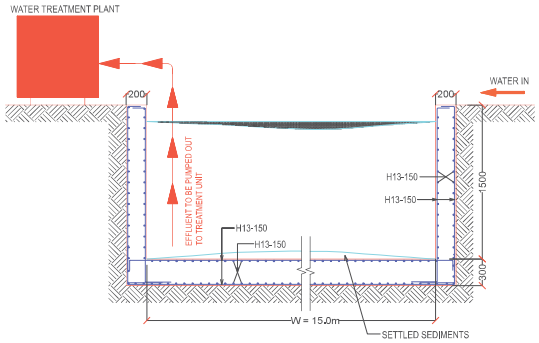
STORAGE TANK 3 (SECTION 3-3)

SCALE: 1:25



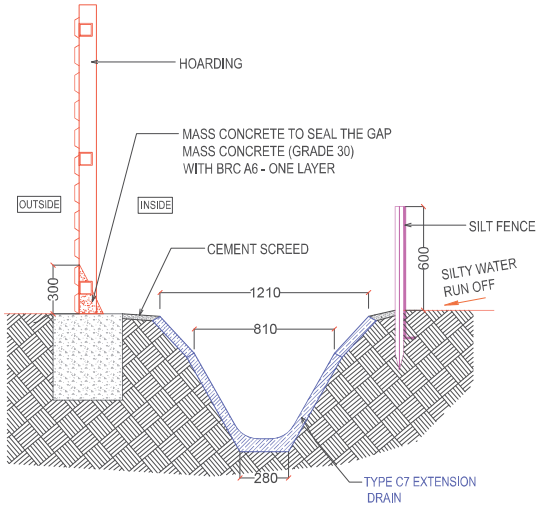
STORAGE TANK 4 (SECTION 4-4)

SCALE: 1:25



STORAGE TANK 5 (SECTION 5-5)

SCALE: 1:25

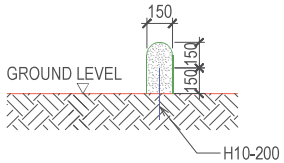


HOARDING, DRAIN AND SILT FENCE SECTION A-A

SCALE: 1:15

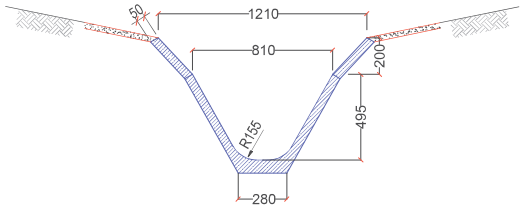
NOTE:

1. SILT FENCE IS A FILTER MEMBRANE MADE OF WOVEN POLYPROPYLENE FABRIC OR EQUIVALENT WHICH ALLOWS WATER TO FLOW THROUGH IT, BUT NOT SUSPENDED SOIL PARTICLES.
2. INSTALLED SILT FENCE SHALL HAVE A MINIMUM EXPOSED HEIGHT OF 600mm ABOVE GROUND LEVEL AND PROPERLY EMBEDDED INTO THE GROUND.
3. OPEN CUT SLOPE TO BE PROTECTED WITH SOIL EROSION BLANKET OR APPROVED MATERIAL.
4. REGULAR INSPECTION AND REVIEW OF THE EROSION CONTROL SCHEME TO BE CARRIED ON A MONTHLY BASIS OR WHEN THE CONSTRUCTION NEEDS ARISE.
5. LENGTH AND WIDTH OF THE EXPOSED AREA CAN BE ALTERED BUT DO NOT EXCEED MAX. EXPOSED AREA ALLOWED.



CONCRETE BERM (TYP.) SECTION B-B

SCALE: NTS



DETAIL FOR CUT-OFF TYPE C7 EXTENSION DRAIN

SCALE: 1:15

008 sheet of 008

PROJECT REF. NO. : E2850-00015-2020

PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHK'D

DEVELOPER/OWNER:

HOUSING & DEVELOPMENT BOARD (HDB)
BLK 480, LORONG 6 TOA PAYOH,
#01-01 HDB HUB
Singapore 310480

TEL: 9797 0089

CONTRACTOR:

JIN CHOON CIVIL ENGINEERING PTE LTD
12 TUAS SOUTH STREET 6,
Singapore 636911

TEL: 6565 9511
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EMAIL: generalenquiry@jinchoon.com.sg

QUALIFIED PERSON (QP):

SURBANA JURONG CONSULTANTS PTE LTD
BLK 168, JALAN BUKIT MERAH,
#01-01 CONNECTION ONE
Singapore 150168

TEL: 6284 1373

PROJECT TITLE:

INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE:

STORAGE TANK 1, 2, 3, 4 AND 5
SECTION A-A
SECTION B-B

PROFESSIONAL ENGINEER:

VASU CHARTERED ENGINEERS LLP
20 Sin Ming Lane, #05-88 Midview City,
Singapore 573968
Email: submission@vce.com.sg
Tel: 6749 0385 Fax: 6742 8092

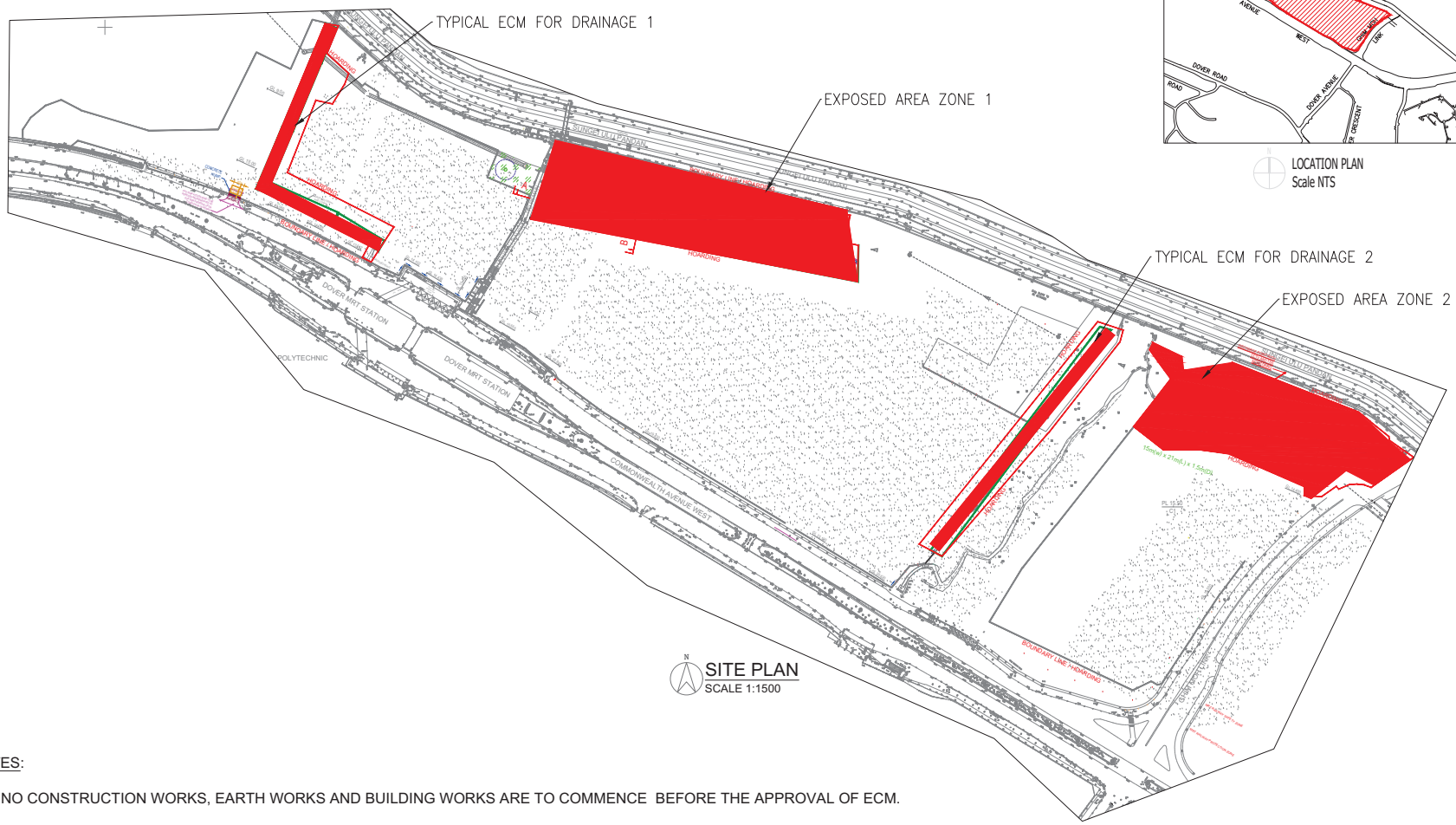
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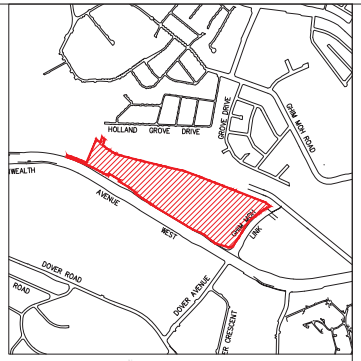
PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO.	REV
VCE/220xx	ECM	-	8	-

FILE NAME : HDB INFRASTRUCTURE WORKS - ECM

APPENDIX G – ECM PLAN (GIW) & TSS COLOUR CHART



N
SITE PLAN
SCALE 1:1500



LOCATION PLAN
Scale NTS

PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHKD

LANDOWNER:

DEVELOPER/ OWNER:
HOUSING & DEVELOPMENT BOARD (HDB)
BLK 480, LORONG 6 TOA PAYOH,
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Singapore 310480

TEL: 9797 0089

ARCHITECTS:

CONTRACTOR:
JIN CHOON CIVIL ENGINEERING PTE LTD
12 TUAS SOUTH STREET 6,
Singapore 636911

TEL: 6565 9511
FAX: 6565 9513
EMAIL: generalenquiry@jinchoon.com.sg

PROJECT TITLE
INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE
SITE PLAN

PROFESSIONAL ENGINEER (ECM)
VCE CONSULTANTS & ENGINEERING PTE LTD
20 Sin Ming Lane, #05-69 Midview City,
Singapore 573968
Email: submission@vce.com.sg
Tel: 6749 0365 Fax: 6742 9262

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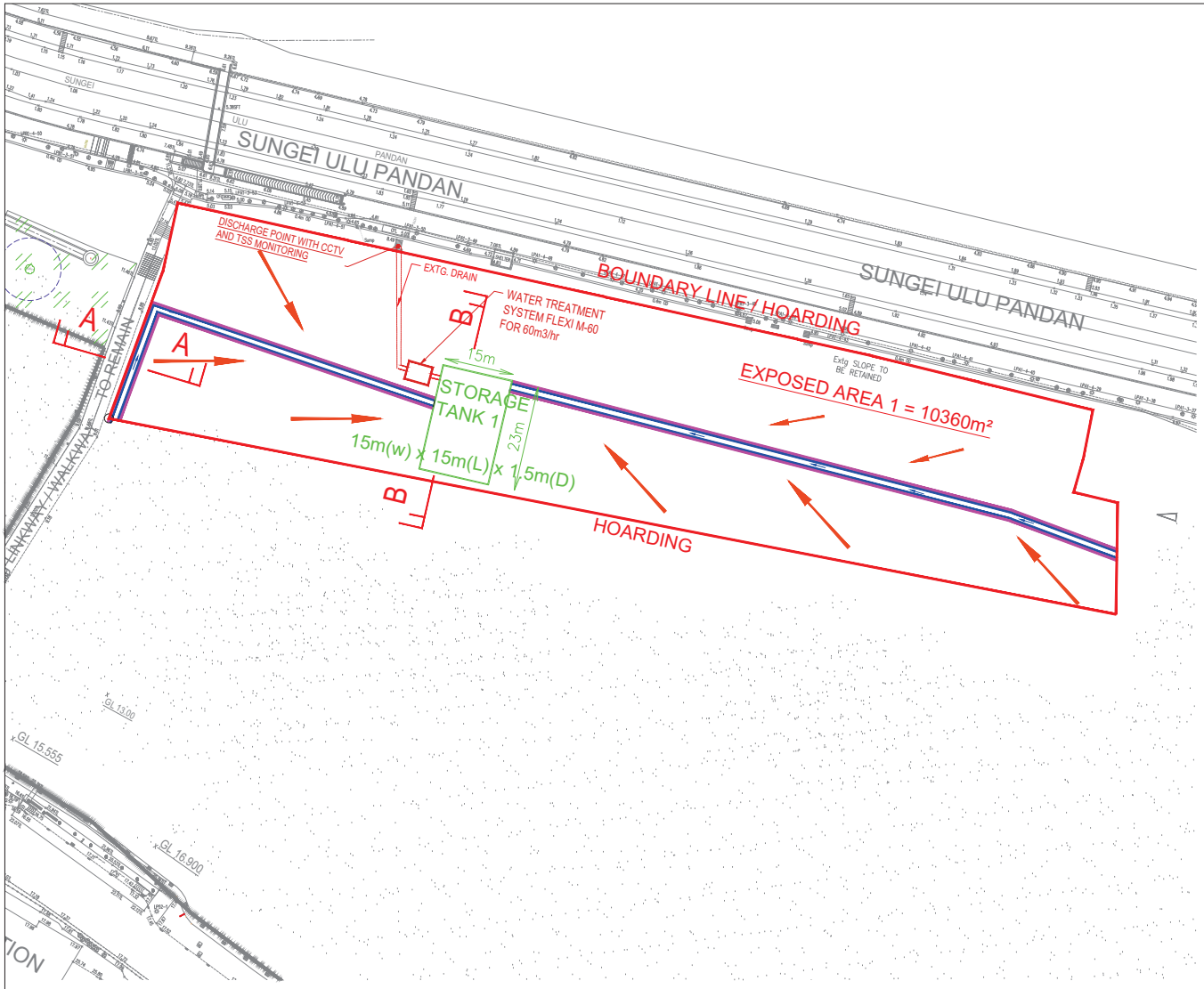
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AF	01.2024	HHB	HHB	AS SHOWN

PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220XX	ECM	-	01	-

FILE NAME : ECM Drawing_stage 2(Jan 2024)

NOTES:

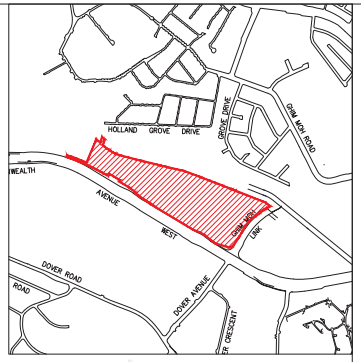
1. NO CONSTRUCTION WORKS, EARTH WORKS AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
2. ALL STORM WATER SHALL BE TREATED WITHIN 10hrs TO ENSURE SUFFICIENT STORAGE AVAILABLE FOR THE NEXT STORM.
3. ALL EXISTING LIVE DRAIN TO BE KEPT GOOD AND NO ONSTRUCTION INSIDE DRAIN AND NO DISCHARGE OF SILTY WATER TO PUBLIC DRAIN.
4. SILT FENCE IS A FILTER MEMBRANE MADE OF WOVEN POLYPROPYLENE FABRIC OR EQUIVALENT WHICH ALLOWS WATER TO FLOW THROUGH IT, BUT NOT SUSPENDED SOIL PARTICLES.
5. INSTALLED SILT FENCE SHALL HAVE A MINIMUM EXPOSED HEIGHT OF 600mm ABOVE GROUND LEVEL AND PROPERLY EMBEDDED INTO THE GROUND.
6. OPEN CUT SLOPE TO BE PROTECTED WITH SOIL EROSION BLANKET OR APPROVED MATERIAL.
7. REGULAR INSPECTION AND REVIEW OF THE EROSION CONTROL SCHEME TO BE CARRIED ON A MONTHLY BASIS OR WHEN THE CONSTRUCTION NEEDS ARISE.
8. LENGTH AND WIDTH OF THE EXPOSED AREA CAN BE ALTERED BUT DO NOT EXCEED MAX.EXPOSED AREA ALLOWED.



ECM ZONE 1
SCALE 1:500

LEGEND:

- HOARDING
- SILT FENCE
- PERIMETER DRAIN (C7)
- STORM RUN-OFF



LOCATION PLAN
Scale NTS

NOTES:

1. NO CONSTRUCTION WORKS, EARTH WORKS AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
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8. LENGTH AND WIDTH OF THE EXPOSED AREA CAN BE ALTERED BUT DO NOT EXCEED MAX.EXPOSED AREA ALLOWED.

ECM TANK	: 1.5 m x 15m x 23m	=	517.50 m³
PERIMETER DRAIN (C7)	: 0.17m² x 160 m	=	27.20 m³
	TOTAL STORAGE VOLUME	544.70 m³ >	VOLUME OF STORM RUN-OFF = 538.72m³

PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHKD

LANDOWNER:

DEVELOPER/ OWNER:
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Singapore 310480

TEL: 9797 0089

ARCHITECTS:

CONTRACTOR:
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12 TUAS SOUTH STREET 6,
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TEL: 6565 9511
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EMAIL: generalenquiry@jinchoon.com.sg

PROJECT TITLE
INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE
ZONE 1 PLAN

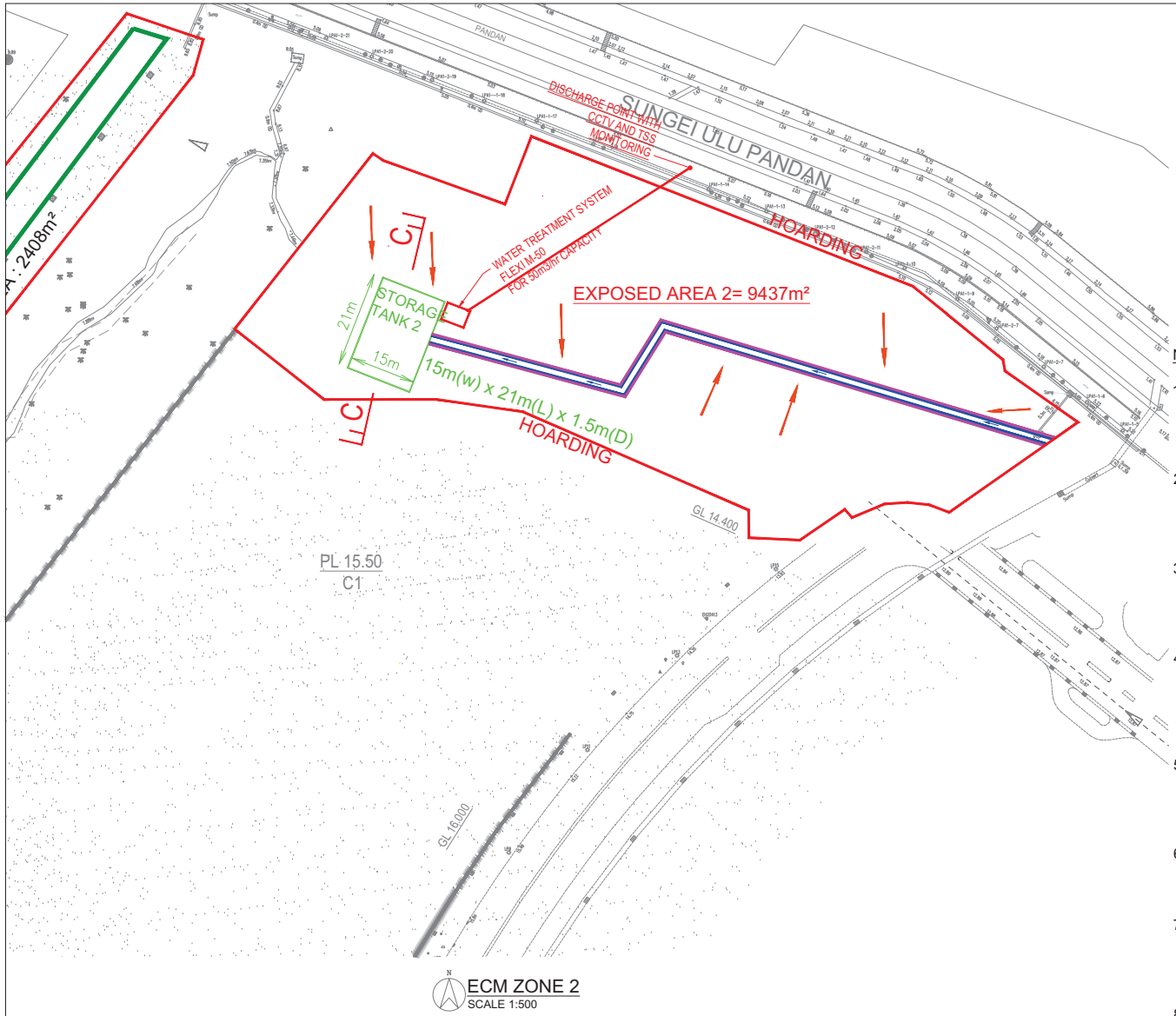
PROFESSIONAL ENGINEER (ECM)
VCE CONSULTANTS & ENGINEERING PTE LTD
20 Sin Ming Lane, #05-68 Midview City,
Singapore 573968
Email: submission@vce.com.sg
Tel: 6749 0365 Fax: 6742 9262

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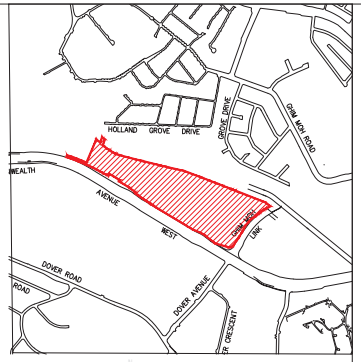
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AF	01.2024	HHB	HHB	AS SHOWN

PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220XX	ECM	-	02	-

FILE NAME : ECM Drawing_stage 2(Jan 2024)



ECM ZONE 2
SCALE 1:500



LOCATION PLAN
Scale NTS

NOTES:

1. NO CONSTRUCTION WORKS, EARTH WORKS AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
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8. LENGTH AND WIDTH OF THE EXPOSED AREA CAN BE ALTERED BUT DO NOT EXCEED MAX.EXPOSED AREA ALLOWED.

LEGEND:
- HOARDING
- SILT FENCE
- PERIMETER DRAIN (C7)
- STORM RUN-OFF

ECM TANK	: 1.5 m x 15m x 21m	= 472.50 m³
PERIMETER DRAIN (C7)	: 0.17m² x 150 m	= 25.50 m³
TOTAL STORAGE VOLUME	498.00 m³ >	VOLUME OF STORM RUN-OFF = 490.72m³

PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHKD

LANDOWNER:

DEVELOPER/ OWNER:
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Singapore 310480

TEL: 9797 0089

ARCHITECTS:

CONTRACTOR:
JIN CHOON CIVIL ENGINEERING PTE LTD
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PROJECT TITLE
INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE
ECM PLAN FOR ZONE 2

PROFESSIONAL ENGINEER (ECM)
VCE CONSULTANTS & ENGINEERING PTE LTD
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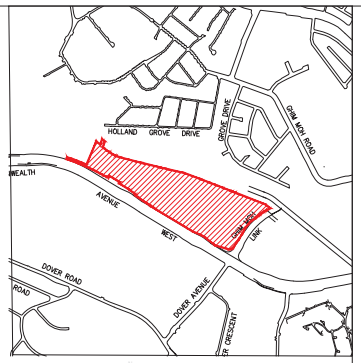
PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220XX	ECM	-	03	-

FILE NAME : ECM Drawing_stage 2(Jan 2024)



TYPICAL DRAINAGE 1
SCALE 1:500

TYPICAL DRAINAGE 2
SCALE 1:500



LOCATION PLAN
Scale NTS

NOTES:

1. NO CONSTRUCTION WORKS, EARTH WORKS AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
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PROFESSIONAL ENGINEER
CIVIL
HE HONGBO
5130
SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHKD

LANDOWNER:

DEVELOPER/ OWNER:
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ARCHITECTS:

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TEL: 6565 9511
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PROJECT TITLE

INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE

TYPICAL ECM

PROFESSIONAL ENGINEER (ECM)

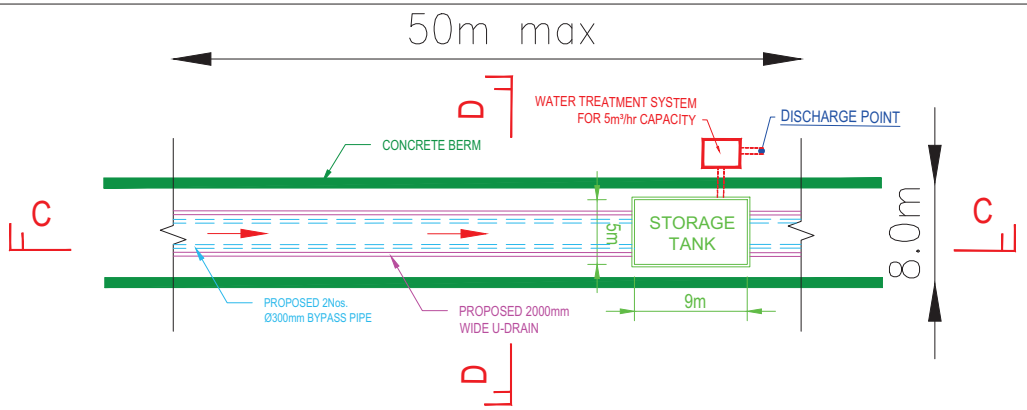
VCE CONSULTANTS & ENGINEERING PTE LTD
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Email: submission@vce.com.sg
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PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220XX	ECM	-		-

FILE NAME : ECM Drawing_stage 2(Jan 2024)

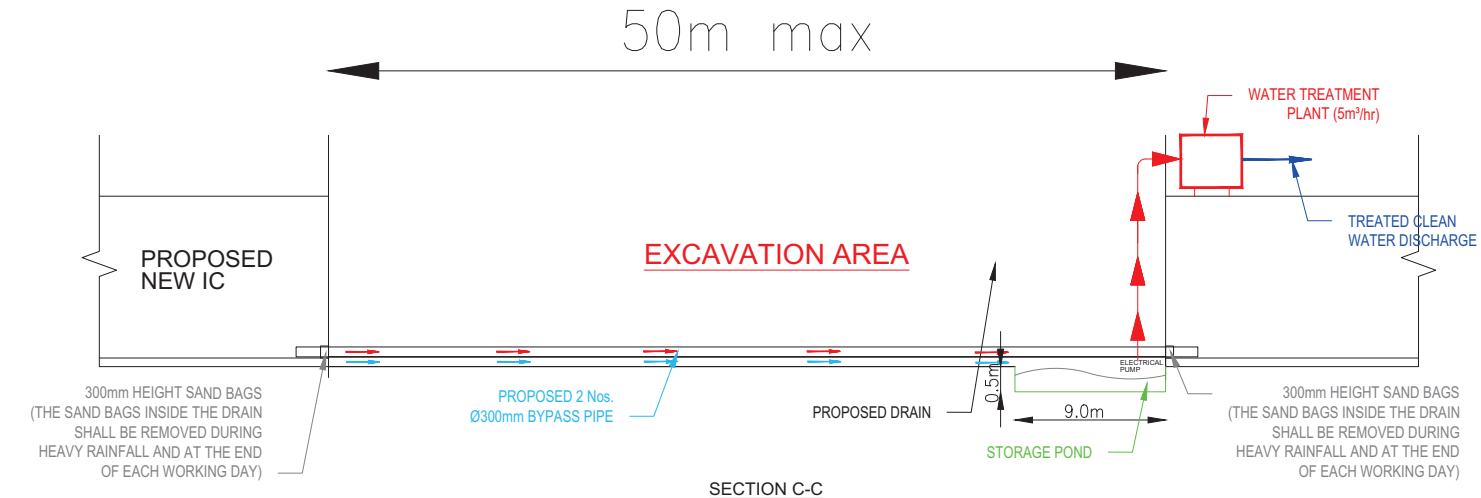


TYPICAL ECM PLAN FOR DRAINAGE CONSTRUCTION (MAX EXPOSED LENGTH 50M)

SCALE: 1:200

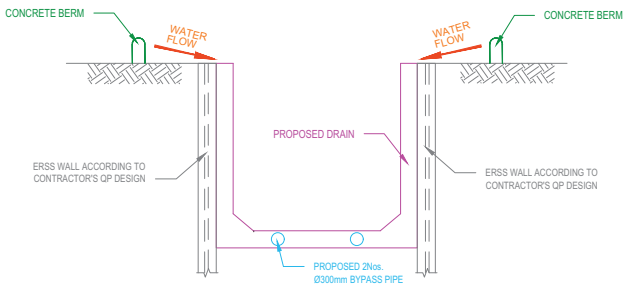
NOTES:

1. NO CONSTRUCTION WORKS, EARTH WORKS AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
2. ALL STORM WATER SHALL BE TREATED WITHIN 10hrs TO ENSURE SUFFICIENT STORAGE AVAILABLE FOR THE NEXT STORM.
3. ALL EXISTING LIVE DRAIN TO BE KEPT GOOD AND NO CONSTRUCTION INSIDE DRAIN AND NO DISCHARGE OF SILTY WATER TO PUBLIC DRAIN.



SECTION C-C

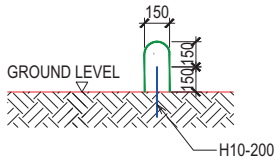
SCALE: 1:150



SECTION D-D

SCALE: 1:30

EXPOSED AREA (m²)	VOLUME OF RUNOFF (m³)	STORAGE POND				REQUIRED CAPACITY FOR TREATMENT PLANT (m³/hr)	PROVIDED CAPACITY FOR TREATMENT PLANT (m³/hr)	SILTY WATER TREATMENT SYSTEM
		L(m)	W(m)	D(m)	V(m³)			
400m²	20.80m³	9.0	5.0	0.5	22.50	2.10m³/hr	5m³/hr	FLEXI



CONCRETE BERM (TYP.)

SCALE: NTS

LEGEND:

- SILTY WATER FLOW
- TREATED CLEAN WATER DISCHARGE
- WATER TREATMENT PLANT
- EXISTING DRAIN WATER
- STORAGE TANK

PROFESSIONAL ENGINEER (CIVIL) HE HONGBO 5130 SINGAPORE

QECP No: Q0349

REV	DATE	NAME	SUBJECT	CHKD

LANDOWNER:

DEVELOPER/ OWNER:
HOUSING & DEVELOPMENT BOARD (HDB)
BLK 480, LORONG 6 TOA PAYOH,
#01-01 HDB HUB
Singapore 310480

TEL: 9797 0089

ARCHITECTS:

CONTRACTOR:
JIN CHOON CIVIL ENGINEERING PTE LTD
12 TUAS SOUTH STREET 6,
Singapore 636911

TEL: 6565 9511
FAX: 6565 9513
EMAIL: generalenquiry@jinchoon.com.sg

PROJECT TITLE

INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE

PROFESSIONAL ENGINEER (ECM)

VCE CONSULTANTS & ENGINEERING PTE LTD
20 Sin Ming Lane, #05-69 Midview City,
Singapore 573968
Email: submission@vce.com.sg
Tel: 6749 0365 Fax: 6742 9262

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AF	01.2024	HHB	HHB	AS SHOWN

PROJECT ID	AUTHOR	MODEL PART / ZONE / BLOCK	DRAWING NO	REV
VCE/220XX	ECM	-		-

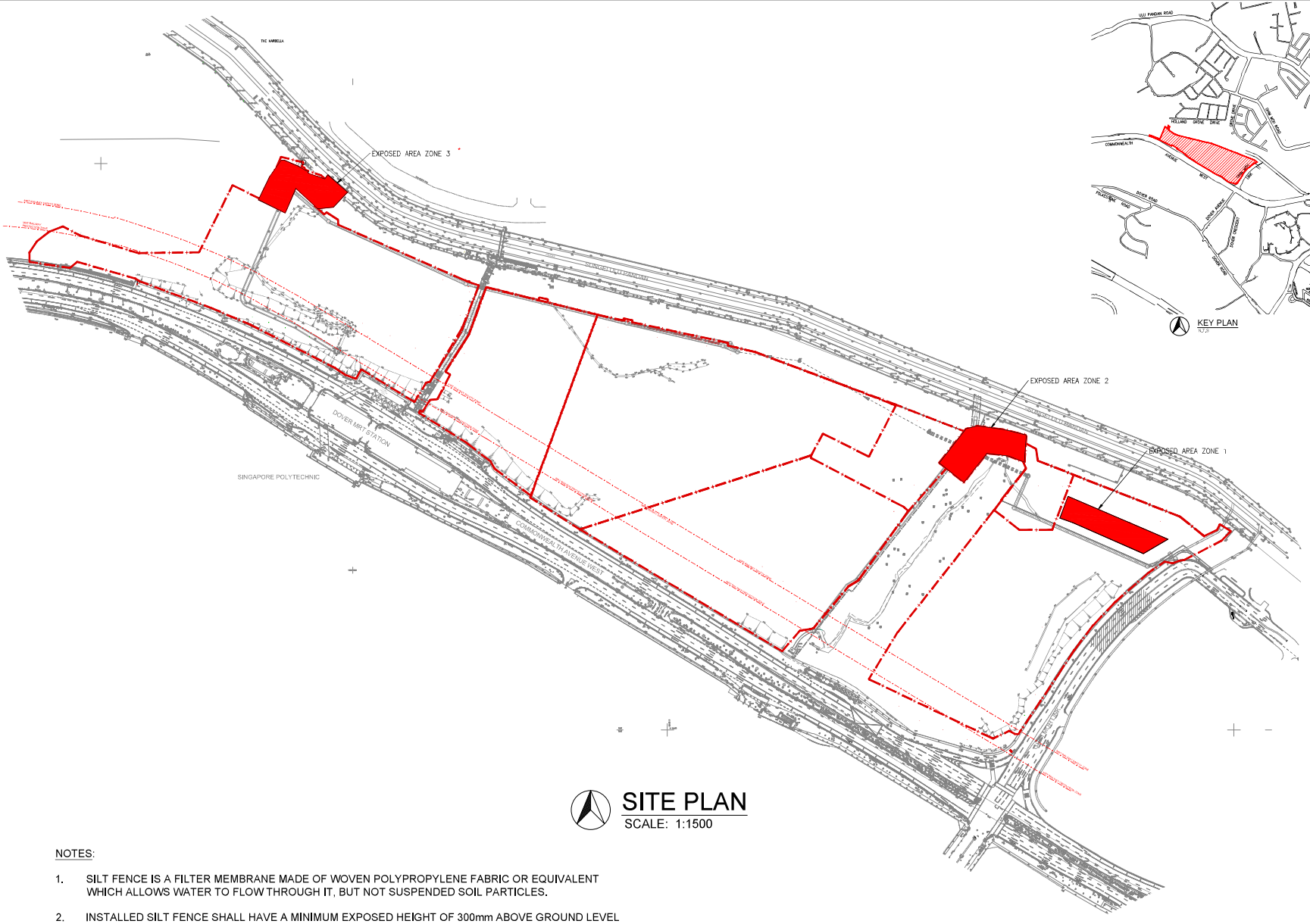
FILE NAME :

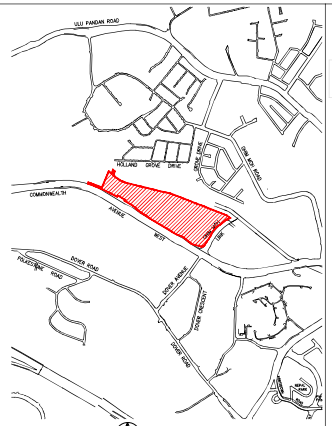
Colour of Water Samples at Various Silt Concentrations



Measurement of Total Suspended Solids (TSS) in mg/l

APPENDIX H – ECM PLAN (REVISED DRAIN ALIGNMENT)





SITE PLAN
SCALE: 1:1500

NOTES:

1. SILT FENCE IS A FILTER MEMBRANE MADE OF WOVEN POLYPROPYLENE FABRIC OR EQUIVALENT WHICH ALLOWS WATER TO FLOW THROUGH IT, BUT NOT SUSPENDED SOIL PARTICLES.
2. INSTALLED SILT FENCE SHALL HAVE A MINIMUM EXPOSED HEIGHT OF 300mm ABOVE GROUND LEVEL AND PROPERLY EMBEDDED INTO THE GROUND.
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PROJECT TITLE

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DRAWING TITLE

SITE PLAN

PROFESSIONAL ENGINEER (ECM)

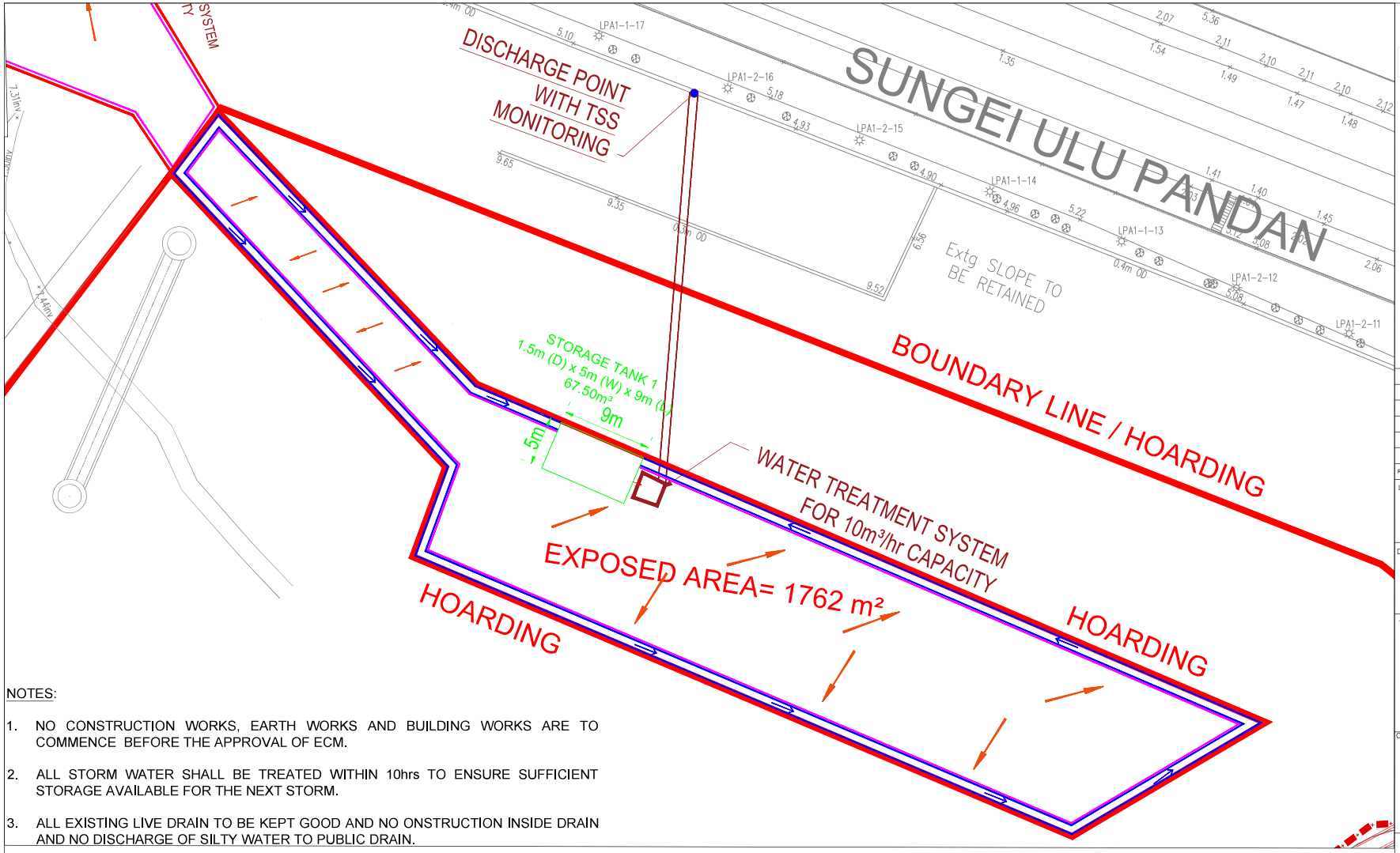
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8. LENGTH AND WIDTH OF THE EXPOSED AREA CAN BE ALTERED BUT DO NOT EXCEED MAX.EXPOSED AREA ALLOWED.

ECM PLAN FOR AREA 1

SCALE: 1:200

LEGEND:

- PERIMETER DRAIN (TYPE C7 EXT) AND WATER FLOW DIRECTION
- HOARDING ALONG BOUNDARY LINE
- SILT FENCE
- STORM RUN-OFF

ECM TANK	: 1.5 m x 5m x 9m	= 67.50 m³
PERIMETER DRAIN (C7)	: 0.17m² x 200 m	= 34.00 m³
TOTAL STORAGE VOLUME	101.50 m³ >	VOLUME OF STORM RUN-OFF = 91.62m³

FOR PUB ECM SUBMISSION

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ECM PLAN AREA 1

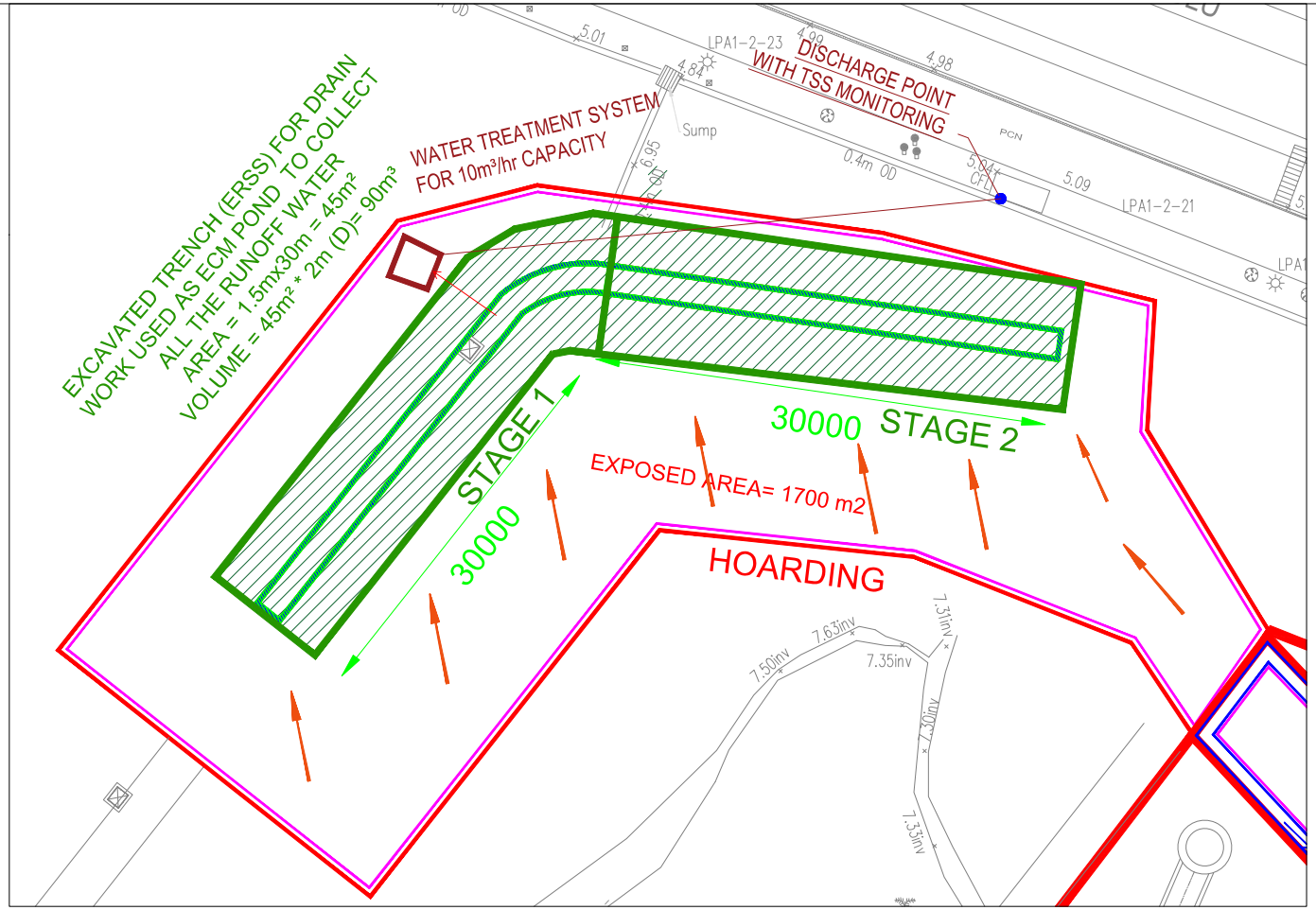
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ECM PLAN FOR AREA 2

SCALE: 1:150

NOTES:

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LEGEND:

- PERIMETER DRAIN (TYPE C7 EXT) AND WATER FLOW DIRECTION
- HOARDING ALONG BOUNDARY LINE
- SILT FENCE
- STORM RUN-OFF

ECM TANK	: 2 m x 1.5m x 30m =	90.00m³
TOTAL STORAGE VOLUME	90.00 m³	> VOLUME OF STORM RUN-OFF = 88.40m³

FOR PUB ECM SUBMISSION

IES / ACES QECP Q0349 HE HONGBO PE (Civil) 5130

QECP No: Q0349

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DRAWING TITLE
EXPOSED AREA 2

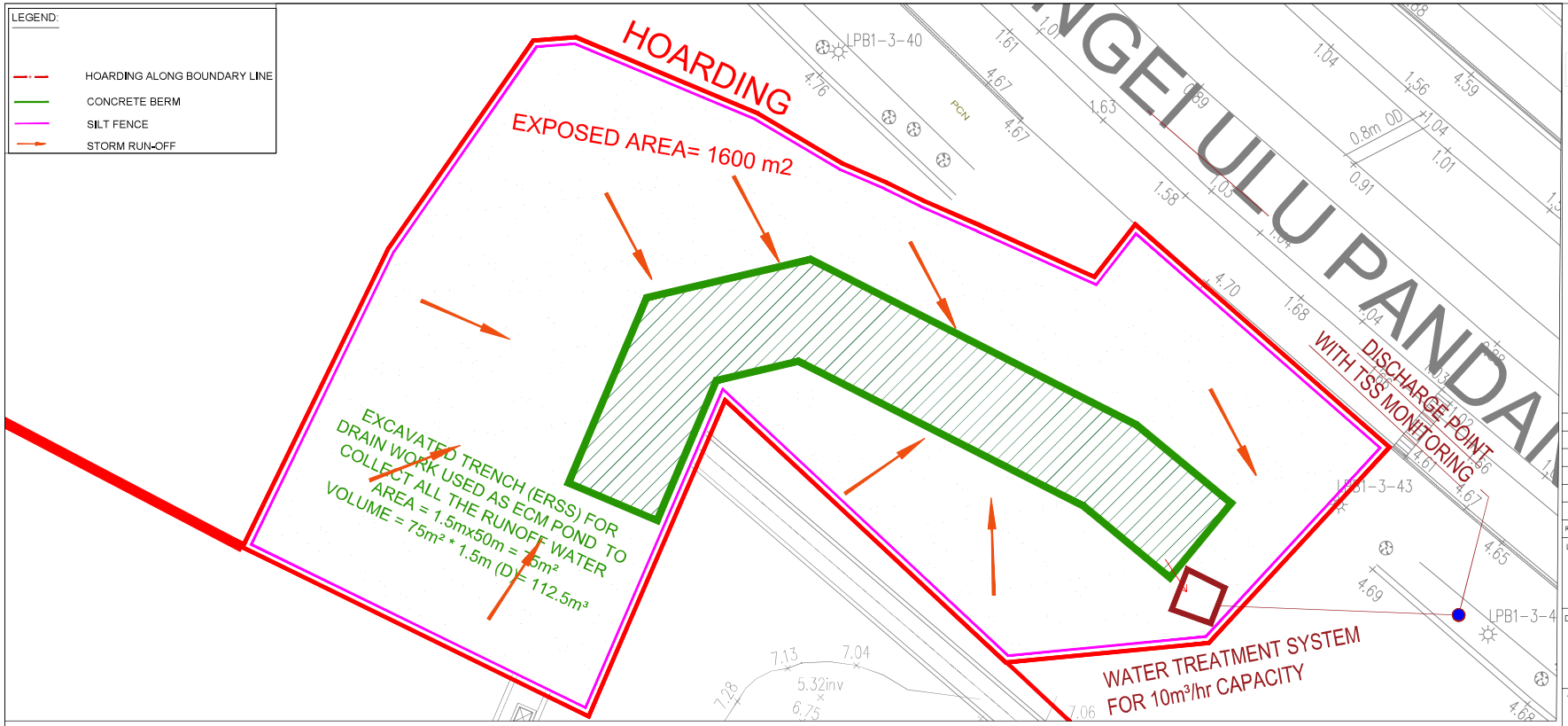
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ECM PLAN FOR AREA 3

SCALE: 1:150

NOTES:

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LEGEND:
HOARDING ALONG BOUNDARY LINE
SILT FENCE
STORM RUN-OFF

ECM TANK : 1.5 m x 50m x 1.5m = 112.5 m³

TOTAL STORAGE VOLUME 112.5 m³ > VOLUME OF STORM RUN-OFF = 83.20m³

04 sheet of 06

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INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT ON LOT 05193M MK 03 AT COMMONWEALTH AVENUE WEST (QUEENSTOWN PLANNING AREA)

DRAWING TITLE
EXPOSED AREA 3

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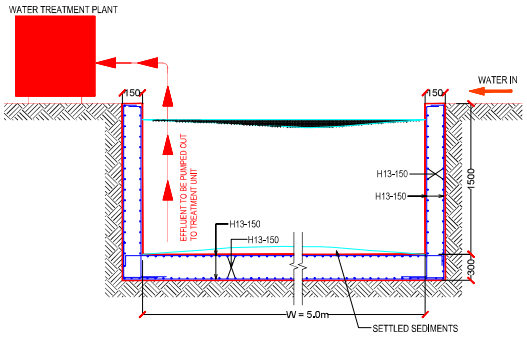
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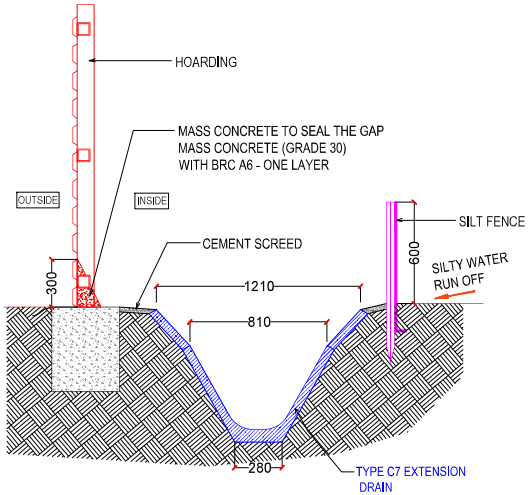
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TYPICAL STORAGE TANK DETAILS

SCALE: 1:25



HOARDING, DRAIN AND SILT FENCE

SCALE: 1:15

NOTE:

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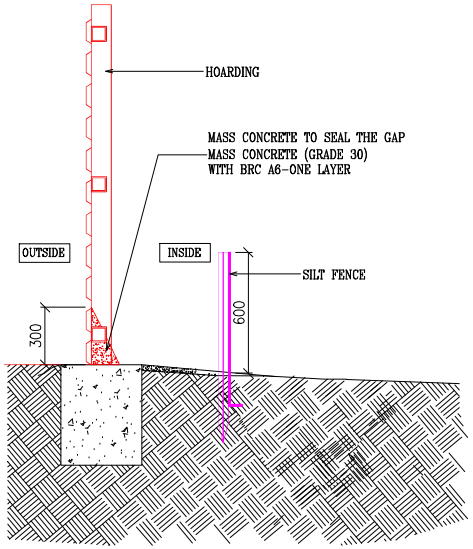
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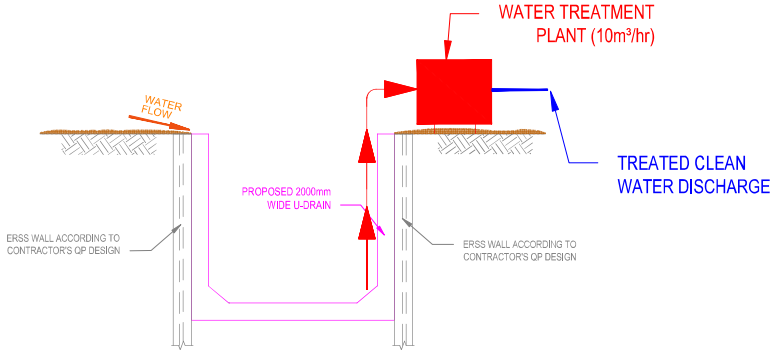
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TYPICAL HOARDING DETAILS WITH SEALED FOOTING FOR DRAIN FOR DRAIN (AREA 2 AND 3)
SCALE: 1:15



TYPICAL TRENCH, HOLDING TANK & ECM PLANT DETAILS FOR DRAIN (AREA 2 AND 3) FOR DRAIN (AREA 2 AND 3)
SCALE: 1:20

NOTES:

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PROJECT TITLE

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ANNEX 1 – ENVIRONMENTAL STUDY REPORT

Intended for
Housing & Development Board

Document type
TAC/21118/Env Study/RT02

Date
27 December 2022

INFRASTRUCTURE WORKS AT HDB DEVELOPMENT IN ULU PANDAN EAST

Environmental Study Report



Submitted by

TEMBUSU
Asia

Description	Environmental Study Report for Infrastructure Works at HDB Development in Ulu Pandan East
Project Ref	TAC/21118

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ABBREVIATIONS

Abbreviation	Definition
µg/m^3	microgram per cubic meter
ARI	Average Recurrence Interval
ASR	Air Sensitive Receptor
BMP	Best Management Practices
CEMMP	Construction Environmental Management and Monitoring Plan
CO	carbon monoxide
COP	Code of Practice
Cult.	Cultivated
dB(A)	A-weighted decibel
DOS	Department of Statistics
DTSS	Deep Tunnel Sewerage System
ECM	Earth Control Measure
ECMO	Earth Control Measure Officer
ECO	Environmental Control Officer
EMMP	Environmental Management and Monitoring Plan
EPH	Environmental Public Health
EPHA	Environmental Public Health Act
EPM	Environmental Protection and Management
EPMA	Environmental Protection and Management Act
ERSS	Earth Retaining Stabilising Systems
ES	Environmental Score
FM	Frequency Modulated
GPS	Global Positioning System
HDB	Housing & Development Board
ha	Hectors
hp	Horsepower
hr	hour
ISA	International Society of Arboriculture
ITT	Invitation to Tender
IUCN	International Union for the Conservation of Nature
JRL	Jurong Region Line
kHz	kilohertz
km	kilometre
kVA	Kilovolt-amps
LA_{eq}	equivalent continuous A-weighted sound power level
Leq	equivalent continuous noise level
LTA	Land Transport Authority
m	meter
m^2	meter square
mg/L	milligram per litre
mg/m^3	milligram per cubic meter
mgd	million gallon per day
mins	minutes

Abbreviation	Definition
ms	milliseconds
NSR	Noise Sensitive Receptor
MOB	Membrane-Ozone-BAC
MND	Ministry of National Development
NEA	National Environment Agency
n.d.	no date
NO_2	Nitrogen Dioxide
NParks	National Parks Board
O_3	Ozone
PAR	Photosynthetic Active Radiation
PCN	Park Connector Network
PM_{10}	Particulate matter with diameter ≤ 10 micrometres
$PM_{2.5}$	Particulate matter with diameter ≤ 2.5 micrometres
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
PRO	Public Relations Officer
PSI	Pollutant Standards Index
PUB	Public Utilities Board
QECP	Qualified Erosion Control Professional
RFP	Request for Proposal
RIAM	Rapid Impact Assessment Matrix
s	seconds
SHD	Singapore Height Datum
SO_2	Sulfur Dioxide
SS	Singapore Standards
SSO	Singapore Statutes Online
SJ	Surbana Jurong Consultants Pte Ltd
t	Tonnes
TAC	TEMBUSU Asia Consulting Pte Ltd
TIW	Toxic Industrial Waste
TPZ	Tree Protection Zone
TSS	Total Suspended Solid
TWPS	Treated Water Pumping Station
URA	Urban Redevelopment Authority
US EPA	United States Environmental Protection Agency
VCO	Vector Control Operator
VSR	Vibration Sensitive Receptor
WHO	World Health Organisation

GLOSSARY

Abundance: The number of a single species recorded at any given time period or location.

Biodiversity: The variety of plant and animal life in the world, habitat or location, a high level of which is usually considered to be important and desirable. Biodiversity can be assessed at more focused taxonomic groups such as “bird biodiversity”, in which case it is interchangeably with “diversity”.

Conservation Status: A status given to a species that is threatened with becoming extinct either locally or globally. These species may be restricted to only a small area, show noticeable decline in abundance over time, or have a historically low global population size. Assessments can be made either at global level under the IUCN’s Red List of Threatened Species or at national level (e.g., Singapore’s Red Data Book of Threatened Plants and Animals).

Ecology: The pattern of relations between organisms and their environment.

Edge Effect: The effect of an abrupt transition between two quite different adjoining ecological communities on the numbers and kinds of organisms in the marginal habitat

Fauna: Referring to all animal life present in an area. Animals are defined as any species from the Kingdom Animalia.

Flora: Referring to all plant life present in an area. Plants are defined as any species from the Kingdom Plantae.

Genus: A taxonomic group above species. A genus consists of closely related species. For example, Grey Heron and Purple Heron are closely related species in the same genus *Ardea*, hence their scientific names are *Ardea cinerea* and *Ardea purpurea* respectively.

Habitat: The natural home or environment of an animal, plant, or other organisms.

Herpetofauna: A taxonomic sub-group that includes amphibians and reptiles.

Impact: Any positive or negative alteration of existing conditions caused directly or indirectly by the project.

kHz (kilohertz): A measure of frequency equivalent to 1,000 cycles per second. Human hearing may extend up to 20 kHz. Most bat calls are beyond 20 kHz, extending locally up to 245 in the case of *Kerivoula hardwickii*.

Microclimate: Local atmospheric zone where the climate differs from the surrounding area.

Mitigation Measure: Means to prevent, reduce, or control negative environmental effects of a project, and repair any damage to the environment caused by those effects through replacement, restoration, compensation, or any other means.

Ms (milliseconds): 1/1000 of a second. Duration of individual bat pulses typically range from 2 ms, in some species of *Myotis*, to more than 50 ms, in some local emballonurids such as *Saccolaimus saccolaimus*.

Odonates: A taxonomic sub-group of Insects that includes dragonflies and damselflies.

Population: The term population can be in reference to the total number of a species found in a given area (e.g., global population, or Singapore population). It is also used as a term to define distinct sub-sets of a species based on the level of inter-mixing. For example, an island may hold two populations of a species if there are two groups of the same species present and those groups are sufficiently prevented (geographically or behaviourally) from mixing, forming separate breeding populations.

Species: The standard classification of living organisms. It is defined as a group of living organisms consisting of similar individuals capable of exchanging genes or interbreeding. It is represented by the second word of the scientific name of an organism. For example, the scientific name of a long-tailed macaque is *Macaca fascicularis*, where *fascicularis* is its species name.

Taxa: In reference to a specific taxonomic group. In order of specificity, the taxonomic groups are Kingdom, Phylum, Class, Order, Family, Genus, Species.

Transect: A predefined line or belt along which observations and/or measurements are taken.

EXECUTIVE SUMMARY

Ulu Pandan has been earmarked for residential development in URA's Master Plan since 2003. As shared in 2021, the conceptual plans for the Ulu Pandan site were revised based on the findings of the Environmental Baseline Study (EBS) conducted in 2017, feedback from Nature Groups and the public, as well as NParks' Ecological Profiling Exercise. The Housing & Development Board (HDB) will conduct infrastructure works for Ulu Pandan East, which would be developed in the near-term to meet the strong housing demand in mature estates. A green corridor along the canal and a retained stream area will be incorporated as part of the development.

The development is located within a vegetated area with several habitat types. Although a large proportion of the project site consists of non-native vegetation, the habitats within this forest are important refuges for fauna species and nesting sites for bird species.

This Environmental Study report aims to provide an updated baseline assessment of the project site, identify the sensitive receptors, assess the potential impacts, recommend appropriate mitigation measures to reduce the residual impacts to acceptable levels during the earthworks and infrastructure works phase. The potential impacts on the following environmental aspects have been considered in this assessment:

- Biodiversity
- Noise
- Hydrology & Water Quality
- Ambient Air Quality
- Vibration
- Light
- Waste Management
- Vector Control

Overall, environmental impacts from this development project are expected from activities associated with vegetation clearance and earthworks, which may impact flora and fauna within and around the site, as well as the human receptors around the site. These impacts are of slight to moderate negative levels. With the diligent implementation of mitigation measures, these impacts can be reduced to minor levels and lower.

The main findings of each environmental aspect studied have been summarised as follows.

Biodiversity

The project site is located within the Pandan Reservoir Catchment Area. Baseline surveys were conducted within the project study area comprising various field survey methodologies including modified gentry plots for flora, visual fauna transects, camera trapping, netting, and trapping of aquatic fauna, and acoustic bat recording.

The aim of the current biodiversity study was to update the previous biodiversity baseline established by AECOM in their field surveys conducted in 2017 (AECOM, 2020). The difference in study areas is shown in Figure 1.1.



Figure 1.1. Map showing the previous and current study areas

Floristically, the current study and past baseline study (AECOM, 2020) observed a total of at least 193 flora species, at least 21 of which were of local conservation significance. Exotic-dominated secondary forest is the most common habitat type within the project study area. Scrubland is another relatively common habitat type, located close to the pedestrian linkway between Dover MRT Station and Holland Grove Drive. Patches of abandoned kampong can be found in between the Exotic-dominated secondary forest and scrubland. A list of plant species recorded in the current survey and AECOM (2020) can be found in Appendix A of the report.

The current study found a higher number of flora species as compared to the previous study, which was likely due to the different methodology employed in the current study which focused on Ulu Pandan East. Current surveys utilised modified gentry plots[1] and covered a larger percentage land area in Ulu Pandan East. Current surveys also recorded herbaceous species within quadrats[2], which was not a requirement in the past study. More information on the differences in survey methodology can be found in Section 4.4 of the report.

[1] Modified gentry plots are demarcated sampling areas within which woody flora with a diameter at breast height (DBH) of 2.5 cm or more were recorded.

[2] Quadrats are sampling areas of 1m by 1m within which herbaceous species were recorded.



Figure 1.2. Map showing habitats and streams in the project site

There were some flora species of conservation value. In particular, the native bamboo *Gigantochloa ligulata* was notable as it was not recorded in the previous baseline study. While there was a high proportion of non-native flora species, these species provided habitat for fauna species on site. In particular, the presence of a large number of Albizia trees provided suitable canopies for nesting raptors such as the changeable hawk-eagle, that was observed nesting during the baseline survey period. The presence of cavities on several Albizia trees also provides habitat for nesting species such as the Oriental pied hornbill and may be used by other species such as monitor lizards and common palm civets.

A total of 202 fauna species (birds, mammals, reptiles, amphibians, butterflies, odonates, freshwater fish, and molluscs) were recorded within the project study area from the past and present surveys, 14 of which are threatened. In terms of fauna, the main species of conservation value were birds, given the indirect connectivity between this forested site and other forested sites around Singapore. One notable fauna species recorded in the current survey is the long-winged tomb bat (*Taphozous longimanus*) which was not recorded in the previous survey. Other threatened species include the straw-headed bulbul (*Pycnonotus zeylanicus*), the buffy fish owl (*Ketupa ketupu*), and the locally rare apple snail (*Pila scutata*).A list of fauna species recorded in the current survey and AECOM (2020) can be found in Appendix C of the report.

Impacts from construction activities may have undesirable impacts to biodiversity, especially to species of conservation value found within and around the project site. With the implementation of appropriate mitigation measures (Table 1.1), it is expected that any such impacts will be reduced to minor levels and below.

Hydrology & Water Quality

The project site is located within the Pandan Reservoir Catchment Area. There are three streams flowing across the project site (Figure 1.2). In general, the surface water quality of these streams complied with the applicable standards except for the Dissolved Oxygen, total suspended solids, and Ammoniacal Nitrogen. Possible impacts from the construction phase of proposed project includes disturbance to local hydrological pattern due to backfilling of two natural streams within project footprint, impact to water quality due to sediment runoff and trade effluent discharge. Recommended mitigation measures (Table 1.1) will help to reduce the impact on water quality of project area.

HDB has catered for Stream 1 to be retained, along with a forested buffer along each side of the stream due to the presence of natural banks and swamp forest which are ideal habitats for aquatic biodiversity such as the locally rare apple snail *Pila scutata*. The main source of flow within Stream 1 is from the upstream sub catchment area. By ensuring that upcoming drainage on this site does not block the flow of water into Stream 1, the flow within Stream 1 during the operation of the project is likely to be maintained.

Noise

As the project site is vegetated, it is inhabited by various fauna species which may be sensitive to noise. There are sensitive human receptors situated around the project study area. A seven-day continuous (24x7) noise monitoring was carried out at four locations, which established that baseline noise levels generally complied with Singapore's noise regulations. It is anticipated that the main noise sources during the construction phase will be associated with high-impact stationary and mobile equipment. The overall impact of noise on the sensitive receptors has been assessed as minor and can be further controlled if recommended noise mitigation measures are adopted.

Ambient Air Quality

The current baseline study of ambient air quality utilised the National Environmental Agency (NEA)'s measurements over the past 5 years from 2017 to 2021. It was observed that there were several pollutants that had exceeded the long-term targets. Sensitive receptors were also identified around the project study area. The air quality will potentially be temporarily affected by activities associated with earthworks and construction of infrastructure, especially from an increase in airborne particulates and heavy-vehicle exhaust emissions. Mitigation measures are recommended to reduce the direct impact on local air quality.

Vibration

Currently there are no major sources of vibration within project study area. Main vibration sources include mainly vehicular traffic along Commonwealth Avenue West. Baseline monitoring was carried out at three locations to establish baseline vibration levels. There are sensitive receptors located around the project study area, including animals in forested areas and humans in the nearby premises. The overall impact of vibration has been assessed as minor and can be further controlled by recommended mitigation measures including the use of equipment or methods which generate lower vibration levels.

Light

Impacts of light pollution during the construction period may take place, but such impacts are expected to be minor. Additionally, there is moderate baseline light levels from the streetlights

surrounding the project site. Nonetheless, mitigation measures are recommended to further reduce the impacts of light pollution to the remaining forested areas (i.e., retained stream area and Ulu Pandan west).

Waste Management

It is anticipated that the main sources of waste during construction phase will be from cut vegetation, excavated material, general construction waste, personal waste and/or hazardous waste. With the implementation of the mitigation measures proposed (Table 1.1), any negative impact is expected to be reduced to an acceptable level.

Vector Control

The primary impact of the construction phase of the project is a potential increase in the immediate vector population. Secondary to this, an increase in the number of vectors has the potential to increase the likelihood of vector-borne diseases affecting humans. With the implementation of mitigation measures (Table 1.1), it is expected that these impacts can be reduced to an insignificant level. Considering the sensitive nature of the forested area, fogging is not recommended to be carried out as part of vector control measures.

Table 1.1. Summary of key mitigation measures to be implemented

Environmental aspect	Key mitigation measures
Biodiversity	• Erect hoarding and noise barriers around the work site • Avoid heavy construction activities at night • Establish Tree Protection Zones • Three days of rest between shrub clearance and tree clearance • Pre-felling inspection of trees and burrows • As far as practicable, avoid commencement of tree felling during peak bird nesting period (February to July) • Directional clearance towards the western forest patch • Implement additional measures within the retained stream area ◦ Avoid placement of boreholes near native, mature trees ◦ Salvage or retain all conservation significant flora where possible ◦ Construction works and demobilisation to be limited to daylight hours ◦ No SI boreholes to be within 10 m of Stream 1 ◦ Any SI borehole works in the retained area to be conducted manually ◦ Vegetation clearance to be kept to a minimum ◦ Reinstate working areas with selected native species • Monitor tree and vegetation health during the construction phase • Daily checks of Earth Control Measures (ECM) blankets and pits by ECO • ECM blankets to be made of wildlife-friendly, biodegradable material • Environmental training sessions for workers • Identify plants of high conservation significance for transplantation • Replanting of new planting verges with native plant species
Hydrology and Surface Water Quality	• Implement PUB-approved ECM Plan including: ◦ Secondary containment for slurry storage tanks ◦ Storage tanks for slurry ◦ Controlled site discharges ◦ Open sump • Minimum dry weather flow to be maintained in Stream 1 • Vegetated buffer at least 10 m from Stream 1 • No SI boreholes within 10 m of Stream 1 • Temporary hoarding to be erected at the northern and southern ends of Stream 1 for the construction of drains • Regular water quality monitoring • Concrete wash bays to be located away from waterbodies • Emergency spill kits to be present to handle any chemical spillages

Environmental aspect	Key mitigation measures
Noise	• Avoid heavy construction at night • Use of quieter construction equipment • Construction personnel to be trained in noise-reduction behaviours • Install 2.4 m to 6 m high noise barriers (STC 20) around the work site • Acoustic enclosures to reduce noise at the following locations • Around drilling rigs for SI works • For equipment such as compressors • 10 m on each side of retained vegetated buffer along Stream 1 • Continuous noise monitoring throughout construction duration
Ambient Air Quality	• Implement the dust suppression plan • Regular watering to reduce dust emissions from exposed site surfaces • Regular maintenance of construction vehicles and fuel-burning equipment • Provision of additional dust screen near sensitive receptors if required • Stockpiles to be located away from sensitive receptors • Stockpiles to be covered with impervious sheeting or dampened with water
Ground-borne Vibration	• Use of low-vibration equipment where possible • Switch off machinery when not in use • Keep haul roads in good condition for smooth travelling surface • Route heavily loaded trucks away from sensitive receptors where possible • Vibrating equipment to be placed on isolators • Control speed of vehicles at worksite • Advanced notification to nearby sensitive receptors about work activities
Light	• Limit heavy construction works to daylight hours • Turn off all unnecessary lights outside working hours • Implement an NParks-approved Lighting Management Plan • Minimum number/ intensity of lights needed for safety and security • Any temporary lighting for nighttime should be fully shielded, facing downwards, and directed away from forested areas
Waste Management	• Implementation of waste management plan • Compliance to all waste related regulations • No illegal dumping of waste into forested areas • Recovery of scrap metals for recycling • Reuse surplus excavated material within project site as much as possible • Disposal of inert general waste by an NEA-licensed general waste collector
Vector Control	• Implementation of vector management plan • Food to be stored in rodent-proof rooms/cabinets • Compliance to all vector control related regulations • Vector control team to carry out regular checks of work areas

Table 1.2. Summary of residual impacts

Environmental aspect	Impacts before mitigation	Impacts after mitigation
Biodiversity	Moderate Negative to Slight Negative	Minor Negative to No Impact
Hydrology and Surface Water Quality	Minor Negative to Slight Negative	Slight Negative
Noise	Slight Negative	Slight Negative
Ambient Air Quality	Slight Negative to No Impact	No Impact
Ground-borne Vibration	Minor Negative to Slight Negative	Slight Negative
Light	Slight Negative	No Impact
Waste Management	Slight Negative	Slight Negative to No Impact
Vector Control	Slight Negative	Slight Negative to No Impact

Construction Environmental Management and Monitoring Plan

A Construction Environmental Management and Monitoring Plan (CEMMP) has been proposed to manage the identified environmental impacts during construction phase. It also includes environmental monitoring requirements comprising of on-site visual compliance monitoring and physical monitoring. These will help to verify the effective implementation of mitigation measures during construction stage. The CEMMP has been developed based on the recommended mitigation measures in this Environmental Study report. This will be strictly implemented throughout the construction phase to ensure the development of this project in environmentally sensitive manner.

1 INTRODUCTION

The Housing & Development Board (HDB) plans to conduct infrastructure works in Ulu Pandan East. The development is located within a vegetated area with several habitat types. The importance of the site for biodiversity is known among residents and nature enthusiasts. Although a large proportion of the project site consists of non-native vegetation, the habitats within this forest are important refuges for fauna species and nesting sites for bird species.

Given the potential sensitivity of this site for flora and fauna and its role in the wider ecological connectivity of Singapore, HDB called for environmental consultancy services to understand the project site and ensure that adverse impacts to the natural environment are minimised and mitigated during the works. The scope of these services includes updating of the existing Environmental Baseline Study (EBS), conducting an Environmental Study on the impacts, framing the Environmental Management and Monitoring Plan (EMMP), and implementing the EMMP during the construction period.

TEMBUSU Asia Consulting Pte Ltd has been commissioned by HDB to provide the environmental consultancy services for this project. For consistency with agencies' collaterals, the study site will be referred to as Ulu Pandan (also known as Dover Forest).

An Inception Report covering the environmental baseline survey methodology and study area was prepared and submitted to HDB and NParks in March 2022. Upon confirmation of the Inception Report, the environmental baseline surveys were carried out in the period between March 2022 and May 2022.

1.1 Objectives of the Environmental Study Report

The Environmental Study was undertaken to cover the earthworks and infrastructure works of the proposed development on the environment.

The principal objective of the Environmental Study is to provide clear and concise technical information for decision-making on potential environmental impacts associated with the proposed work activities.

The key objectives of this Environmental Study are to:

- Understand and update the environmental baseline through the collection of primary and secondary data.
- Assess the impacts of the earthworks and infrastructure works for the upcoming development at Ulu Pandan East during the construction and post-construction phases of the project on the environment.
- Present appropriate mitigation measures to reduce the level of impact for each activity assessed that has a moderate to major impact.
- Recommend an environmental management framework to monitor the mitigation measures implementation.

It is understood that the information presented in the Environmental Study report will contribute to decisions on:

- The overall acceptability of any adverse environmental consequences that are likely to arise due to the proposed construction of Ulu Pandan East.
- The conditions and requirements for the construction of Ulu Pandan East to mitigate adverse environmental consequences whenever practicable; and
- The acceptability of residual impacts after the proposed mitigation measures are implemented.

The undertaking of the Environmental Study will therefore promote environmentally sound and sustainable development.

1.2 Report Structure

The Environmental Study report is structured as follows:

- Chapter 1 introduces the project background and the general information of the Environmental Study, covering its objectives, report structure, and limitations.
- Chapter 2 provides the description of the proposed project, and activities associated with the proposed project.
- Chapter 3 outlines the Environmental Study approach, including its scope and impact assessment methodology that is applied in the preparation of this report.
- Chapter 4 presents assessment of environmental impacts on biodiversity and its proposed mitigation measures.
- Chapter 5 discusses the noise impacts and proposes the mitigation measures.
- Chapter 6 describes the hydrology and water quality of the project study area and provides the impacts and mitigation measures.
- Chapter 7 provides a description of the ambient air quality impacts of the project and proposes the mitigation measures.
- Chapter 8 discusses the impacts from ground-borne vibration and proposes the mitigation measures.
- Chapter 9 discusses the impacts from light pollution and proposes the mitigation measures.
- Chapter 10 discusses the waste impacts and proposes the mitigation measures.
- Chapter 11 details the vector control assessment and mitigation requirements.
- Chapter 12 summarises the impact assessment and mitigation measures of each environmental aspect.
- Chapter 13 lists the references used in the report.

1.3 Limitations of the Environmental Study Report

The Environmental Study is conducted as per the requirements specified by HDB in the Invitation to Tender (ITT), and outcome of consultancy with the relevant Technical Agencies. The extent of collection of baseline data is guided by these requirements.

In preparing this report, we relied, in whole or in part, on data and information provided by HDB, infrastructure consultant Surbana Jurong (SJ), and third parties, which have been assumed to be accurate, complete, and reliable as of the time of writing.

2 PROJECT OVERVIEW

2.1 Project Background

Ulu Pandan has been earmarked for residential development in URA's Master Plan since 2003. The conceptual plans for the Ulu Pandan site were revised based on the findings of the Environmental Baseline Study (EBS) conducted in 2017, feedback from Nature Groups collected in 2019, public feedback upon the disclosure of the EBS report, as well as NParks' Ecological Profiling Exercise.

As shared in 2021, Ulu Pandan East (from Ghim Moh Link to Dover MRT station) will be developed in the near-term, to meet the strong housing demand in mature estates. A green corridor would be established along Ulu Pandan canal along with a proposed park around a retained stream in Ulu Pandan East. Ulu Pandan West would be retained in the medium term, with a sizeable nature park safeguarded. Plans for Ulu Pandan West will continue to be studied and revisited sometime around 2030, taking into consideration Singapore's land use needs at that time. An updated EBS for Ulu Pandan East was conducted by TAC in 2022.

2.2 Project Location

The project site is located southwest of Singapore, adjacent to Dover MRT station. It is bounded by Ulu Pandan Park Connector to the north, Ghim Moh Link to the east, and Commonwealth Avenue West to the south.

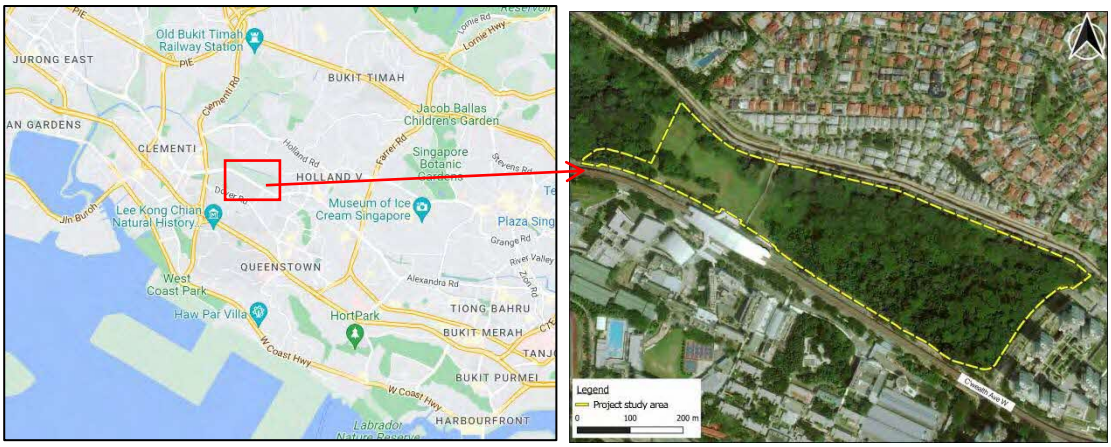


Figure 2.1. Project location plan

2.3 Historical Land Use

Historical evidence suggests that the riparian environments in the Pandan area, like the Ulu Pandan Canal, were most likely freshwater swamp forests, which derived its water from rainfall and streams (Wong & Ganesan, 2019).

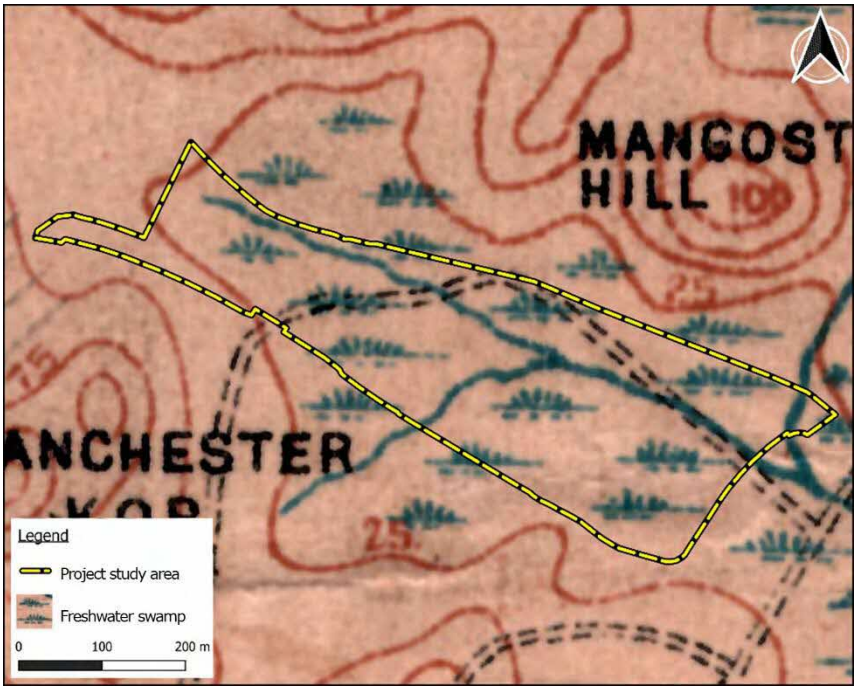


Figure 2.2. Historical map from 1914, obtained from https://libmaps.nus.edu.sg

From the 1920s to the 1940s, as depicted in Figure 2.3, the western part of Ulu Pandan East became part of a rubber plantation (Neo et al., 2013) while the core middle part was still forested. The plantation activity discontinued during the Second World War, where topographic mapping undertaken in 1953 indicates recovering species-poor forest dominated by Tiup-tiup, *Adinandra dumosa* (Lee et al., 2021).

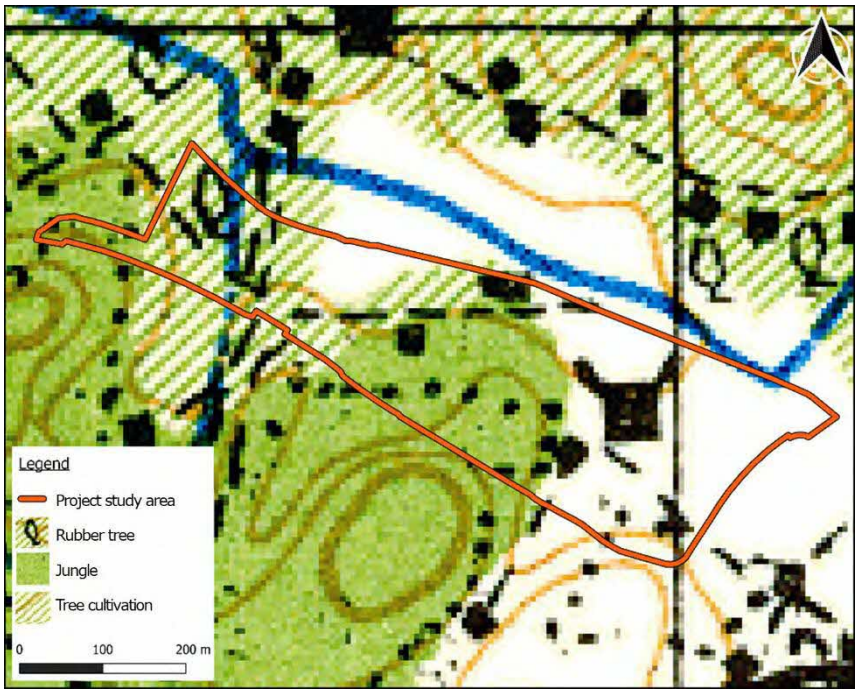


Figure 2.3. Historical topographical map from 1945, obtained from https://libmaps.nus.edu.sg

In the 1960s and 1970s, the vegetation was classified as mostly scrubland, suggesting

that the area under tree cultivation had been cleared in the early 1960s, except for the northern parts fringing the Sungei Ulu Pandan (Neo et al., 2013). From the 1970s onwards, the vegetation was characterised as sundry tree cultivation and scrubland (Figure 2.4). After this period, settlers left cultivated land, resulting in its succession toward recovering forest as known today. Ulu Pandan was earmarked for residential development in 2003 by the Urban Redevelopment Authority (Lee et al., 2021).

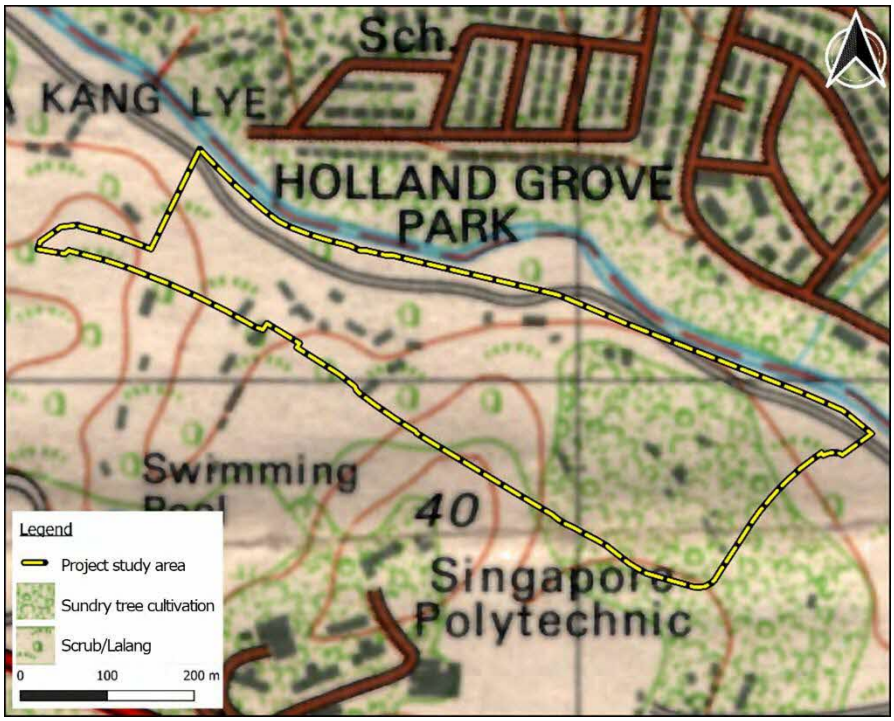


Figure 2.4. Historical topographical map from 1975, obtained from https://libmaps.nus.edu.sg

The hydrological conditions of the study area were also changing over time. Between 1914 and 1945, the flow of the Ulu Pandan Canal was reversed such that water now drains toward Jurong instead of the Alexandra and Singapore Rivers (Lee et al., 2021). There was also historical evidence of aquaculture taking place along the Ulu Pandan Canal. Between 1975 and 1978, Ulu Pandan was cut through by a road and the source drain of Ulu Pandan East would most likely been constructed in this period to prevent flooding (Lee et al., 2021).

The period between 1987 and 1992 marked the disappearance of the settlements and roads running through Ulu Pandan East, and presumably the time in which the wetlands had started to accumulate and store discharge (Lee et al., 2021).

Due to songbird poaching, Ferris (1980) observed a reduction in avian species richness and their associated ecosystem services along the Ulu Pandan Canal in 1980.

2.4 Project Scope and Implementation Schedule

The infrastructure works involve clearance of vegetated areas, earthworks, pipe jacking by the means of slurry shield jacking machine or handshield, and other related activities.

The following infrastructures will also be constructed:

- Underground piping and services
- Earth-retaining structures
- Drains and other supporting features (e.g., pipe culverts, sumps, inspection chambers, temporary shafts)
- Sewer line along the northern boundary of the project site
- Cycling path along Commonwealth Avenue West and Ghim Moh Link with markings, signages, and other related works

The project will be conducted in five phases, with Phase 4 further divided spatially into 3 areas. Works from Phase 2 onwards will be carried out concurrently. All activities are expected to be completed in the third quarter of 2024. The implementation schedule is provided in Table 2.1. The respective areas for each phase are shown in Figure 2.5.

Table 2.1. Implementation schedule of entire project

Phase	Description of Works
1	Preliminary works, setting out, and CEMMP
2	Whole construction of drains, pipe culverts, sumps, inspection chambers, etc. and all related works
3	Construction of 1800 mm diameter sewer line, including diversion of 1676 mm diameter sewer line, etc. and all related works
4A	Whole earthworks for Zone 3, including site clearance works, backfilling, construction of temporary silt trap, drains at site areas
4B	Whole earthworks for Zone 2, including site clearance works, backfilling, construction of temporary silt trap, drains at site areas
4C	Whole earthworks for Zone 1, including site clearance works, backfilling, construction of temporary silt trap, drains at site areas
5	Construction of cycling path and all related works

2.5 Overview of Construction Work Areas

The layout plan is shown in Figure 2.5 and described below.

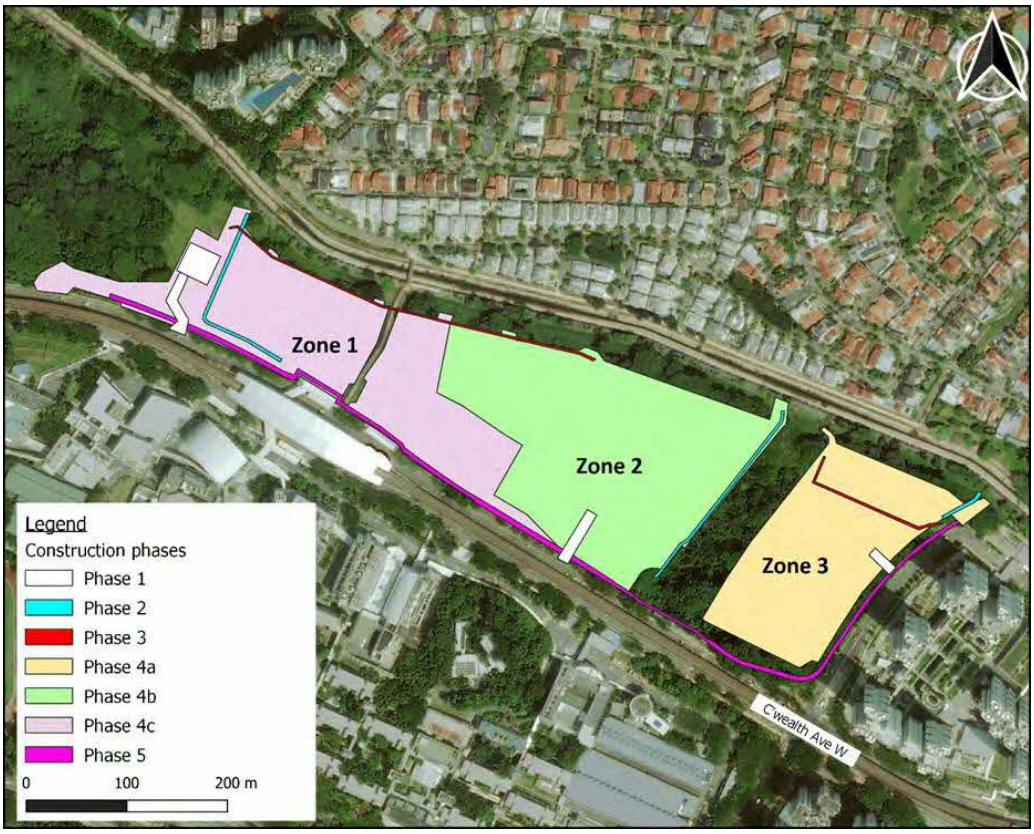


Figure 2.5. Phased construction areas in the project site

Phase 1 – Preliminary Works, Setting Out, and CEMMP

The project will begin with preliminary works, covering the construction of site office and temporary access roads, establishment of hoarding along the contract boundary, mobilisation of equipment into the site areas, as well as felling of trees along the hoarding line and in the temporary access road areas. This phase also includes the setting out of the detailed CEMMP.

Phase 2 – Construction of Drains and Other Supporting Features

Three drain alignments with its supporting features (i.e., pipe culverts, sumps, inspection chambers) will be constructed to support the existing drainage system in the project site. Drain no. 1 in the west of project site will be 2 m wide, drain no. 2 at the west of Stream 1 will be 1.5 m wide, while drain no. 3 at the eastern edge of project site will be 1.2 m wide.

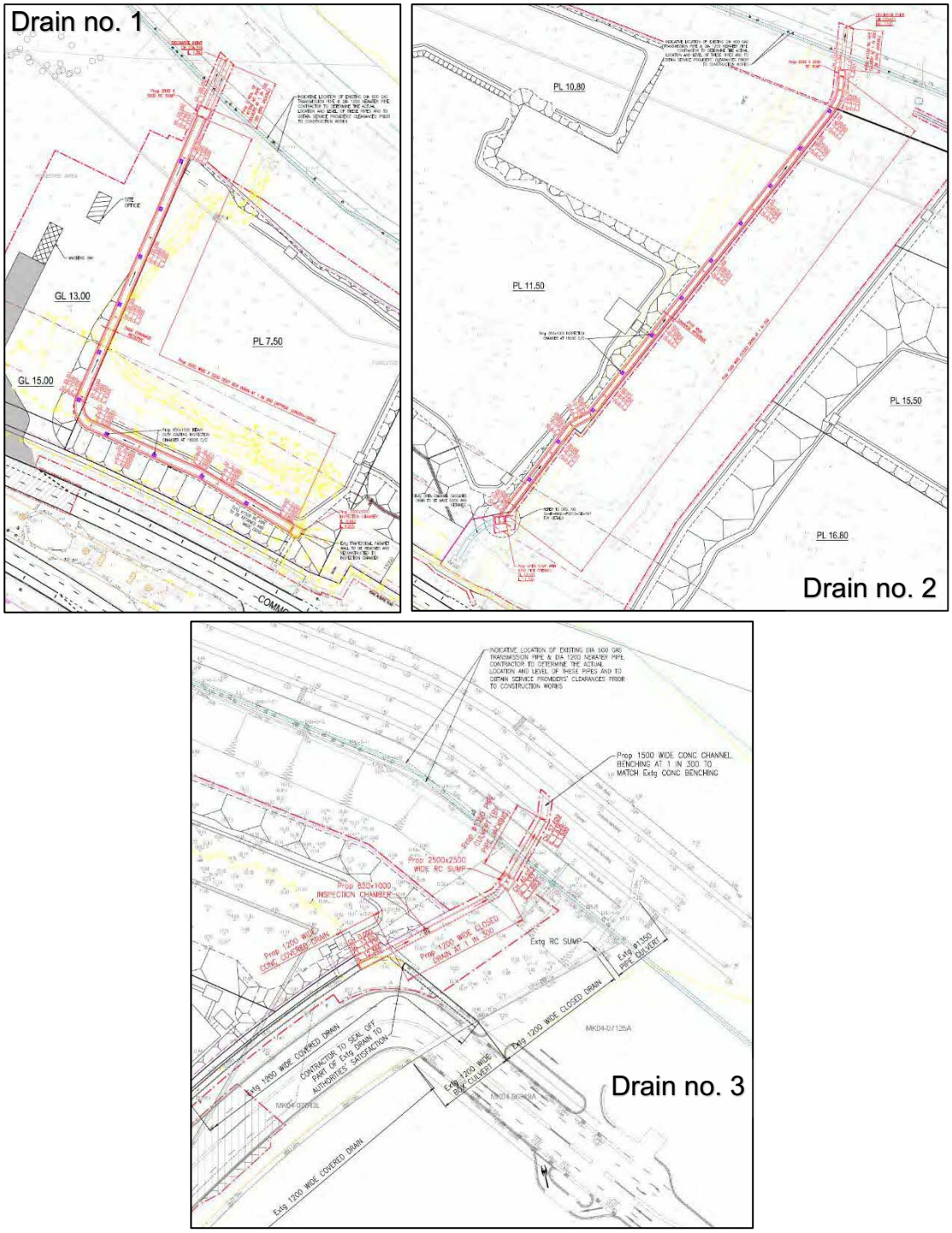


Figure 2.6. Layout plan for outlet drains, obtained from the Contractor

Phase 3 – Construction of 1800 mm diameter Sewer Line and All Related Works

Approximately 570 m long underground sewerage alignment will be constructed by pipe jacking by means of slurry machine or hand shield method, divided into two sewers of approximately 170 m in Zone 3 at the east of the project site and approximately 400 m in Zone 2 at the west of the site. These sewer alignments, which will have the diameter of 1800 mm, will be constructed along the northern edge of the project site, parallel to the Ulu Pandan PCN. A total 4 manholes will be created for the sewer in Zone 3 (see Figure 2.7) and 8 manholes for the sewer in Zone 2 (see Figure 2.8 and Figure 2.9). In addition, the existing 1676 mm diameter sewer line will be diverted at three locations as a result of these new alignments. Piling activities will be conducted for each manhole of the sewer alignment only when required, subject to the outcome of soil investigation works and utlising bored micropiles to minimise impacts on the environment. Piling of the micropiles is scheduled to be the last activity of this phase.

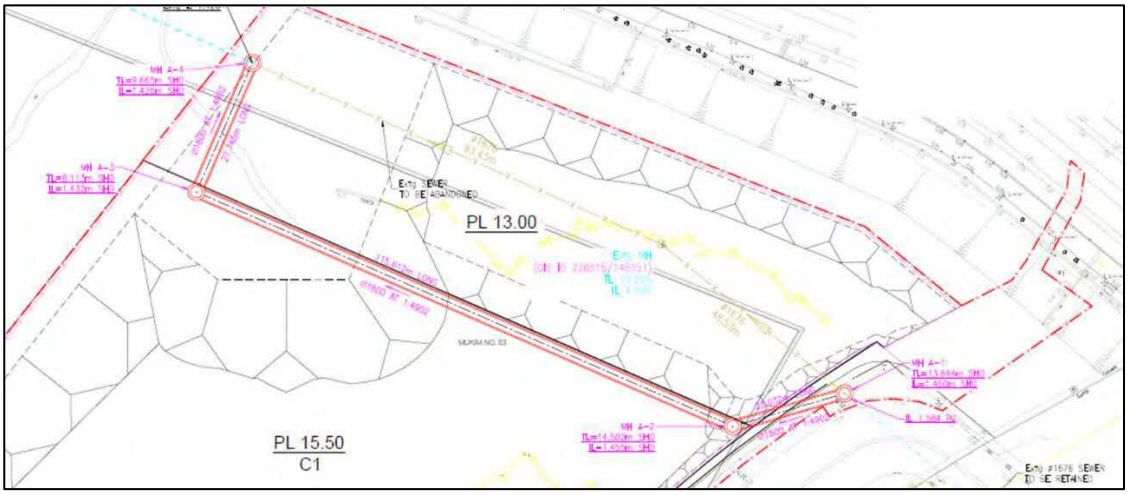


Figure 2.7. Manhole layout plan for MHA-1–4, obtained from the Contractor

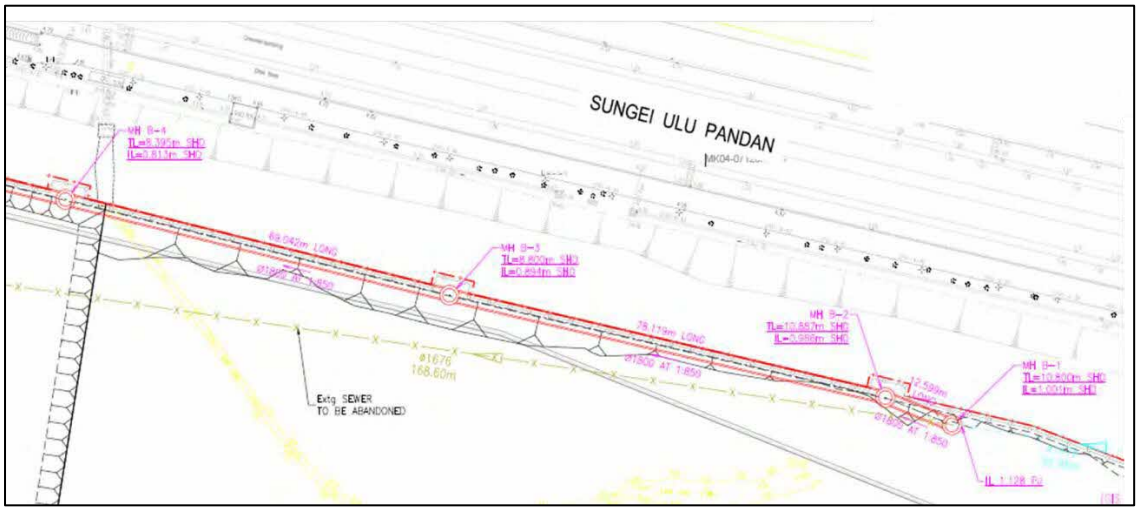


Figure 2.8. Manhole layout plan for MHB-1–4, obtained from the Contractor

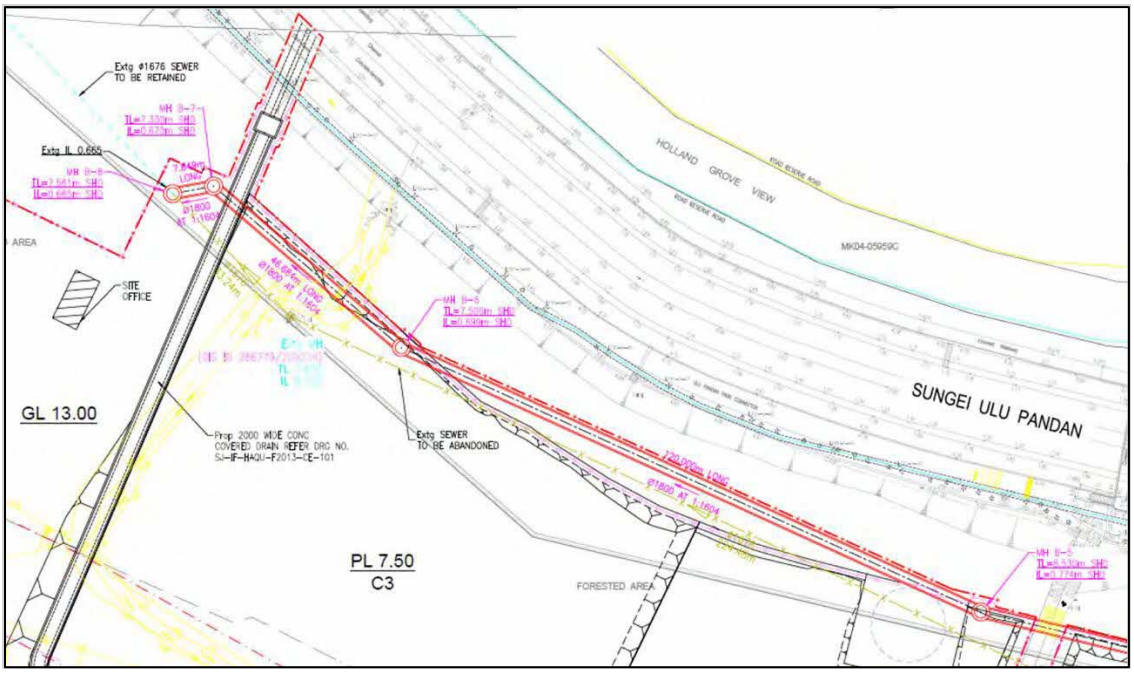


Figure 2.9. Manhole layout plan for MHB-5–8, obtained from the Contractor

Phase 4 – Earthworks for Zones 1, 2, and 3

Work areas in Phase 4 cover a major portion of the project site, which span over existing forested areas and has an uneven terrain with elevation range of 9–22 m throughout. Site clearance and earthworks will be carried out to remove unsuitable soil and form the platform level required for future housing development at the site. Related activities in this phase include backfilling as well as construction of temporary silt traps and drains in the work areas.

Phase 5 – Construction of Cycling Path and All Related Works

The cycling path and footpath with related markings and signages will be constructed along Commonwealth Avenue West and Ghim Moh Link, spanning approximately 1 km long.

2.6 Construction Approach

The project site will be divided into three zones (see Figure 2.10).

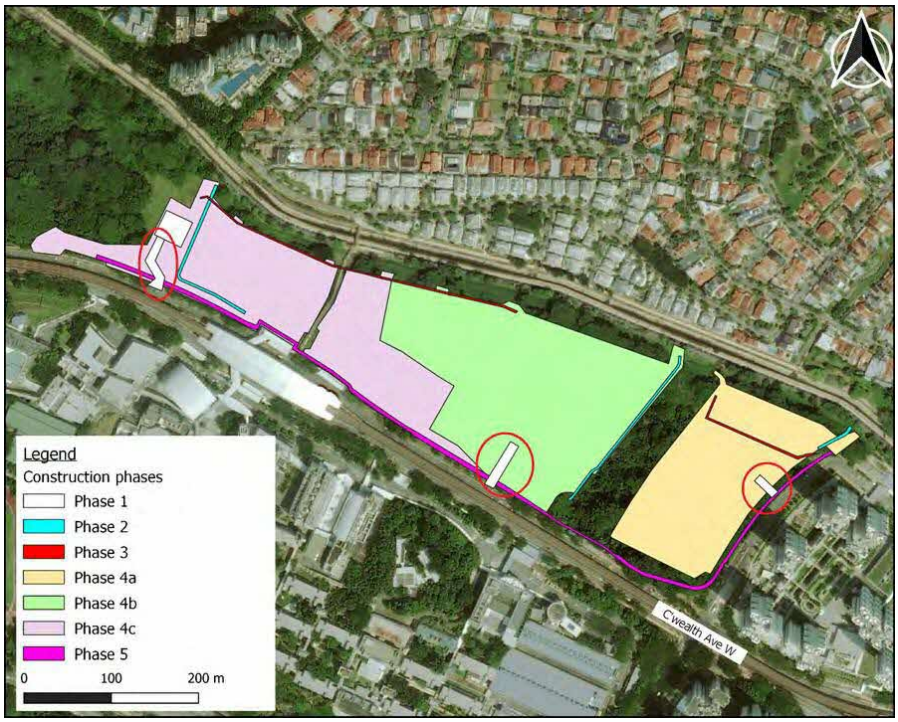


Figure 2.10. Zones in the project site with the proposed temporary access roads

Temporary Construction Access Road

Three temporary construction access roads are proposed to create a separate entry into each of the three zones. The temporary access roads would allow easier transport of construction resources into the works areas and thus contribute to timely completion of the construction activities. Upon completion of works, the temporary roads will be removed and reinstated to suit the new housing development. The red circles in Figure 2.10 highlight the locations of the access roads.

Construction of Drains and Other Supporting Features

Trial trenches and services detections will be first conducted along and around designated drain alignments to determine all services that may affect critical works. Excavation will then proceed in accordance with the approved construction drawings, to be carried out in stages to minimise disturbance to the surrounding ground. Subsequent construction of drains, sumps, and other supporting features will follow the details specified in the construction drawings and PUB/LTA Standard Details. Connection to downstream outlet will be carried out upon completion of drainages, with the desilting carried out thoroughly.

Construction of Temporary Shafts

Temporary shafts will be constructed prior to pipe jacking. Once pipe jacking works are completed, the manholes will be constructed within the temporary shafts before they are backfilled, have their shoring extracted, and the affected area around the shafts are reinstated. Locations of the shafts/manholes will be confirmed and finalised after trial holes and all existing service diversions (if any) are carried out as necessary, which will

ensure that the proposed jacking and receiving shafts can be constructed. Excavators, mini excavators, and tipper trucks will be deployed in the project site for the shaft excavation. The working platform will be casted with concrete. Settlement markers will be installed around the shaft area to monitor any ground movement.

Pipe Jacking for Construction of Sewers

The pipe jacking will be executed mainly using slurry shield jacking machine. The hand-shield method will be used as an alternative if the ground condition is stable. Horizontal grouting will be conducted prior to hand-shield works due to the soft ground condition. Timber lagging at the face of the shield will be installed if required (i.e., when excavation stops for a prolonged period).

Site Clearance and Earthworks

As the terrain is uneven, the proposed platform levels will be designed to minimise cut-and-fill works as well as the number of earth-retaining structures required. This approach will not only ease construction but also minimise impact to the nearby environment. The vegetation clearance plan will be submitted to and approved by NParks prior to removal of shrubs and trees in the project site. Tree felling will be conducted by the means of chainsaw, excavator, and lorry operations.

Soil Investigation (SI) works

There are proposed SI boreholes at this site. The number of boreholes should follow the Building and Construction Authority's (BCA) requirements on ground investigation, load test, and quality control test for building foundations (BCA, 2016). All the boreholes should be more than 10 m away from the natural stream. Any SI borehole works in the retained stream area should be conducted manually and vegetation clearance is to be kept to a minimum.

3 ENVIRONMENTAL STUDY APPROACH

3.1 Singapore's Environmental Study Context

Singapore adopts a systematic framework to determine and mitigate the potential impact of any new development on the environment. In general, development projects are required to undergo a thorough evaluation process that addresses the development's potential impact on traffic, public health, heritage, and the environment. In addition, proposed development projects near sensitive areas, such as Nature Reserves, Nature Areas, marine and coastal areas, forested areas, and other areas of significant biodiversity or with potential trans-boundary impact, are subject to greater scrutiny.

For this Environmental Study, an Inception Report illustrating the Environmental Study scope was submitted to HDB and relevant Technical Agencies in advance of the commencement of the Environmental Study to confirm the scope.

3.2 Scope of the Environmental Study

This Environmental Study is conducted as per the requirements specified during the scoping consultation process with the relevant Technical Agencies. As noted earlier, an Inception Report describing the scope of the Environmental Study was submitted to the relevant Technical Agencies prior to the commencement of the Environmental Study.

The Environmental Study shall:

- Describe the baseline conditions of the proposed study area and the environmental constraints considering seasonal migratory variations;
- Establish Environmental Quality Objectives (EQOs) and define the acceptable impact levels in a given environmental receptor. The tolerance limits include:
  - Suspended sediment and sedimentation impact on streams/aquatic habitats, aquatic plants, animals, or hydrophytes;
  - Noise, dust, vibration impact on animals / aquatic habitat, or hydrophytes;
  - Minimum amount of freshwater flow required to maintain Stream 1's current condition; and to support existing aquatic biodiversity.
- Define, classify and assess potential impacts and determine the significance of impacts on sensitive receptors; including ecological connectivity to the surrounding greeneries;
- Outline water pollution and construction waste management plans;
- Identify the freshwater discharges, water quality and key hydrological parameters affecting the Projects site and earth streams;
- Quantify and assess the magnitude, likelihood of the potential environmental impacts;
- Propose and justify effective mitigation measures (if any) to minimise environmental impacts (e.g., pollution, environmental disturbance and nuisance) during earthworks and infrastructure works;
- Identify, predict and evaluate the residual environmental impacts (i.e., after practicable mitigation) and the cumulative effects expected to arise during earthworks and infrastructure works in relation to the sensitive receptors and potential affected uses;

- Identify, assess and specify methods, measures and standards, to be included during earthworks and infrastructure works which are necessary to mitigate the residual environmental impacts and cumulative effects and reduce them to minimal levels;
- Investigate the extent of the secondary environmental impacts that may arise from the proposed mitigation measures and to identify constraints associated with the mitigation measures (if any) recommended in the Environmental Study, as well as the provision of any necessary modification;
- Tailor mitigation measures to address different type and stages of construction works; and
- Propose an Environmental Monitoring and Management Plan (EMMP) to document specific monitoring and environmental impact management procedures for the Project that includes:
  - Flora and Fauna Management Plan
  - Wildlife Management, Protection and Monitoring Plan
  - Earth Control Measures Plan
  - Water Pollution Management Plan
  - Air Pollution Control Plan
  - Noise, Dust, and Vibration Management Plan
  - Waste Management Plan
  - Vector Control Plan

Table 3.1 lists relevant legislation, regulations and guidelines that govern the various environmental parameters within Singapore. The latest legislations and relevant subsidiary regulations can be accessed from the website of Singapore Statutes Online (SSO) (n.d.) at https://sso.agc.gov.sg/.

Table 3.1. List of applicable Singapore legislations, regulations, and guidelines

Parameter	Legislation, Regulations and Guidelines
General	• Environmental Protection and Management Act, 1999 • Environmental Public Health Act, rev. 2020 • Singapore Code of Practice on Pollution Control (SS593: 2013)
Biodiversity	• The Wildlife Act 2020 • The Parks and Trees Act 2005 • The Parks & Trees Regulations 2006 • The Parks & Trees Preservation Order 1998 • Parks & Trees (Composition of Offences Regulations) 2006 • Parks & Trees (Planning Areas) Notifications 2006 • Parks & Trees (Heritage Road Green Buffers) Order 2006 • Singapore Red Data Book, Second Edition, 2008 • Singapore Red Data Book, Third Edition (online), 2021 • IUCN Red List of Threatened Species to assess species vulnerability (2021) • CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as the Washington

Parameter	Legislation, Regulations and Guidelines
	Convention) 1983 • NParks Biodiversity Impact Assessment (BIA) Guidelines (2021)
Noise	• Environmental Protection and Management Act 1999, Part VIII Noise Control • Environmental Protection and Management (Control of Noise at Construction Sites) Regulations 2008 • Environmental Protection and Management (Boundary Noise Limits for Factory Premises) Regulations 2008 • NEA Code of Practice on Pollution Control SS 593 (2013) • Code of Practice for Noise Control on Construction and Demolition Sites SS602 (2014)
Surface Water Quality	• Sewerage and Drainage Act 2001 • Sewerage and Drainage (Surface Water Drainage) Regulations 2007 • Sewerage and Drainage (Trade Effluent) Regulations revised 2007 • Environmental Protection and Management Act 2002, Part V on water pollution • Environmental Protection and Management Act (Trade Effluent) Regulations 2008 • PUB Code of Practice on Surface Water Drainage (2018) • PUB Handbook on Managing Urban Runoff (2013) • NEA Code of Practice on Pollution Control SS 593 (2013) • PUB Guidebook on Erosion and Sediment Control at Construction Sites (2018)
Ambient Air Quality	• Environmental Protection and Management Act 2002, Part IV on Air Pollution Control • Environmental Protection and Management (Vehicle Emissions) Regulations 2008 • Environmental Protection and Management (Prohibition on Use of Open Fires) Order 2008 • Environmental Protection and Management (Air Impurities) Regulations 2008 • NEA Singapore Ambient Air Quality Targets (Long Term Targets) • NEA Code of Practice on Pollution Control SS 593 (2013)
Waste Management	• Environmental Protection and Management Act 2002, Part VII on Hazardous Substances • Environmental Protection and Management (Hazardous Substances) Regulations 2008 • Environmental Public Health (General Waste Collection) Regulations 2000 • Environmental Public Health (Toxic Industrial Waste) Regulations 2000 • NEA Code of Practice on Pollution Control SS 593 (2013)

Parameter	Legislation, Regulations and Guidelines
Vector Control	• NEA Guidelines on Rainwater Collection System and Mosquito Prevention • Control of Vectors and Pesticides Act 2002 • Environmental Public Health Act (EPHA) 2002

3.3 Environmental Study Area and Environmental Aspects

The Environmental Study area denotes the area where construction of the proposed project is predicted to have impacts on various environmental aspects within the site. Figure 3.1 below shows the extent of the proposed study area.

The present Environmental Study area comprises of predominantly one forest patch (on the east) and the mowed lawn stretching out to part of the western patch (Figure 3.1). They are separated by a pedestrian path connecting Dover MRT station to the residential estate. The project area is bounded by a small road, Ghim Moh Link and to the west by more turf area and a forest patch. The Environmental Study area extends northwards to the Ulu Pandan Park Connector, and south to Commonwealth Avenue West.

The study area covers a vegetated area of approximately 15.5 ha.



Figure 3.1. Map showing current project area

The environmental aspects that were studied for this project, along with a brief description of each aspect and explanation of its relevance in the study, are presented below. The identified sensitive receptors are listed down in Table 3.2.

Biodiversity

This aspect covers flora and fauna groups inhabiting the project site that may be impacted by future construction and operation of the project. The main groups studied are vegetation on site, birds, mammals, amphibians, reptiles, butterflies, and odonates. Aquatic surveys of natural streams were also conducted, covering freshwater fish, molluscs, and decapod crustaceans. Impacts to biodiversity during the project implementation were assessed, and mitigation measures to address the potential impacts were recommended.

Hydrology and Water Quality

This aspect concerns natural waterbodies within the project site that may be impacted during the construction stage. Free-flowing streams were mapped, and water quality analysis and stream characteristics were carried out at points along each stream to establish the baseline condition. Of the three streams mapped, Stream 1 was found to be a habitat for the locally rare Apple Snail (*Pila scutata*) and was also considered to be of the highest conservation value. Based on HDB's housing plans, Stream 1 was proposed to be preserved as a natural stream. In addition to stream characterisation and water quality analysis on all the streams, changes to the flow rate, and volume of inflow and outflow, due to the proposed development around Stream 1 were modelled. Direct and indirect impacts to streams during the project implementation were studied.

Noise

The infrastructure works at Ulu Pandan will likely increase noise levels beyond current ambient level. Many fauna species are sensitive to noise. Noise levels were measured at sensitive receptors and analysed to assess the baseline condition. Impacts of noise from construction activities were assessed to recommend mitigation measures.

Ambient Air Quality

Construction activities are known to release dust and other particulate matters that may harm the health of sensitive receptors in surrounding area, in this case flora and fauna species and human receptors within project study area. The baseline ambient air quality was established. The impacts generated from construction activities were assessed and recommendations to mitigate the impacts are provided.

Vibration

Construction activities involve the use of heavy equipment generating vibration that may harm the health of sensitive receptors in surrounding area. The baseline vibration levels were established. The impacts generated from construction activities were assessed and recommendations to mitigate the impacts are provided.

Light

Increased artificial light during night-time construction activities could disrupt circadian cycles of animals and distort the day–night cycle of plants. Impacts from increased artificial light were qualitatively studied, and mitigation measures proposed to reduce adverse impacts to the surrounding environment.

Waste Management

The main impacts in relation to the storage, handling, transport and disposal of waste include deterioration of the environment and health & safety risks with regards to hazardous waste, if they are not managed properly. These impacts were assessed and mitigation measures to overcome these impacts were proposed.

Vector Control

Possibility of vector borne diseases in Singapore's warm tropical climate is always present. As the majority of vector-borne diseases in Singapore are transmitted by mosquitoes, these impacts were assessed and mitigation measures to overcome these impacts were proposed.

3.4 Identification of Sensitive Receptors

Table 3.2 provides the overview of the identified sensitive environmental receptors that may be affected during the development of the proposed project.

Table 3.2. Overview of identified sensitive receptors

Environmental Aspects	Sensitive receptors
Biodiversity	• Native flora and fauna of international conservation significance (i.e., classified as Critically Endangered, Endangered, or Vulnerable according to IUCN classification system) within project study area • Native flora and fauna of national conservation significance (i.e., classified as Critically Endangered, Endangered, and/or Vulnerable according to Singapore Red Data Book (Davison et al., 2008) or other relevant local status publications) within project study area • Native flora and fauna endemic to Singapore within project study area • Habitats with high ecological value (i.e., environments that support species of conservation significance)
Surface Water Quality	• Aquatic flora and fauna within project study area • Surface waterways that support habitats of conservation significance, particularly Stream 1, which will be conserved as part of the development
Noise	• Species that are susceptible to noise pollution (e.g., species that require a quiet environment to find prey and species with acute hearing) • People working on the site (e.g., construction workers) • Residents of Holland Grove View and Ghim Moh Link • Singapore Polytechnic blocks T11A, T11B, T1A, and W1

Environmental Aspects	Sensitive receptors
Ambient Air Quality	• Flora and fauna living within project study area • People working on the site (e.g., construction workers, consultants) • Residents of Holland Grove View and Ghim Moh Link • Singapore Polytechnic blocks T11A, T11B, T1A, and W1
Vibration	• Fauna within project study area • Residents of Holland Grove View and Ghim Moh Link • Singapore Polytechnic blocks T11A, T11B, T1A, and W1
Light	• Species that are susceptible to light disturbance (e.g., nocturnal fauna) within project study area

3.5 Impact Assessment Methodology

3.5.1 Identification of Impacts

The proposed project involves earthworks and infrastructure works within the project study area. This will involve clearance of vegetation and earthworks for working spaces (e.g., project footprint, access routes, storage space for construction equipment and materials), which has several potential impacts on surrounding environment. These impacts include those that are direct in nature, such as loss of species, habitat destruction due to vegetation clearance, and indirect impacts such as fragmentation of habitats, isolation of population due to reduced connectivity and fauna movement, increased edge effect[3], and noise, light and air pollution during construction and operation phases of the project.

Assessment of the impacts of the proposed project will include:

- Elements of the community, man-made environment, and natural environment likely to be affected by the project (including ecological impacts);
- Disturbances to wildlife considering seasonal migratory variations;
- Suspended sediment and sedimentation impact on stream/aquatic habitats, aquatic plants, animals, or hydrophytes;
- Noise, dust, vibration impact on animals / aquatic habitat, or hydrophytes;
- Minimum amount of freshwater flow required to maintain the stream's current condition; and to support existing aquatic biodiversity.
- Impacts on sensitive receptors; including ecological connectivity to the surrounding greeneries;
- Water pollution and construction waste management;
- Freshwater discharges, water quality and key hydrological parameters affecting the Projects site and earth streams;
- Magnitude and likelihood of the potential environmental impacts;
- Environmental impacts (e.g., pollution, environmental disturbance and nuisance) during earthworks and infrastructure works;

[3] i.e., higher temperature, light, noise, and pollution levels on the edges compared to the interior of a forest resulting in retraction or loss of species sensitive to these disturbances.

- Residual environmental impacts (i.e., after practicable mitigation) and the cumulative effects expected to arise during earthworks and infrastructure works in relation to the sensitive receptors and potential affected uses;
- Extent of the secondary environmental impacts that may arise from the proposed mitigation measures

3.5.2 Assessment of Impacts

Based on the impact analysis of construction and post-construction activities of the proposed development, suitable mitigation measures are recommended to lower the magnitude of negative impacts on the environment to within acceptable levels as much as practically possible.

Potential impacts were quantified using the Rapid Impact Assessment Matrix (RIAM) method, a scoring system in which impacts of each construction activity are evaluated against environmental receptors (adapted from Pastakia & Barber, 1998). The RIAM method attributes values to each condition based on its importance (I), magnitude (M), permanence (P), reversibility (R), and cumulative impact (C).

The parameters are tabulated in Table 3.3.

Table 3.3. List of parameters and respective scores assigned in RIAM method

Parameter	Description	Score
Importance (I)	Important to national/international interests	5
	Important to regional/national interests	4
	Important to areas immediately outside the local condition	3
	Important to the local condition (within a large direct impact area)	2
	Important only to the local condition (within a small direct impact area)	1
Magnitude (M)	Major positive benefit or change	+4
	Moderate positive benefit or change	+3
	Minor positive benefit or change	+2
	Slight positive benefit or change	+1
	No change/status quo	0
	Slight negative disadvantage or change	-1
	Minor negative disadvantage or change	-2
	Moderate negative disadvantage or change	-3
	Major negative disadvantage or change	-4
Permanence (P)	No change/Not applicable	1
	Temporary	2

	Permanent	3
Reversibility (R)	No change/Not applicable	1
	Reversible or controllable through Environmental Management and Monitoring Plan	2
	Irreversible	3
Cumulative Impact (C)	No change / Not applicable	1
	Non-cumulative/single	2
	Cumulative/synergistic	3

Given the ambiguity in the nature of assessing the “magnitude” component, we use the following criteria, tabulated in Table 3.4, to aid the assessment.

Table 3.4. Description of the value of magnitudes in RIAM method

Magnitude	Description
Major positive benefit or change	Refers to significant improvements in baseline conditions and a significant reduction of stress or improvement in the baseline states of sensitive receptors.
Moderate positive benefit or change	Refers to significant improvements in local baseline conditions, which may lead to a moderate reduction of stress to sensitive receptors or improvement in their baseline state.
Minor positive benefit or change	Refers to minor positive benefit or change implies that positive changes to baseline conditions are discernible but local. These changes may lead to local and limited reduction of stress to sensitive receptors.
Slight positive benefit or change	Refers to slight positive benefit or change implies that changes in baseline conditions are unlikely to be detectable on-site, and thus are unlikely to cause discernible reduction of stress to sensitive receptors.
No change/status quo	Refers to no change/status quo implies that changes in the baseline conditions are not expected, and unlikely to cause any stress to sensitive receptors.
Slight negative disadvantage or change	Refers to changes in baseline conditions that are unlikely to be detectable in the field, and thus are unlikely to cause discernible stress to sensitive receptors.
Minor negative disadvantage or change	Refers to negative changes to baseline conditions that are discernible but local. These may also refer to changes that are approaching thresholds for established standards or guidelines. These changes may lead to a local and limited increase in stress to sensitive receptors.
Moderate negative disadvantage or change	Refers to significant adverse changes in local baseline conditions. These may also refer to changes that are very close to exceeding established standards or guidelines or causing significant ecological impacts. These changes may lead to a moderate increase of stress to sensitive receptors.
Major negative disadvantage or change	Refers to significant adverse changes in baseline conditions. These may also refer to changes that exceed established standards or guidelines or causing a complete loss of certain habitats or ecological components. These changes may lead to an unacceptable increase of stress to sensitive receptors.

These values will then contribute to the condition's environmental score, where:

$$Environmental\ Score\ (ES)\ =\ I * M * (P + R + C).$$

The ES attained for each condition correlates to a measure of its impact, tabulated in Table 3.5

Table 3.5. List of ES range along with the degree of impact associated with each range

Range	Impact
116 to 180	Major positive change/impact
81 to 115	Moderate positive change/impact
37 to 80	Minor positive change/impact
7 to 36	Slight positive impact
-6 to +6	No impact / Status quo / Not applicable
-7 to -36	Slight negative change/impact
-37 to -80	Minor negative change/impact
-81 to -115	Moderate negative change/impact
-116 to -180	Major negative change/impact

3.5.3 Mitigation Measures

In general, mitigation measures follow two concepts:

- ALARP : "As Low as Reasonably Practical"
- BATNEEC : "Best Available Technology Not Entailing Excessive Costs"

The first concept is a hierarchy of actions that aims to find anything that can be done to avoid, minimise, or reduce the predicted/ potential adverse (negative) environmental impacts, as practically feasible and reasonable. The second concept comes in when discussing whether to adopt certain available technology that could address/reduce environmental impacts.

This Environmental Study utlises both concepts for the development of mitigation measures for this project.

4 BIODIVERSITY

4.1 Introduction

The project site is part of a vegetated patch of forest located in the Ulu Pandan area. Due to its land use history, the site comprises of several habitat types, of which the exotic-dominated secondary forests are the most prevalent. Other habitat types include abandoned kampong, scrubland, and riparian along the streams. Floristically, some species of conservation value are found on the site, and in particular, the native bamboo *Gigantochloa ligulata* was notable as it was not recorded in the previous baseline study.

While there was a high proportion of non-native flora species, these species provided habitat for fauna species on site. In particular, the presence of a large number of Albizia trees provided suitable canopies for nesting raptors such as the changeable hawk-eagle (*Nisaetus cirrhatus*), that was observed nesting during the baseline survey period. The presence of cavities on several Albizia trees also provides habitat for nesting species such as the Oriental pied hornbill (*Anthracoceros albirostris*) and may be used by other species such as monitor lizards (*Varanus* spp.) and common palm civets (*Paradoxurus musangus*).

This following section describes the methodology of field surveys that were carried out to update the baseline for biodiversity and identify the existing sensitive receptors within the project study area. The results of these surveys are then analysed and utilised for the impact assessment, to assess the likely impacts of the proposed development to the sensitive biodiversity receptors. Measures to mitigate these impacts are recommended for implementation during project implementation.

4.2 Conventions

The species' local conservation status was mainly based on *Singapore Red Data Book* (2008). However, the National Parks Board (NParks) is in the process of updating local conservation statuses of native species, and as the statuses of mammals, reptiles, and amphibians have been updated, these were taken from the lists uploaded on NParks' website (National Parks Board, 2021).

For flora, a combination of the *Flora of Singapore: Checklist and bibliography* (Lindsay, et al., 2022) and *The Checklist of the Total Vascular Plant Flora of Singapore* (Chong, Tan, & Corlett, 2009) were the main references. Conservation status for *Odonata* was derived from *The Dragonflies of Singapore: An updated checklist and revision of the national conservation statuses* (Ngiam & Cheong, 2016). For butterflies, Singapore does not have conservation statuses, but conservation status is listed according to the species' rarity based on *A field guide to the butterflies of Singapore* (Khew, 2015). Global conservation statuses were derived from the IUCN Red List of Threatened Species (International Union for Conservation of Nature and Natural Resources (IUCN), 2021).

Table 4.1 provides a consolidated list of statuses from the various sources. In this report, exotic plant species with no local status were categorised as Not Evaluated. In this report, flora species with local status of EX, CR, EN, VU, and DD are considered of

conservation significance.

Table 4.1. Conservation status for flora & fauna species & respective definitions, adapted from IUCN Red List (2021), Singapore Red Data Book (Davison et al., 2008), Flora of Singapore (Lindsay, et al., 2022), and The Total Vascular Plant Flora of Singapore (Chong, Tan, & Corlett, 2009).

Conservation Status	Definition
Global	
Extinct (EX)	There is no reasonable doubt that the last individual has died. Exhaustive surveys in known and/or expected habitat, at appropriate times, throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	Known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. Exhaustive surveys in known and/or expected habitat, at appropriate times, throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CR)	Considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	Does not qualify as Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	Does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	Inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat.
Not Evaluated (NE)	Not yet been evaluated against the criteria.
Local	
Presumed Nationally Extinct (NE)	This species is extinct in Singapore but still survives outside Singapore. It has not been recorded with the last 30 years (plants) and 50 years (animals).
Critically Endangered (CR)	There are fewer than 50 mature individuals, or if more than 50 mature individuals but less than 250, with some evidence of decline or fragmentation.
Endangered (EN)	There are fewer than 250 mature individuals, and no other evidence of decline or fragmentation.
Vulnerable (VU)	There are fewer than 1000 mature individuals, but more than 250 and there may or may not be any other evidence of decline, small range size, or fragmentation.
Local (non-Native flora)	
Cultivated-Only	Exotic species that can only be found in cultivation.
Casual	Exotic species that have established outside of cultivation but rely on

Conservation Status	Definition
	repeated introductions of propagules for persistence in the wild.
Naturalised	Exotic species that maintain self-replacing populations in the wild independent of new human introductions.
Cryptogenic	Species that can only be found in human-modified habitats for which there is a lack of knowledge of their original biogeographic range.

4.3 Desktop Review

A desktop review to collect secondary data was conducted. This included a thorough review of the previous environmental baseline studies conducted in the project study area, publicly available literature on the ecology and biodiversity of the site, as well as other publicly available material, which may include land use and other maps, photographs, and environmental data found on government websites.

The site was zoned as “Residential” since 2003. Thus, an Environmental Baseline Study was carried out by AECOM in 2017 to better understand the existing topography, flora, fauna and hydrology, and guide HDB’s development plans.

The current study area is a subset of that in the previous environmental baseline study, with the latter comprising of two forest patches with a scrubland in the middle (Figure 4.1).



Figure 4.1. Map showing previous and current study areas

4.3.1 Habitat Types

The area studied consisted of five main habitat types which include abandoned secondary forest, native-dominated secondary forest, waste woodland, riparian habitat, and grassland. The study area was dominated by secondary forest, more specifically secondary forest on abandoned plantations which makes up to 49.25% of the baseline area. The secondary forest on abandoned plantations type was primarily dominated by the exotic species such as Para Rubber Tree (*Hevea brasiliensis*). The abandoned kampong forest type comprised of naturalised fruiting trees such as durian, mango and rambutan trees, as well as endangered species of native Pthraj tree (*Aphanamixis polystachya)*. Majority (44.95%) of the baseline study area was assessed to be in "Good" vegetation condition, which implies that there are clear signs of disturbances but with regeneration potential.

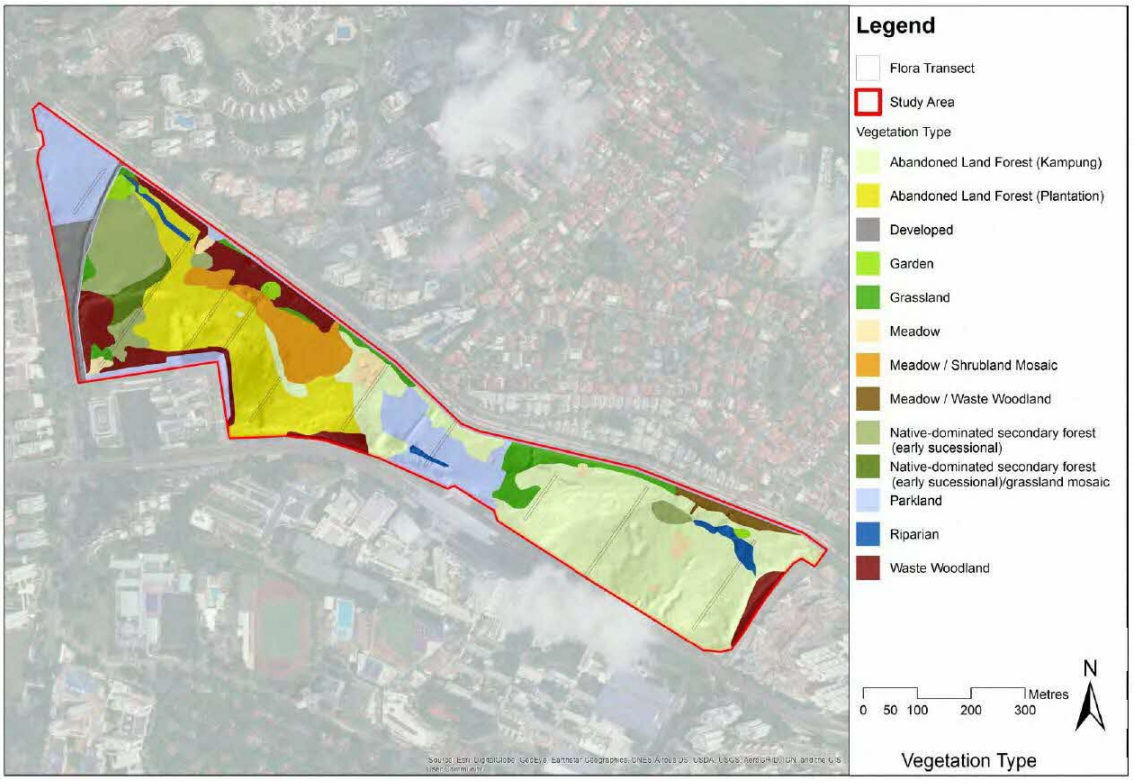


Figure 4.2. Map showing habitat types, adapted from AECOM **(2020)**

Several pockets of native-dominated secondary forest (early successional stage) were recorded in the baseline study area. This vegetation type was predominantly a closed, mono-dominant low canopy of *Dillenia suffruticosa* with common species found in the canopy layer including *Alstonia* spp. and *Macaranga gigantea*. A small patch of native-dominated secondary forest with large trees of *Ficus microcarpa* was also found in the current study area.

Several riparian habitats were found along the four streams identified in the baseline study, three of which lie within the boundaries of the study area. Areas near the streams make up wetlands and swampy areas. There was also a record of a swampy area in the current study area, about 100 metres from the Ulu Pandan Canal.

It was concluded that while the habitat found within the baseline study area is mainly secondary or exotic, the forest is a refuge for the remaining biodiversity that was once more widespread in the area. The site vegetation of the study area also acts as a wildlife corridor for animals moving along the canal or visiting from nearby green areas, such as Holland Woods.

4.3.2 Flora Biodiversity Literature Review

Previous Baseline Study

The baseline study recorded 120 flora species, whereby 42.5% are native, 12.5% threatened. Some threatened species found in the north of the study area seem to have been intentionally planted (*Aphanamixis polystachya*, *Ardisia elliptica*, *Calophyllum soulattri* and *Cratoxylum cochinchinense*), as the area was identified to be part of an old experimental nursery. Together, six species (5% of the overall species) are deemed threatened and likely of native provenance. They are made up of 13 individuals forming 5 clusters. These comprise of species in categories Vulnerable (*Premna serratifolia*, *Glochidion zeylanicum var. zeylanicum*, *Oxyceros longiflorus*, *Ficus aurata var. aurata)*, Endangered (*Ficus vasculosa*) and Critically Endangered (*Ficus virens*). *Ficus virens* was noted to be a fully mature tree of approximately 1,099 cm girth. Following the latest Flora of Singapore Checklist (Lindsay, et al., 2022), *Aphanamixis polystachya, Premna serratifolia* and *Ficus aurata var. aurata* are now categorised as Least Concern, *Ficus virens* as Endangered, and *Calophyllum soulattri* as non-native.

Tree inventory and mapping surveys recorded 370 trees across 46 species, dominated by *Falcataria moluccana* (now *Falcataria falcata*), *Aphanamixis polystachya*, *Cinnamomum iners* and *Hevea brasiliensis*. The latter three species were found to have relatively uniform tree size attributes presumably due to the uniformly young age of the vegetation.

Overall, the previous EBS identified 120 flora species, of which 46 are tree species while the rest are non-tree species. Of the 46 tree species, 22 of them occurred in the current study area. The remaining non-tree species were not included in this study due to the lack of data availability on their spatial distribution. Thus, only 22 tree species from the previous EBS were considered in this Environmental Study.

Other Studies

As Singapore is a small-city state which has undergone rapid urbanisation and faces land use pressure due to its limited land resources much of the island's primeval land conditions have changed. The island has sustained deforestation resulting in the loss of original forest and secondary forest cover (Tan et al., 2013).

Neo et al. (2013) conducted a vascular plant study on both forest patches and found that almost 50% of the forest comprises of exotic and cryptogenic species. The study also found that 15% of the species are nationally threatened. A species that was presumed to be national extinct but found here is *Syzygium myrtifolium*. There were also eight

critically endangered species, five nationally endangered and seven nationally vulnerable species. The critically endangered species were *Cordia dichotoma, Ficus kerkhovenii*, and *Glochidion rubrum* (Neo et al., 2013). The remaining four critically endangered species (i.e., *Gnetum gnemon var. gnemon, Baccaurea motleyana, Nephelium lappaceum* and *Peltophorum pterocarpum*) likely persisted from cultivated rather than local provenance.

The study area also contains three mature trees of Critically Endangered native Grey Fig (*Ficus virens*). One tree, found in Ulu Pandan East (within the current study area), is the 22nd individual to be observed in Singapore. The other two Grey Figs are located in Ulu Pandan West and not part of the present study (Chua, 2021).

Lee et al. (2021) also noted three locally threatened species in the study area – Rambutan (*Nephelium lappaceum*), Common Sterculia (*Sterculia parviflora*), and Pithraj Tree (*Aphanamixis polystachya*). The study also pointed out that wetland sites have a higher species composition of introduced species while uplands sites have a higher species composition of native species (Lee et al., 2021).

4.3.3 Fauna Biodiversity Literature Review

Previous Baseline Study

A total of 158 fauna species from selected vertebrate and invertebrate groups were recorded in the baseline study, though it should be noted that more species are expected to be found if surveys were conducted over a longer period. Together 18 species of locally threatened or near threatened conservation status were observed in the study area, which include Vulnerable grey heron (*Ardea cinerea*), Endangered changeable hawk-eagle (*Nisaetus cirrhatus)*, blue-crowned hanging parrot (*Loriculus galgulus)*, violet cuckoo *(Chrysococcyx xanthorhynchus)*, Oriental magpie-robin (*Copsychus saularis)*, Asian softshell turtle (*Amyda cartilaginea*) and Critically Endangered species of plume-toed swiftlet (*Collocalia affinis*). The plume-toed swiftlet was listed as glossy swiftlet (*Collocalia esculenta*) in the baseline study as it used to be a subspecies of the *C. esculenta* complex. As of 2017, the plume-toed swiftlet has since been classified as its own species and will be listed as plume-toed swiftlet in this report (Rheindt, et al., 2017). Figure 4.2 summarises the fauna results extracted from the previous baseline study.

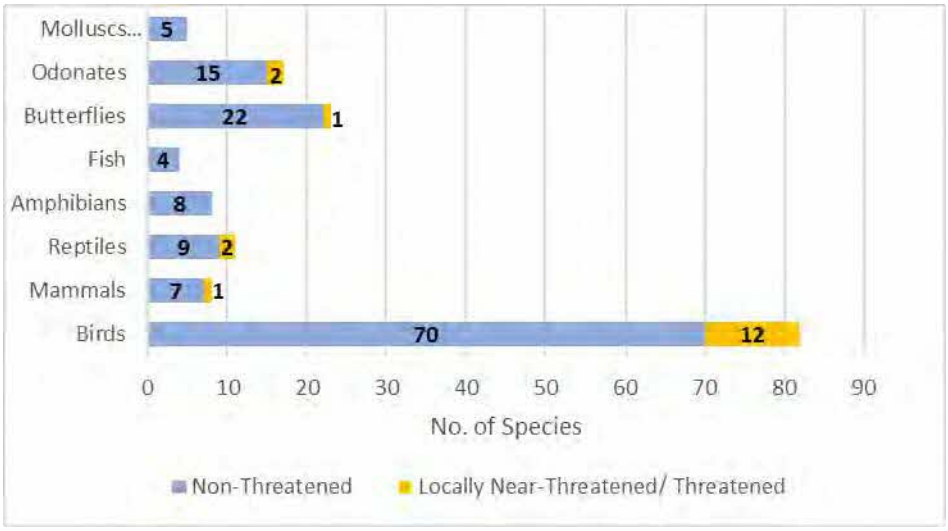


Figure 4.3. Summary of fauna results from the previous baseline study **(AECOM, 2020)**

At a swampy area near the Ulu Pandan Canal, the locally rare apple snail *Pila scutata*) was found (Tan et al., 2013).

Other Studies

Amphibious species of apple snail (*Pila scutata*) were recorded at nearby Buona Vista and Clementi Road ponds before 1990 (Tan et al., 2013). Although formally widespread, more recent studies show that they are no longer found in these nearby ponds after the area was developed for housing and infrastructure. In addition to the land use change impacts, the decline in abundance of this species can also be attributed to competition with the introduced golden apple snail (*Pomacea canaliculata*).

The presence of the Endangered changeable hawk-eagle (*Nisaetus cirrhatus*) and Sunda scops owl (*Otus lempiji*) were identified near the stream in Ulu Pandan East. There were also records of the nationally Threatened red-legged crake (*Rallina fasciata*) which live in swampy areas. In addition, the study indicated high numbers of arthropods, small reptiles and amphibians, fish, and small prey birds. This study of Lee *et al.* (2021) highlighted the need for preservation of the dense forest cover which tailorbirds (*Orthotomus* spp.) rely on for protection from predators.

4.4 Flora Baseline Surveys

4.4.1 Survey Methodology

Modified Gentry Plots

Fifteen Modified Gentry Plots (MGPs) were set within vegetated areas of the study site to cover the requisite 10% of the vegetated area, as per the Biodiversity Impact Assessment (BIA) Guidelines (National Parks Board, 2021). Each MGP consisted of ten 2 × 50 m subplots, within which woody flora with a diameter at breast height (DBH) of 2.5 cm or more will be recorded. In addition, each subplot also had six 1 × 1 m quadrats, where all herbaceous flora were recorded (Monteagudo, 2016; National Parks Board, 2021). Figure 4.3 provides a layout of MGPs within project study area. Flora (including

non-woody shrubs, climbing plants, epiphytes, and herbs) of conservation significance that encountered outside of the MGPs were recorded opportunistically.



Figure 4.4. Layout of the MGPs for vascular flora species within the study area

Each MGP has ten subplots, each subplot having six quadrants.

Survey teams utilised the Trimble® R2 integrated Global Network Satellite System (GNSS) units for geolocational accuracy. The Trimble® R2 GNSS is a receiver that can connect to multiple satellites in orbit if they are flying over the unit. In open areas with no cloud cover, as many as 20 satellites can connect to the Trimble® R2 GNSS unit, making submeter positioning accuracy possible. Accuracy underneath closed canopies is up to 1 m (Trimble, 2021). Data will be collected on a 6th Generation iPad iOS 13.4.1, with locations from the Trimble® R2 GNSS unit linked to the iPad via the GNSS iPad application version 3.0.8.673 by Trimble® (Trimble, 2020). The geolocations and details of the surveyed flora will be recorded using the TreePlotter™ Software Suite by PlanIT Geo™ (PlanIT Geo, 2021). TreePlotter™ is a tree inventory and asset management software that allows users to geolocate and inventory trees in real time. This allows multiple users to work within a specific site and view trees as they are located and recorded, thus ensuring that the same tree is not recorded twice.

Static parameters collected for recorded flora can be found in Table 4.2. Plant samples were collected to facilitate species identification where required.

Table 4.2. Static parameters collected for surveyed flora

Static Parameter	Description
Coordinates (Eastings/Northings)	In SVY21 (EPSG:3414) Coordinate Reference System
Collection date	Date when the tree was geolocated
Flora Identification Number	Unique identification no. for each tree encountered on site
Flora Species	Latin and common name[1]
Form	Is the flora a tree, shrub, palm, herb, fern, climber/vine?
Height	Height of the tree (m)
Girth	Circumference of the tree (cm) at 1.2 m height
Assessor's remarks	Any remarks about the tree, if applicable
Image	At least 1 color image of each tree surveyed (provided as supplementary material)

Note: Some flora species within the Southeast Asian region have no common name

Vegetation and Habitat Mapping

Vegetation and habitat maps were produced based on the flora recorded in the MGPs and opportunistic encounters. Vegetation maps were produced for woody flora with a girth of one metre or greater, and for flora of conservation significance. Habitat types within the site identified during vegetation surveys were demarcated based on species compositions within various areas of the site (Table 4.3).

Table 4.3. Habitat types found within Singapore and general description of each habitat, adapted from the BIA Guidelines **(2021)**.

Habitat	Description	Source(s)
Primary forest	Contains an emergent layer that has dipterocarp trees such as *Shorea* and *Dipterocarpus*. Has a continuous layer of tall native trees, a sub-canopy consisting of smaller trees, and an understorey dominated by saplings of big tree species interspersed with other shrubs and treelets.	(Tan et al., 2007)
Native-dominated young secondary forest	Developed on land cleared not long before the 1960s, or on degraded soils and not near other native-dominated forests. Dominated by native pioneer trees such as *Adinandra*, *Macaranga*, *Mallotus*, and *Trema*.	(Yee et al., 2016)
Native-dominated old secondary forest	Developed on land cleared much earlier than the 1950s, often on less degraded soil and with higher species richness than early successional native dominated secondary forest. Common species found in the canopy layer include *Alstonia* spp., *Calophyllum* spp., *Campnosperma* spp., *Elaeocarpus* spp., *Garcinia* spp., *Litsea* spp., *Rhodamnia* spp. and *Syzygium* spp. Common understorey plants include *Anisophyllea disticha* and *Agrostistachys borneensis*.	(Yee et al., 2016)
Exotic-dominated Secondary Forest	Regrown on land that was recently cleared, usually after the 1960s. Typically dominated by *Acacia auriculiformis* and *Falcataria moluccana* (now *Falcataria falcata*), and in recent years, *Cecropia pachystachya* and *Leucaena leucocephala*, depending	(National Parks Board, 2021)

Habitat	Description	Source(s)
	on the seed sources available from the surroundings during the time of clearance and succession.	
Abandoned kampong	Developed from an abandoned kampong or orchard, usually dominated by fruit trees such as Durian (*Durio zibethinus*) or Rambutan (*Nephelium lappaceum*), or ornamental plants such as *Spathodea campanulata*, *Aglaonema commutatum*, *Dieffenbachia seguine* and *Heliconia* spp.	(Yee et al., 2016)
Abandoned plantation	Developed from an abandoned plantation, usually dominated by Para Rubber (*Hevea brasiliensis*).	(Yee et al., 2016)
Scrubland/Grassland	Exposed areas with very little tree cover, typically dominated by grasses, shrubs, and herbs.	(Yee et al., 2011)
Freshwater swamp forest	Formed where slow-flowing streams drain into shallow valleys. The swamp is flooded periodically or semi-permanently, resulting in waterlogged soils that are anaerobic and unstable. Dominated by plants with special adaptations such as stilt roots, plank-like buttresses and pneumatophores. Examples include *Xylopia fusca* and *Paloquium xanthochymum.*	(Tan et al., 2007)

Comparison with Past Flora Baseline

The final flora checklist is produced by combining current flora survey results with of past baseline flora survey results for Transects 1-4 (AECOM, 2020) which overlap with the current study area (Figure 4.5), and the source of each species will be indicated (i.e. whether a species is recorded in the past baseline, current baseline or both). The vegetation and habitat map are produced using data from current flora survey.

4.4.2 Survey Results

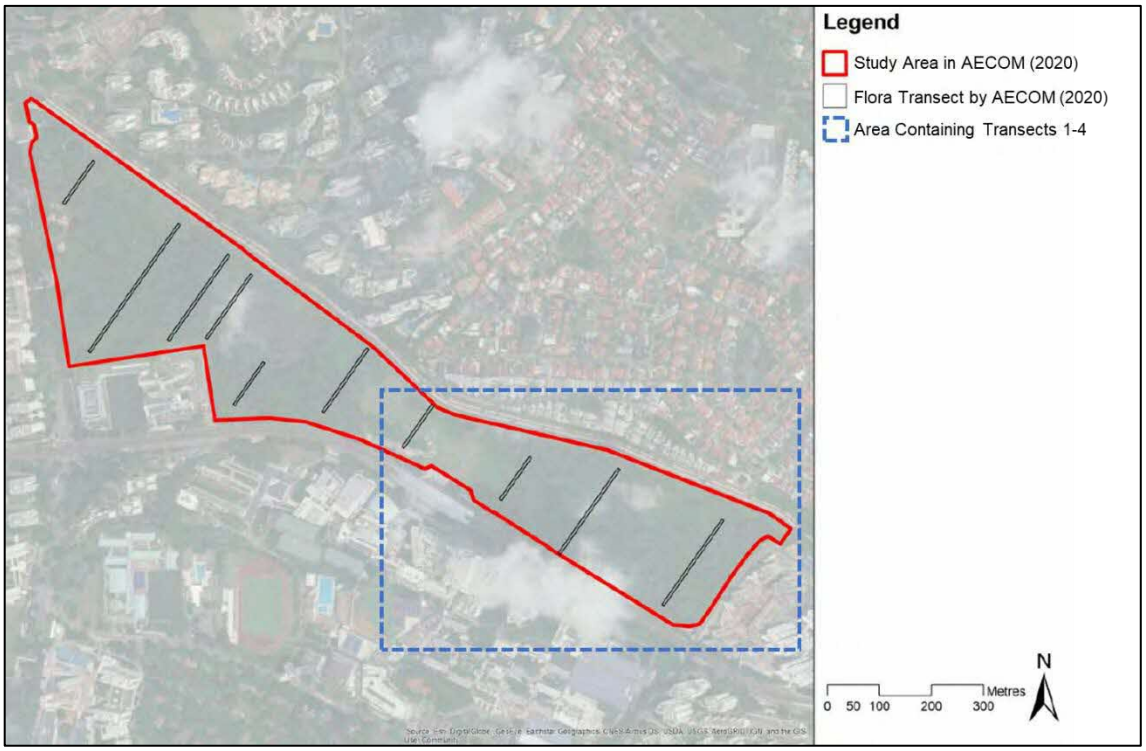


Figure 4.5 Tree species recorded Transect 1–4 in past baseline report (annotated in a blue rectangle with dashed outline) were combined with the current flora survey findings to produce a final flora checklist

Flora Inventory

Across the study area, *Aphanamixis polystachya* and *Cinnamomum iners* were the most commonly encountered vascular flora species throughout the forested habitat of the study area, which consists of Exotic-dominated Secondary Forest and Abandoned Kampong. Sorgum (*Sorghum propinquum*) and Mile-A-Minute weed (*Mikania micrantha)* were the most common species encountered in Scrubland/Grassland habitat located close to the pedestrian linkway between Dover MRT and Holland Grove View.

Albizia trees *(Falcataria falcata)* were found to be locally abundant in Ulu Pandan East near the Ghim Moh housing estates, forming the emergent canopy. Thus, most habitats in Ulu Pandan East are classified as Exotic-Dominated Secondary Forest. As *F. falcata* is an early successional species, they were not able to germinate and grow in areas with shaded understorey. Instead of common native early-successional species like Tiup-tiup (*Adinandra dumosa)* and Simpoh Air (*Dillenia suffruticosa)*, the regeneration of Ulu Pandan is heavily dominated by *A. polystachya* and *C. iners*, which are found throughout the understorey of both Exotic-dominated Secondary Forest and Abandoned Kampong habitat, though in some localised pockets exotic species such as Brown Heart (*Andira inermis)* is the predominant understorey species.

The high number of cultivated flora species found within the study area, especially to the northeast of Ulu Pandan, was expected as the area showed heavy human traffic, as evident from the trails inside the forests and small gardens found along the trails planted

with various cultivated herbs. These species include flora likely planted for food or medicinal values, such as Sabah Snake Grass (*Clinacanthus nutans*), Black Face General (*Strobilanthes scabra)* and Cat's Whiskers (*Orthosiphon aristatus)*. Some fruit trees were also observed within the study area, including Rambutan (*Nephelium lappaceum*), Durian (*Durio zibethinus*) and Jackfruit (*Artocarpus heterophyllus*). Yee et al. (2016) stated that these species are common in the abandoned kampong habitat type, and such habitat tend to be spatially heterogenous when found.

A total of 193 species had been compiled for the study area, in which 171 species were recorded in the current baseline study, 3 species in the past baseline study, and 19 species in both baseline studies. Out of the 193 species, 21 are of conservation significance, which comprises of 5 Critically Endangered, 5 Endangered, 11 Vulnerable, and one Data Deficient flora species. Table 4.4 provides the list of flora species of conservation significance recorded within study area. Table 4.5 presents distribution of conservation significant flora species by numbers and percentages. In general, the diversity of native flora in Ulu Pandan is limited, likely due to lack of native germplasm source in vicinity. Nevertheless, several individuals and seedlings of Critically Endangered species *Melicope lunu-ankenda* had been found occuring sparsely at the Abandoned Kampong habitat at the southern parts of Ulu Pandan. In addition, this survey recorded individuals or clusters of Vulnerable *Horsfieldia polyspherula*, Endangered *Jasminum elongatum* and Critically Endangered bamboo *Gigantochloa ligulata*, which were not recorded in past studies and baselines. The Endangered *Ficus virens* reported by Chua (2021) was observed to be in good condition, though the host plant had since declined in health.

Several conservation significant flora species, such as the Rambai (*Baccaurea motleyana*), Belinjau (*Gnetum gnemon*) and Common Sterculia (*Sterculia parviflora*) likely persisted from cultivated and have limited conservation value (Neo et al., 2013).

Following status changes in the latest Flora of Singapore checklist (Lindsay, et al., 2022), several species that were considered to be threatened in the previous baseline study (*Premna serratifolia, Ficus aurata var. aurata, Calophyllum soulattri* and *Aphanamixis polystachya*) are not listed as threatened species in this current report.

Table 4.4. Flora of local conservation significance encountered within the project study area

Species Name	**Common Name**	**Local Conservation Status[1]**
Ardisia elliptica	Sea-shore Ardisia	Endangered
Baccaurea motleyana	Rambai	Critically Endangered
Breynia androgyna	Cekur Manis	Vulnerable
Bridelia stipularis	Kenidai	Vulnerable
Cyperus brevifolius	Shortleaf Spikesedge, Green Kyllinga	Vulnerable
Cyperus cf. *compressus*	Poorland Flatsedge	Vulnerable
Cyrtococcum accrescens	-	Vulnerable
Cyrtococcum patens	Bowgrass	Vulnerable
Dimocarpus lichi	Mata Kucing, Isau, Sau, Kakus	Data Deficient
Elaeocarpus ferrugineus	Rusty Oil Fruit	Vulnerable

Species Name	Common Name	Local Conservation Status[1]
Ficus virens	Grey Fig, Spotted Fig	Endangered
Geophila herbacea	Snake Pennywort	Endangered
Gigantochloa ligulata	–	Critically Endangered
Glochidion zeylanicum var. *zeylanicum*	–	Vulnerable
Gnetum gnemon	Belinjau	Critically Endangered
Horsfieldia cf. *polyspherula*	–	Vulnerable
Jasminum elongatum	Common Malayan Jasmine	Endangered
Macaranga griffithiana	Mahang Bulan, Mahang Tutup	Vulnerable
Melicope lunu-ankenda	Tenggek Burong	Critically Endangered
Millettia pinnata	Seashore Mempari, Indian Beech	Endangered
Oxyceros longiflorus	Akar Berdara Laut	Vulnerable
Sterculia parviflora	Common sterculia	Critically Endangered

[1] (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)

Table 4.5. Distribution of flora species, covering both present and AECOM **(2020)** surveys

Origin	Local Status	Number of Species	Percentage of Species
Native		**88**	**46.1%**
	Data Deficient	1	0.5%
	Least Concern	67	34.7%
	Vulnerable	11	5.7%
	Endangered	5	2.6%
	Critically Endangered	5	2.6%
Non-native		**89**	**46.1%**
	Cultivated only	15	7.8%
	Casual	21	10.9%
	Naturalised	46	23.8%
	Not Evaluated	7	3.6%
Uncertain		**15**	**7.8%**
	Cryptogenic Weed	15	7.8%
Total Number of Species		**193**	**100%**

Appendix A provides the complete list of flora species recorded in current and past baseline while **Appendix B** presents the photos of some of dominant plant species.

Vegetation and Habitat Mapping

Exotic-dominated secondary forest was the habitat type that was most commonly encountered throughout the forested areas of the study site, with a total area of approximately 7.73 hectares, with the majority of the area occurring to the east of Ulu Pandan and forest edges. The canopy of this habitat is dominated by *Falcataria falcata* and *Spathodea campanulata*. The abandoned kampong habitat type occurred mainly between Exotic-dominated Secondary Forest and Scrubland/Grassland and made up about 2.67 hectares of the study site. Scrubland was another commonly encountered habitat type, located close to the pedestrian linkway between Dover MRT Station and Holland Grove Drive, and accounting for about 3.78 hectares in total. The critically

endangered *Gigantochloa ligulata* is located at the Scrubland on the east of the pedestrian linkway between Dover MRT and Holland Grove View.

The northern portion of Ulu Pandan can become temporarily flooded after rain, and water loving plants such as *Acrostichum aureum* and *Struchium sparganophorum* had been observed at some areas that are usually considered Scrubland/Grassland. Majority of the flora of conservation significance are found in the abandoned kampong habitat, which can be seen in Figure 4.6 and Figure 4.8.

Despite the lack of connectivity between Ulu Pandan and nature reserves, young individuals of late-successional forest species such as *Horsfieldia polyspherula* had been discovered occasionally in the understorey. But overall, the understorey of Ulu Pandan is atypical in the sense that it is heavily dominated by *Aphanamixis polystachya* which is not known to be a native pioneer species. The dominance of *Aphanamixis polystachya* in the understorey might be due to a combination of past cultivation and lack of native flora germplasm sources in the vicinity. Furthermore, seedlings and saplings of cultivated species such as *Andira inermis*, *Calophyllum soulattri* and *Elaeocarpus cf. ngii* had been observed in Ulu Pandan East at areas near to Ghim Moh link, suggesting competition from exotic species for understorey regeneration at some parts of the forest.

Figure 4.6 provides the habitat map of the project study area. Figure 4.7 presents vegetation map of surveyed flora with girth >1 meter while Figure 4.8 shows the locations of species of conservation significance found within Ulu Pandan.

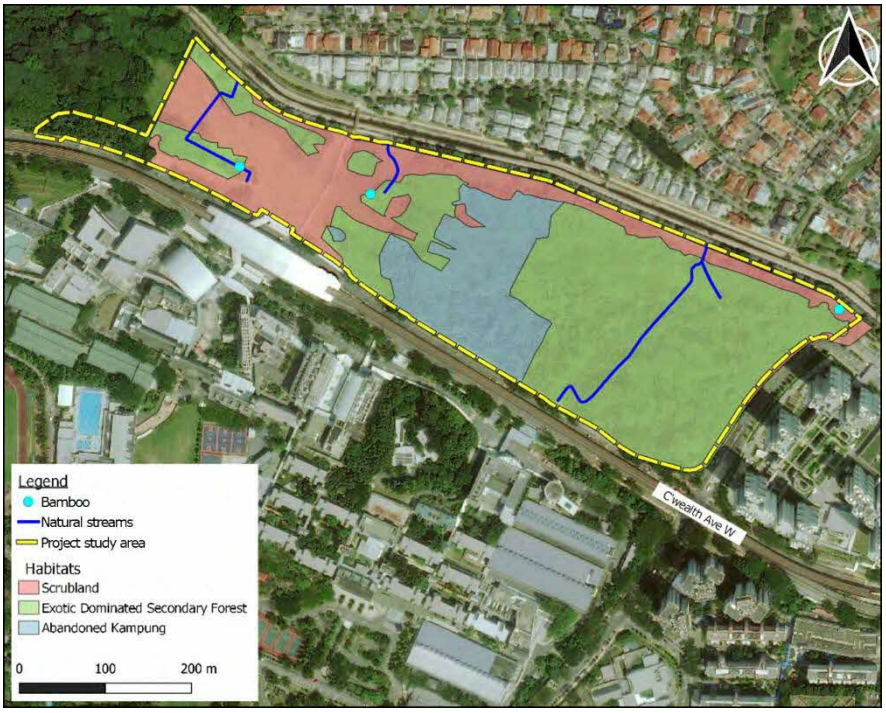


Figure 4.6. Habitat map of the project site

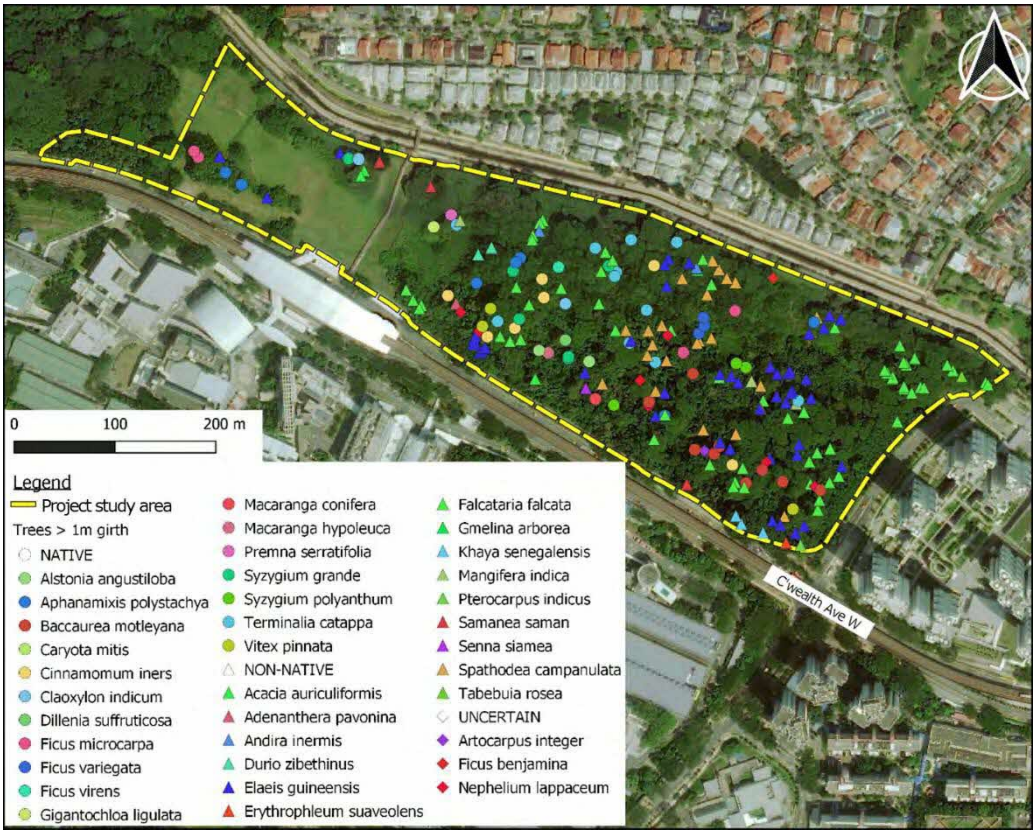


Figure 4.7. Vegetation map of surveyed flora with girth >1 metre

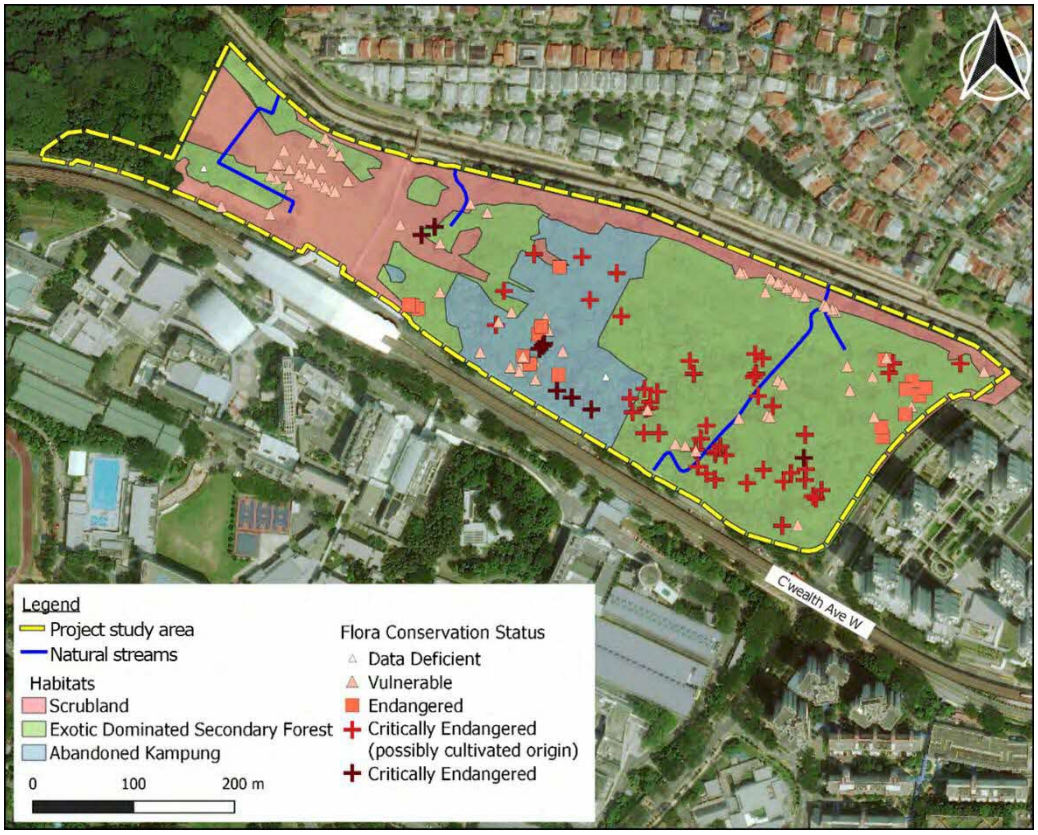


Figure 4.8. Distribution of conservation significant flora in the project site

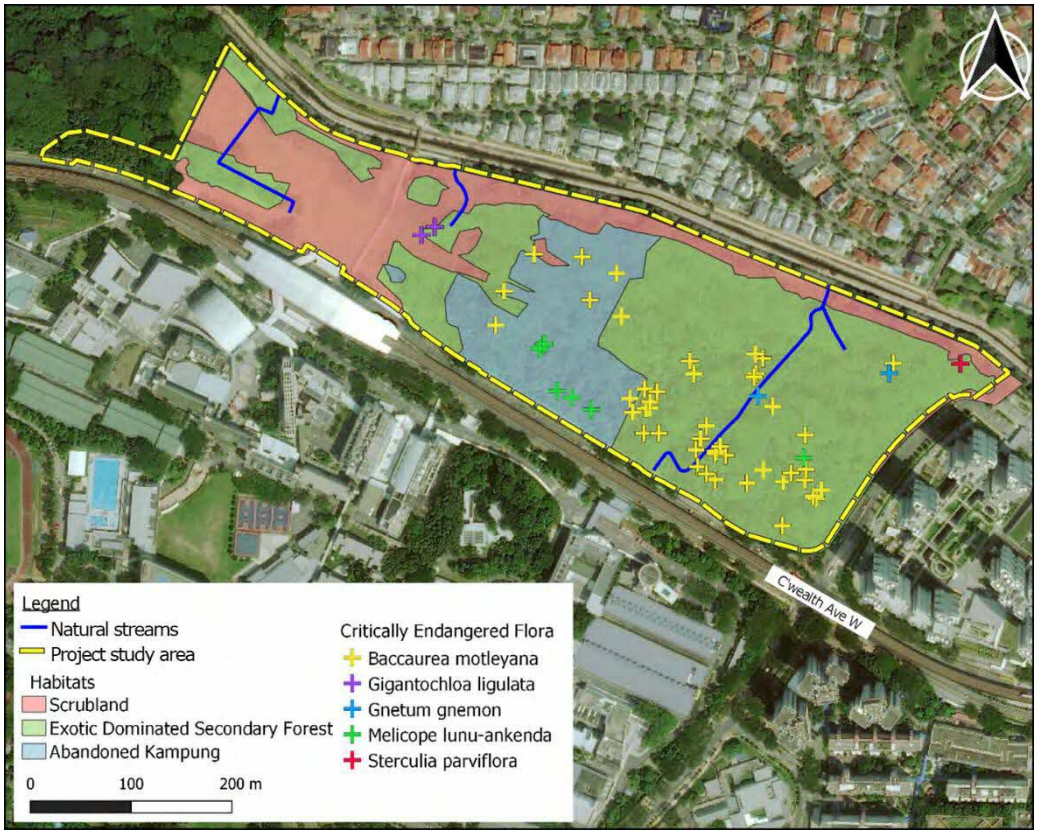


Figure 4.9. Vegetation map of surveyed Critically Endangered flora

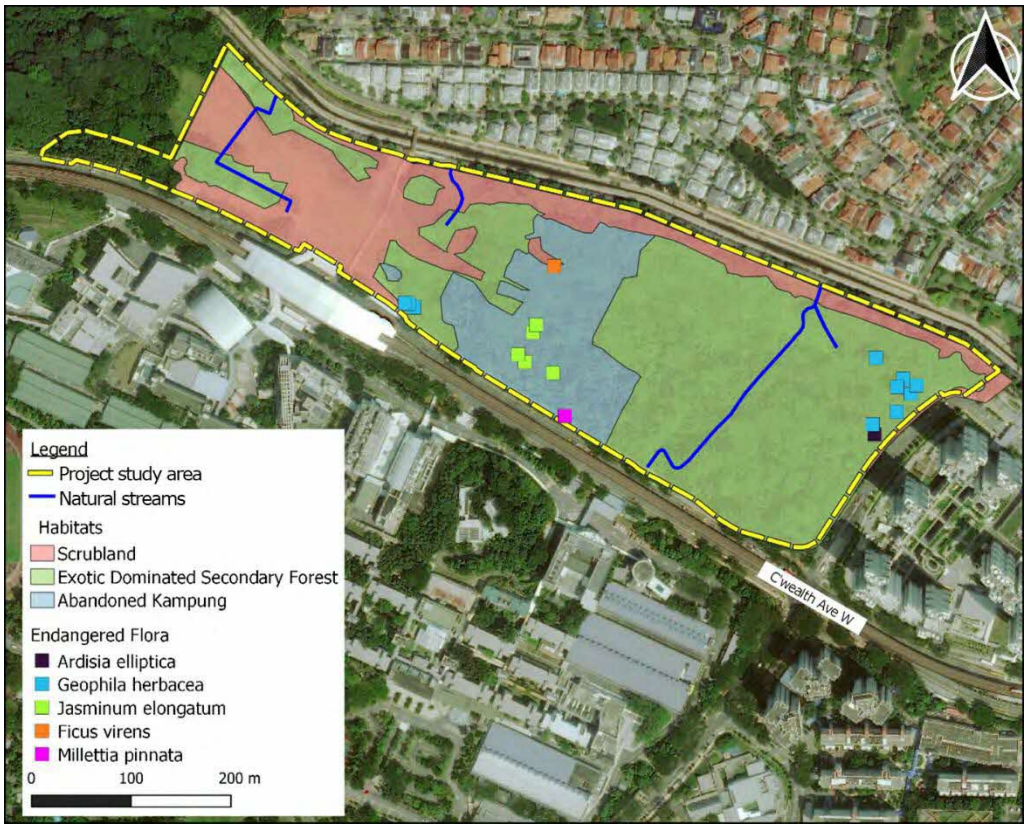


Figure 4.10. Vegetation map of surveyed Endangered flora

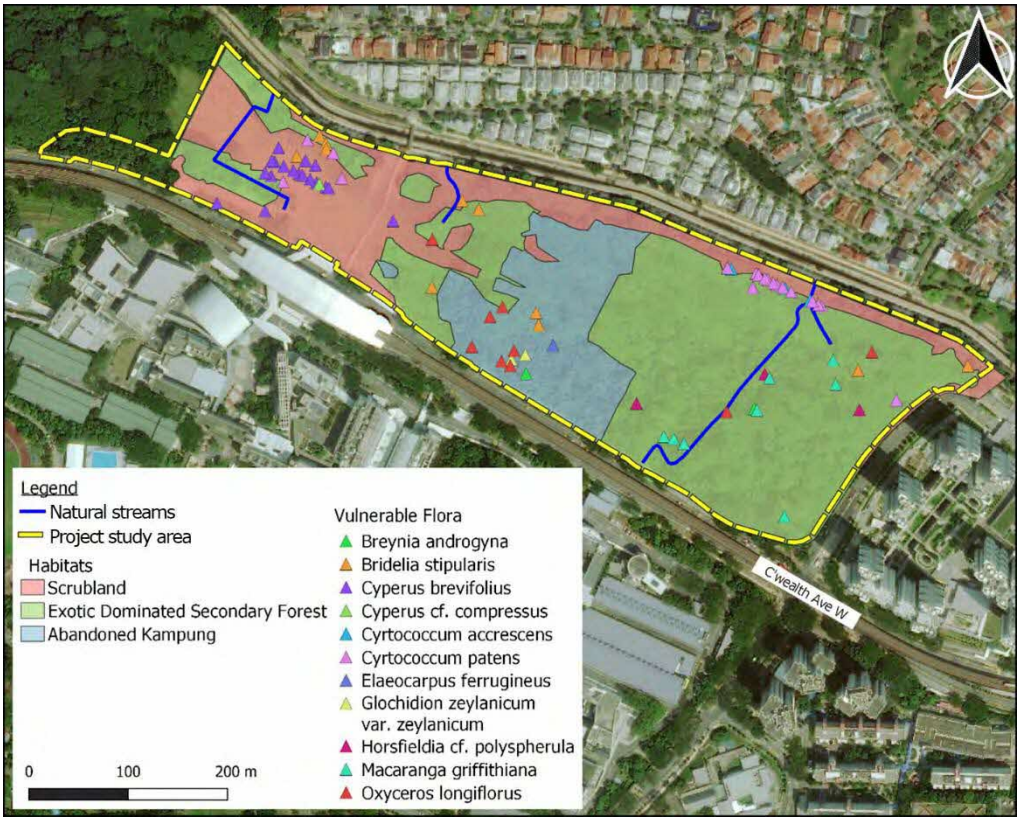


Figure 4.11. Vegetation map of surveyed Vulnerable flora

4.5 Fauna Baseline Surveys

4.5.1 Survey Methodology

The fauna field assessment covered various fauna groups: birds, herpetofauna (reptiles and amphibians), mammals, odonates (dragonflies and damselflies), and butterflies. For the natural, free-flowing streams within the site, aquatic surveys covering fish, molluscs, and decapod crustaceans were also conducted. Table 4.6 summarises the survey methods and appropriate survey timings for each taxonomic group. Fauna species encountered outside their dedicated survey timings are also recorded.

Table 4.6. Survey timings, frequency, and methodology for each fauna group.

Taxonomic Group	Survey Timings	No. of surveys	Survey Methodology
Birds	0700 – 1100	3	Visual encounter survey; call recognition along transects
Mammals (non-volant)	0700 – 1000 2000 – 0000	3 diurnal, 2 nocturnal	Visual encounter survey; call recognition along transects
	24 hrs	1 month	Camera traps attached on tree trunks 30 cm above ground level
Mammals (bats)	1900 – 0700	2	Acoustic recording
Herpetofauna	0700 – 1100 2000 – 0000	3 diurnal, 2 nocturnal	Visual encounter survey; call recognition along transects

Taxonomic Group	Survey Timings	No. of surveys	Survey Methodology
Butterflies	0900 – 1200	3	Visual encounter survey along transects
Odonates	0900 – 1200	3	Visual encounter survey along transects
Aquatic Fauna (fish, molluscs, decapod crustaceans)	Diurnal (0900 – 1500) Nocturnal (2000 – 0000)	1 diurnal, 1 nocturnal, 1 overnight trapping	Sweep sampling with dip/hand nets for diurnal. Visual detection for nocturnal. Baited traps for both, overnight

Visual Encounter Surveys

An updated baseline survey of fauna found in the study area was conducted along systematic transects, following available trails and roads that span the length of the proposed alignment (Figure 4.12). A total of 3 diurnal surveys and 2 nocturnal surveys for dedicated groups were conducted. Visual observations were conducted by at least two observers along each transect. These surveys focused on birds, mammals, reptiles, amphibians, odonates, and butterflies. Animal tracks, scats, and locations of raptor nests were also recorded.

Point count surveys were conducted for birds. These involved observers staying at a fixed location and recording the number of birds identified by sight and sound over a specific duration. Point count surveys were conducted for 5 minutes per point in non-forested areas and 10 minutes per point in forested areas. In forested areas, an additional 5 minutes was given to allow birds to settle after any initial disturbance from the surveyors. For mammals, herpetofauna, odonates, and butterflies, visual encounter surveys were conducted along the same transects, with observers walking at a slow, steady pace, to record all animals seen and heard along each transect. GPS locations for each species observed as well as the number of individuals detected were also recorded.

Both diurnal (day) and nocturnal (night) surveys were conducted because a large proportion of the target groups, particularly mammals and herpetofauna (reptiles and amphibians), are predominantly nocturnal.



Figure 4.12. Fauna survey transects in the project study area

Camera Trapping

To supplement the visual encounter surveys, camera trapping was also conducted within the project study area (Figure 4.13, Figure 4.14). This method is particularly useful for elusive or rare animals that are not often observed during visual encounter surveys. While a variety of animals were captured in the camera traps, these traps mainly target medium to large ground-dwelling mammals. A total of 6 camera traps were deployed over a period of one month. These cameras were secured on tree trunks at about 30 cm above ground level. The camera traps were programmed to be active 24 hours a day, with the camera capturing 3 photos and a 10 second video each time it is triggered.

Table 4.7. Coordinates of the camera traps within project study area

ID	Latitude (°N)	Longitude (°E)
CAM1	1.310302	103.782489
CAM2	1.311336	103.782449
CAM3	1.311016	103.781207
CAM4	1.311180	103.780024
CAM5	1.312214	103.780185
CAM6	1.312269	103.778266



Figure 4.13. Example of a camera trap setup at Camera 1



Figure 4.14. Location of camera traps within project study area

Acoustic Bat Surveys

Acoustic bat surveys were conducted twice along transects. As far as possible, bats were identified to species level based on the recordings, spectrograms obtained and availability of call library data. Locations of large bamboo clusters used or have potential to be used by bamboo bats were also recorded on site.

Acoustic sampling was performed using a handheld Echo Meter Touch 2 Pro (Wildlife Acoustics, Inc.) attached to an iPad (Apple, Inc.) during nocturnal terrestrial transects. The Echo Meter functions by detecting ultrasonic sounds in real-time and converting them into audible digital signals that can be heard and visualised using the Echo Meter Touch App on the iPad. Each time sounds resembling a bat call is detected, it is automatically recorded and saved onto the iPad as a 16-bit WAV file.

Bat call structure was then analysed using Kaleidoscope v.5.4.7 (Wildlife Acoustics, Inc.). Key call structure parameters include call shape, frequency (kHz) and duration (ms). Each echolocation recording was identified to species level based on call shape, frequency (minimum, maximum, and peak) and call duration (Pottie et al., 2005). Once these parameters were inspected, the results were compared to Pottie et al. (2005) which provided bat echolocation signatures for several species in Singapore and TAC's internal database from past surveys.

The echolocation calls of bats can be used to identify bats to species as they are unique to each species (Fenton & Bell, 1981). However, call structure varies depending on habitat type and foraging mode (Schnitzler et al., 2003). Microchiropteran bats use echolocation to navigate through their environment and locate food (Schnitzler et al., 2003), whereas megachiropteran bats rely on their vision and do not echolocate. Thus, visual encounter surveys were used to detect megachiropteran bats.

Aquatic Surveys

Surveys were conducted along freshwater streams within the project area. One nocturnal survey and 1 diurnal survey were conducted at all 6 points, focusing on freshwater fishes, decapod crustaceans, and molluscs such as gastropods and bivalves. 10-minute point count surveys were conducted at points along any streams or ponds. Surveys relied on visual detection as well as hand-netting. In addition, baited cage traps were deployed for fishes and decapod crustaceans.

Baited traps were left on-site for at least 12 hours before retrieval. A portion of the traps remained above the water surface to reduce the risk of drowning of air-breathing species. All aquatic fauna caught by hand netting or baited traps were sorted, photographed, and identified to species or family level where possible, before being released. The survey locations are indicated in Figure 4.15.



Figure 4.15. Locations of aquatic surveys within project study area



Figure 4.16 Example of aquatic survey at Stream 3

4.5.2 Survey Results

The complete list of fauna sightings and photographs of observed animals can be found respectively in **Appendix C** and **Appendix D**.

Birds

The current surveys yielded 72 species of birds within the project site, of which 11 are locally threatened and 4 are globally threatened or near threatened (refer to Table 4.8 for the list of species of conservation value and Figure 4.17 for the number of threatened bird species at each point count location). Together with the data from AECOM (2020), this brings the number of birds observed on the project site to at least 96. Locally Critically Endangered species include the plume-toed swiftlet (*Collocalia affinis*), Oriental pied hornbill (*Anthracoceros albirostris*), and buffy fish owl (*Ketupa ketupu*). Locally Endangered species include the blue-crowned hanging parrot (*Loriculus galgulus*), changeable hawk-eagle (*Nisaetus cirrhatus*), Oriental magpie-robin (*Copsychus saularis*), and straw-headed bulbul (*Pycnonotus zeylanicus*). The straw-headed bulbul is also listed as globally Critically Endangered.

Other globally threatened species include the Critically Endangered yellow-crested cockatoo (*Cacatua sulphurea*), as well as the Vulnerable long-tailed parakeet (*Psittacula longicauda*) and Javan myna (*Acridotheres javanicus*). The Javan myna and yellow-crested cockatoo are introduced species in Singapore, and not of significant conservation value in Singapore.

Table 4.8. List of all bird species of conservation value found in the project study area

No.	Species name	Common Name	Local Status	Global Status
1	*Ardea cinerea*	Grey Heron	VU	LC
2	*Nisaetus cirrhatus*	Changeable Hawk-Eagle	EN	LC
3	*Psittacula alexandri*	Red-breasted Parakeet	–	NT
4	*Psittacula longicauda*	Long-tailed Parakeet	–	VU
5	*Loriculus galgulus*	Blue-crowned Hanging Parrot	EN	LC
6	*Chrysococcyx xanthorhynchus*	Violet Cuckoo	EN	LC
7	*Collocalia affinis*	Plume-toed swiftlet	CR	LC
8	*Copsychus saularis*	Oriental Magpie-Robin	EN	LC
9	*Acridotheres javanicus*	Javan Myna	–	VU
10	*Gallus gallus*	Red Junglefowl	EN	LC
11	*Anthracoceros albirostris*	Oriental Pied Hornbill	CR	LC
12	*Ketupa ketupu*	Buffy Fish Owl	CR	LC
13	*Pycnonotus zeylanicus*	Straw-headed Bulbul	EN	CR
14	*Cacatua sulphurea*	Yellow-crested Cockatoo	–	CR
15	*Rallina fasciata*	Red-legged crake	VU	LC

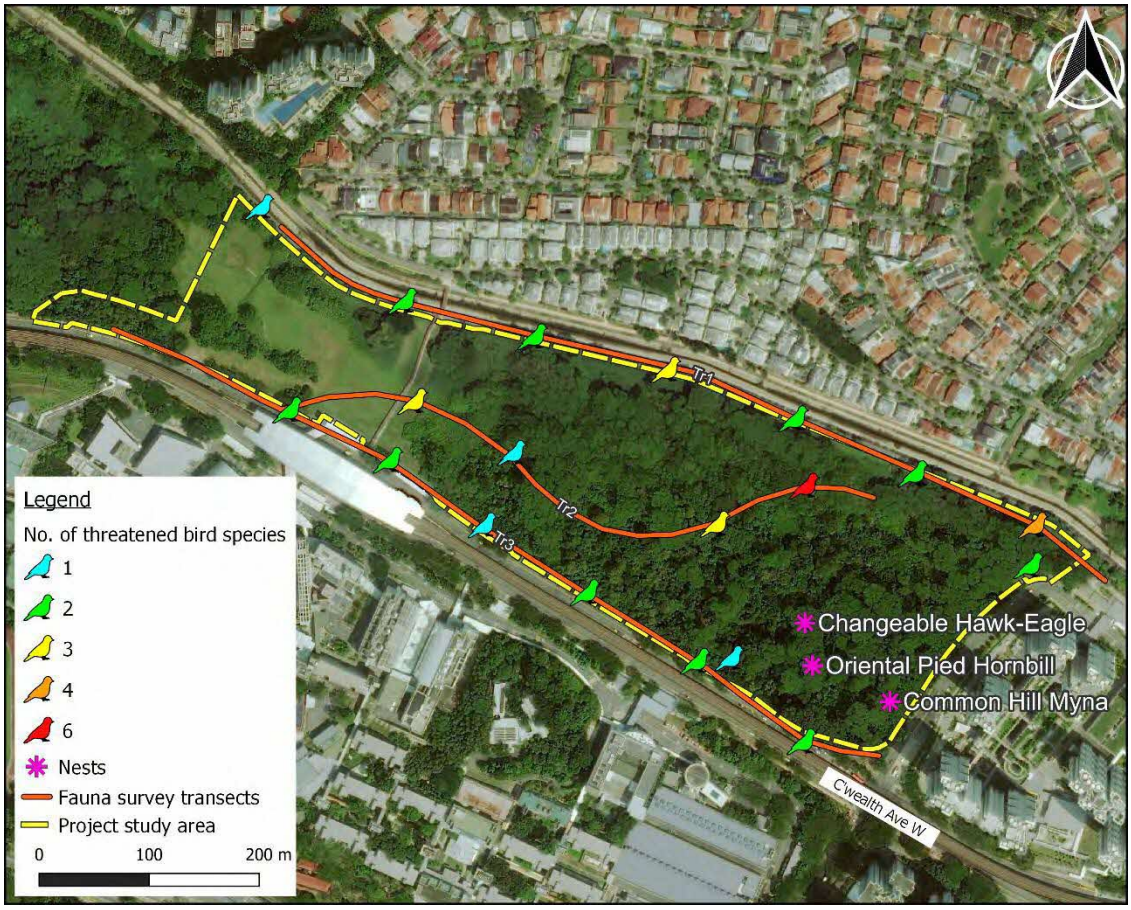


Figure 4.17. Distribution of number of threatened bird species and identified nests in project study area

The surveys overlapped with the end of the annual bird migration period, and as a result, several migratory birds were recorded within the site. These for instance included the Japanese sparrowhawk (*Accipiter gularis*), blue-winged pitta (*Pitta moluccensis*), and Arctic warbler (*Phylloscopus borealis*), which were observed in April 2022.



Figure 4.18. Japanese sparrowhawk (left) and a blue-winged pitta (right) in project study area

Several species observed within the site are birds often associated with relatively good quality forests. These include the straw-headed bulbul, the pin-striped tit babbler, the blue-crowned hanging parrot, and the olive-winged bulbul. The detection of these species on the project site could indicate the site's importance as habitat and foraging ground for such species.



Figure 4.19. Locally Endangered blue-crowned hanging parrot in project study area

The straw-headed bulbul is also a noteworthy species given its globally Critically Endangered status. While populations of straw-headed bulbuls on Singapore's mainland have been stable over the past few years, this species' numbers in the rest of Southeast Asia have been declining (Yong, et al., 2017). Singapore is an important stronghold of this species, and its habitat needs to be preserved for its continued persistence.

The survey period also coincided with active nesting of two bird species, the changeable hawk-eagle and the Oriental pied hornbill (*Anthracoceros albirostris*). Both species had built nests on Albizia (*Falcataria falcata*) trees, and juveniles were spotted on 22 April 2022. As of 17 May 2022, the young birds of both species seemed to have fledged. However, the changeable hawk eagle remained calling in its nest for several hours, indicating that it might still be dependent on its parents for food.



Figure 4.20. Picture of a juvenile changeable hawk-eagle at its nest within the project site, taken from the residential buildings along Ghim Moh Link.

The large number of Albizia trees within the project site provides suitable nesting sites for large birds, particularly raptors. Additionally, several cavities were seen in tree trunks, which would provide further potential nesting areas for cavity-nesting birds such as Oriental pied hornbills. As hornbills and raptors are known to sometimes reuse old nests (Poonswad, 1999; Gunawan & Noske, 2017), the presence of existing nests and cavities on this site is potentially important for threatened bird species such as the changeable hawk-eagle and Oriental pied hornbill.

Mammals

There are currently about 74 species of mammals extant in Singapore. A total of 4 non-volant and 6 volant mammals (i.e., bats) were encountered within the project site in the recent surveys. There were no long-tailed macaques and wild pigs observed during the survey period. All non-volant mammal species recorded from the site are common and widespread in Singapore, while one volant mammal species is of conservation significance (Table 4.9). These mammals were detected through bat acoustic surveys, walking transects, and camera trapping. Together with the data from previous survey (AECOM, 2020), the total number of mammal species observed on the project site is at least 11.

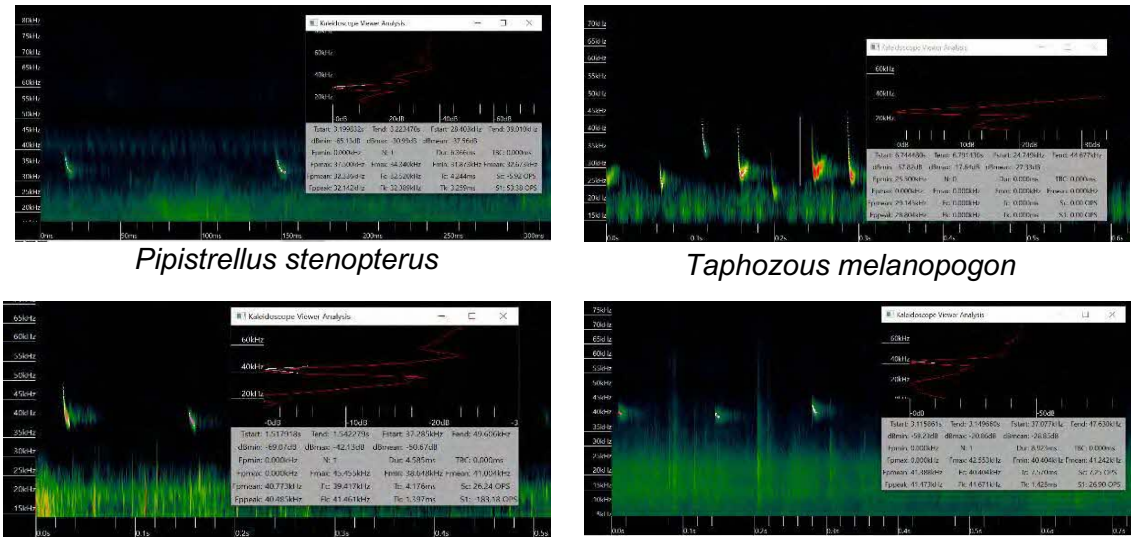
Table 4.9. List of mammal species of conservation value currently found in the project study area

No.	Species name	Common Name	Local Status	Global Status
1	*Taphozous longimanus*	Long-winged Tomb Bat	CR	LC

Singapore's bat species diversity is ambiguous. In an analysis of Singapore's bat fauna, Lane et al. (2006) concluded that 30 species of bats were documented in Singapore (six Megachiroptera and 24 Microchiroptera), with 10 species considered as having gone extinct. However, they inferred that prior to 1819 between 60 to 72 species occurred in Singapore (Lane et al., 2006). At the time of their publication, species diversity had declined to 20 (five Megachiroptera and 15 Microchiroptera), five fewer than what Baker and Lim (2012) had listed in their book. In the updated Singapore Red Data Book,

NParks (2021) lists Singapore's bat species richness at 31 (five Megachiroptera and 26 Microchiroptera). Two recently recorded species (long-winged tomb bat [*Taphozous longimanus*] and big-eared pipistrelle [*Hypsugo macrotis*]) represent new records for Singapore and are only known from Pulau Ubin (Yang, 2018).

Two nights of bat acoustic surveys were conducted, split between two nights covering set transects. Of the mammal species found on site, 7 of these species are bats. Acoustic sampling at study area resulted in 5 species, while the lesser dog-faced fruit bat (*Cynopterus brachyotis*) was recorded during nocturnal visual encounter surveys. One of the 5 species, the long-winged tomb bat, was interpreted tentatively based on peak call frequency (Nick Baker, pers. comms.). One bat species, the pouched tomb bat (*Saccolaimus saccolaimus*) was recorded by AECOM (2020). The spectrograms for the 4 confirmed bat species recorded during acoustic sampling are presented in Figure 4.21.



Pipistrellus stenopterus

Taphozous melanopogon

Myotis muricola

Scotophilus kuhlii

Figure 4.21. Spectrograms showing acoustic call characteristics of detected bat species

In general, the lesser Asian house bat (*Scotophilus kuhlii*) was the most common, found in all transects but most prevalent along the park connector. The black-bearded tomb bat (*Taphozous melanopogon*) was detected only along the forest transect. The transect by Commonwealth Ave West yielded few species, likely due to the constant noise generated by vehicles using the road.

The tentative recording of the long-winged tomb bat marks the only mammal species of conservation significance on the project site, detected only within the forest transect. This species was first described for Singapore in 2018 based on a single example caught in a mist net in Chek Jawa (Teo, 2018). As far as we know, the calls of this bat have not yet been studied in Singapore, however peak frequency of calls recorded at the project site are around 31.5 kHz, which is close to that described from Thailand i.e., 30.83 kHz (± 1.58) (Hughes et al., 2011).

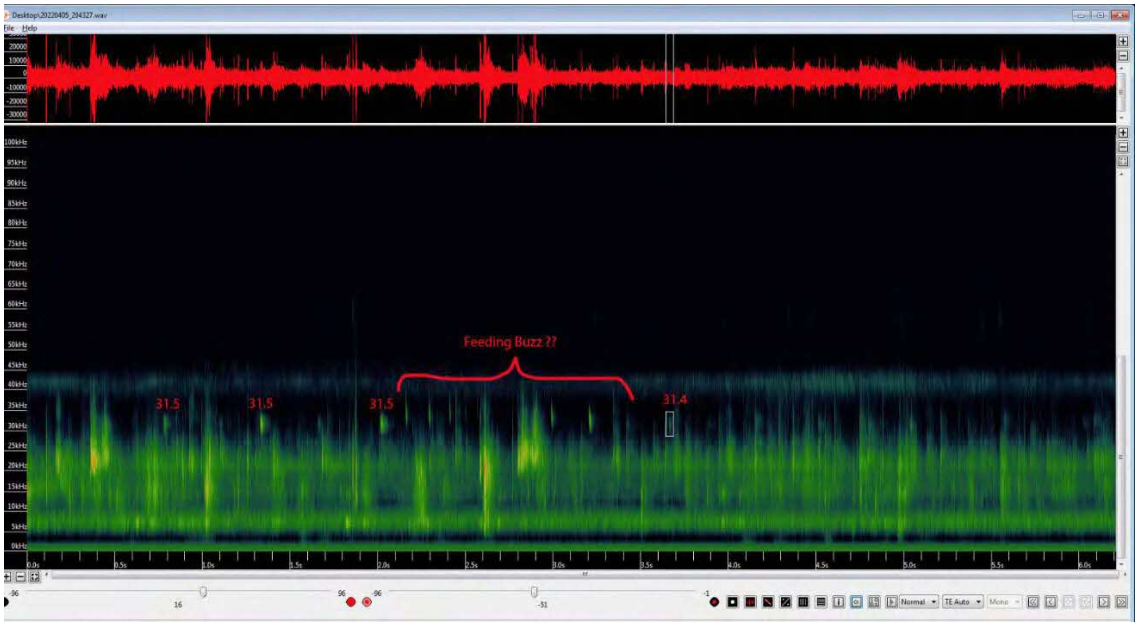


Figure 4.22 Interpretation of tentative recording of long-winged tomb bat (Source: Nick Baker).

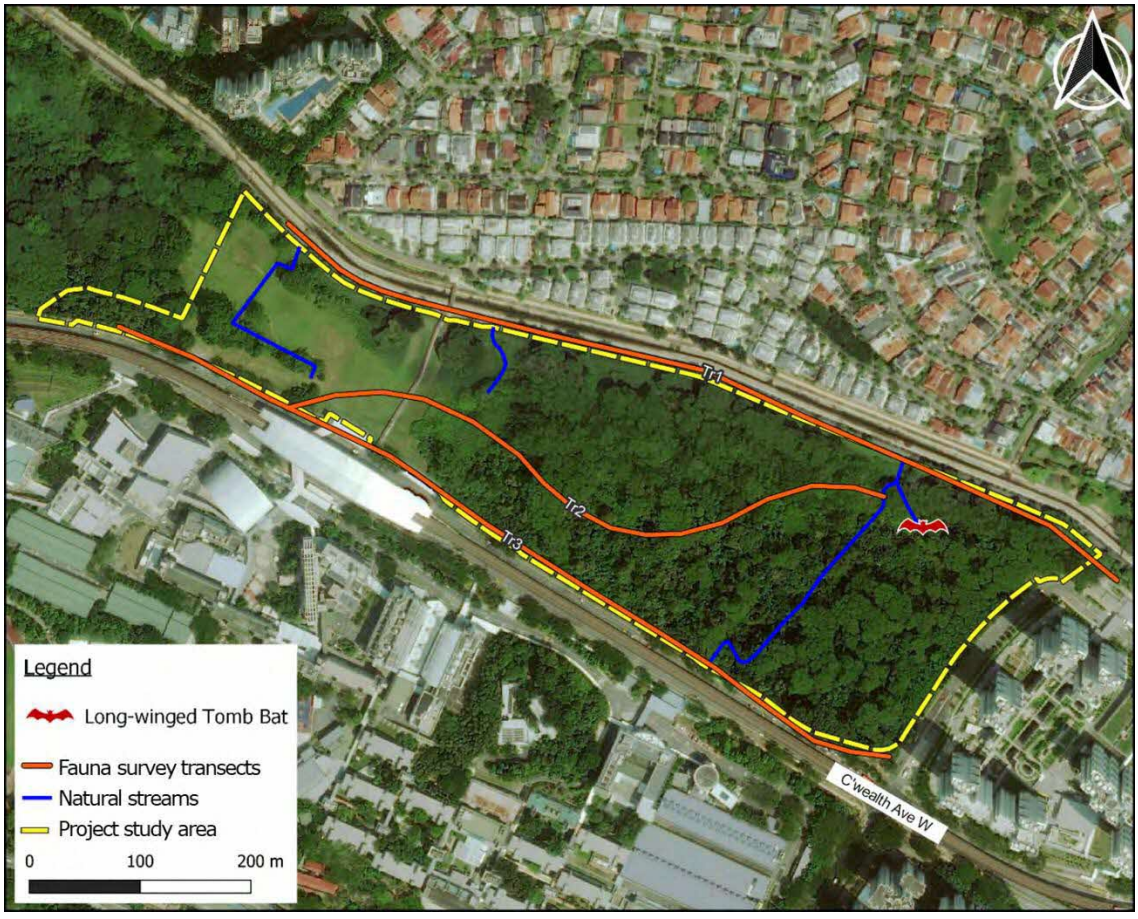


Figure 4.23. Location of mammal species of conservation value within project study area

While there were clumps of bamboo on the project site, no bamboo bat species (*Tylonycteris* spp.) were detected.

Reptiles

Singapore holds a relatively high diversity of reptiles, with at least 109 species being found in Singapore. A total of 13 reptile species were recorded on the project site during the present surveys. All the reptile species observed within the updated project site have either a local conservation status of Least Concern or were introduced species to Singapore. With additional data from AECOM (2020), the total number of reptiles observed on the project site is at least 15.

Previous surveys (AECOM, 2020) had detected the Asian softshell turtle (*Amyda cartilaginea*), but this was found in the Ulu Pandan Canal next to Ulu Pandan West, outside of this Environmental Study area. Hence the Asian softshell turtle was excluded from this analysis.

Other species are considered widespread and common except the green crested lizard (*Bronchocela cristatella*), which is widespread but uncommon in Singapore. Three species, the changeable lizard (*Calotes versicolor*) and Brooke's house gecko (*Hemidactylus brookii*), and brown anole (*Anolis sagrei*), are introduced species in Singapore.

It is likely that the number of reptile species observed on the site is under-represented due to the nature of most reptile species. Reptiles are generally elusive and are not observed frequently in surveys.

Amphibians

There are currently 30 species of amphibians known from Singapore. However, the diversity of amphibian species present is largely dependent on the quality and variability of habitats, particularly waterbodies and streams, present in the site. This is especially because amphibians depend on aquatic habitats for their survival during the juvenile stage.

During the present surveys 10 amphibian species were found on the project site during the recent surveys. All the species observed were not listed as locally or globally threatened. Only the Malayan giant frog (*Limnonectes blythii*) is considered Near-Threatened globally. This species is found in many natural streams in Singapore. Together with the data from AECOM (2020), this brings the number of amphibians observed on the project site to at least 12.



Figure 4.24 Malayan giant frog found near Stream 1 in the project site.

Three of the species recorded have been introduced to Singapore: the greenhouse frog (*Eleutherodactylus planirostris*), banded bullfrog (*Kaloula pulchra*), and Mukhlesur's narrow-mouthed frog (*Microhyla mukhlesuri*). The Gunther's frog (*Sylvirana guentheri*), which was detected in previous surveys, was not detected during the recent surveys. The greenhouse frog is a recent introduction to Singapore. Originating from Cuba, the Cayman Islands, and Northern Bahamas, the greenhouse frog is an introduced species that was first detected in Singapore at Sembawang (Groenewoud & Law, 2016). As this species is a direct developer, it does not go through the tadpole stage and hatches into small frogs from eggs laid in moist leaf axils or leaf litter (Kraus & Campbell, 2002). It was likely introduced to Singapore through the horticultural trade.

The low diversity of amphibians on this site, particularly of rare or threatened species, was expected. Given the specific requirements for waterbodies that many species have, amphibians of conservation value in mainland Singapore are restricted to the mature forests of the Central Nature Reserves and its surrounding areas.

Calderon et al. (2019) reported that species richness and abundance of amphibians were negatively correlated with phosphate and nitrate concentrations, and positively correlated with electrical conductivity and dissolved oxygen. Species richness was also affected negatively by turbidity (Calderon et al., 2019). Given the relatively low dissolved oxygen (DO) and slightly acidic natural streams (Table 5-9 and Table 5-10), those factors are likely to contribute to lower amphibian diversity.

Terrestrial Invertebrates

Butterflies

Singapore is home to about 338 species of butterflies. At least 24 butterfly species were recorded within the project site during the present surveys, all of which were either

Common or Moderately Common. The previous surveys by AECOM (2020) also detected the moderately rare Saturn (*Zeuxidia amethystus amethystus*). Including data from AECOM (2020), the total number of butterflies observed on the site amounts to at least 34.

Table 4.10. List of butterfly species of conservation value within project study area

No.	Species name	Common Name	Local Status (*Butterflies of Singapore*, 2nd ed)
1	*Zeuxidia amethystus amethystus*	Saturn	Moderately Rare

Odonates

At least 133 species of odonates are currently known from Singapore. Of these, 14 odonates (dragonflies and damselflies) were found within the project site during the present surveys. None the odonates detected are listed as Vulnerable or above. Together with the data from AECOM (2020), the number of odonates observed on the project site is at least 21.

In Singapore, all species of odonates that are no longer found here had faced extirpation due to the loss of key forest habitats they dependent on for their survival (Tang et al., 2010). Much like amphibians, odonates are dependent on waterbodies for survival during their juvenile stage, and their diversity in each site is determined by the quality and variety of waterbodies present.

Based on the current surface water quality sampling (Table 5-9 and Table 5-10), most of the parameters including temperature, pH, total Nitrogen, total Phosphorous, and conductivity all lie within the allowable limits as listed by NEA (2020). However, the concentrations of dissolved oxygen in Streams 1 and 2 are lower than the threshold limits, and the measurement for total suspended solids in Stream 2 is exceedingly past the limit. These conditions might make it less favourable for odonates to thrive in. The presence of odonates in these streams despite the conditions suggests that water quality may not be the main controlling factor of odonates presence. Tippler et al. (2018) concluded that the presence of odonates nymphs is generally controlled by the riparian habitat as a whole rather than the water quality itself.

Aquatic Fauna

10 aquatic fauna species were detected in the project study area during these surveys, covering 6 freshwater fish species and 4 molluscs. Together with the AECOM (2020) data, 14 aquatic fauna species are known in the study area.

Table 4.11. Recorded aquatic fauna composition in the streams within current project study area

Species Name	Common Name	Stream 1	Stream 2	Stream 3
Freshwater Fish				
Poecilia sphenops	Green Molly			Y
Poecilia reticulata	Guppy	Y		Y
Xiphophorus maculatus	Southern Platy	Y		
Gambusia affinis	Mosquitofish	Y		Y
Cichlasoma urophthalmum	Mayan Cichlid	Y		

Species Name	Common Name	Stream 1	Stream 2	Stream 3
Monopterus javanensis	Sunda Swamp-eel	Y		Y
Molluscs				
Physa acuta	Acute bladder snail	Y		
Melanoides tuberculata	Malayan Trumpet Snail	Y		Y
Pila scutata	Apple Snail	Y		
Radix rubiginosa	Pond Snail	Y		Y
	Total	**9**	**0**	**6**

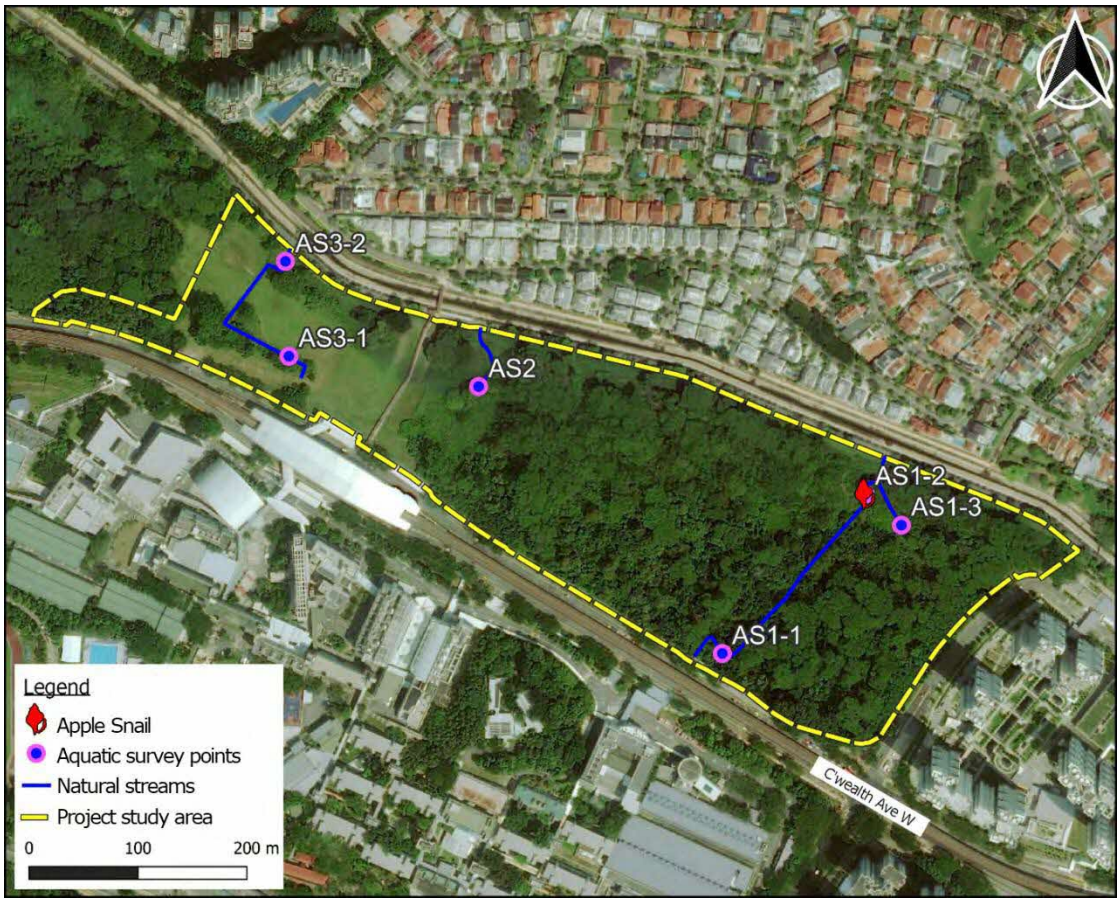


Figure 4.25. Location of aquatic fauna species of conservation value within project study area

The apple snail (*Pila scutata*) is the only species of conservation status found during the surveys, in or along Stream 1. While once common and widespread in Singapore, is now considered locally rare (Tan et al., 2013). However, their numbers have been reduced for several reasons, including the introduction of the non-native snail *Pomacea canaliculata*.

The previous baseline study also recorded the Mozambique Tilapia (*Oreochromis mossambicus*). However, the coordinates for this aquatic fish were not reported and hence is not shown in the map. While this species does not have a local conservation status, it is considered globally Vulnerable.

Overall, Stream 1 recorded the highest diversity of aquatic fauna, followed by Stream 3. No aquatic fauna was recorded at Stream 2. Streams 1 and 3 were observed to have a continuous flow of water while Stream 2 was often found to be stagnant or slow-moving.



Figure 4.26. From left to right: Pictures of a Sunda swamp-eel (*Monopterus javanensis*), bottom and top of an apple snail (*Pila scutata*)

The water quality of Streams 1 and 3 generally fall within Singapore's standards (National Environment Agency, 2020). While there are standards for water quality per se, there are no strict water quality standards for biodiversity. Therefore, multiple sources were used to better understand how aquatic fauna might be affected by water quality (Ministry of Natural Resources and Environment of Vietnam, 2011; Agriculture and Resource Management Council of Australia and New Zealand, 2000). While Stream 1 recorded low dissolved oxygen concentrations downstream, the values are relatively close to the threshold and the aquatic fauna might have been able to tolerate it. This concentration also increases during wet weather. There was a variety of wildlife found within Stream 1, but these species are known to be tolerant to disturbed habitat. The native Sunda swamp-eel is widespread in Singapore, found in different waterbodies including canals, and needs to breathe atmospheric air for survival (Baker & Lim, 2012). The apple snail (*Pila Scutata*), while rare in Singapore, is also tolerant of disturbed environments, and was known to exist in many ditches and ponds around Singapore (Tan et al., 2013).

Stream 2 recorded 146 and 357 mg/L of total suspended solids during dry and wet weather respectively (Table 5-9 and Table 5-10). These are extremely high values compared to the threshold limit of 50 mg/L (National Environment Agency, 2020). In addition, Stream 2 also had low dissolved oxygen concentrations of 0.99 and 3.22 mg/L during dry and wet weather respectively. This is lower than the threshold limit of at least 4 mg/L (National Environment Agency, 2020). The high amount of total suspended solids and low concentration of dissolved oxygen might have made Stream 2 an unsuitable habitat for aquatic fauna, thus explaining their absence.

Camera Trapping

Six camera traps were deployed for a total of 29 nights, between 31 March and 29 April 2022. As the camera traps took a sequence of 3 photos and a 10-second video each time they were triggered, the photos were grouped according to respective sequences. Sequences separated by more than 60 s were assumed to be independent sightings.

A total of 331 independent sightings (Table 4.12) identified from 1418 photos of 17 identified fauna species were collected from the camera traps. For every camera trap, each independent sighting was categorised into their respective taxonomic groups and

summarised in Figure 4.25 below.

Bird sightings dominated the detections in Camera 1, of which 121 out of the 152 bird sightings were the spotted dove (*Spilopelia chinensis*). On the other hand, majority of the detections in Cameras 3, 4, and 5 were comprised of mammal sightings. The most frequently recorded species here is the plantain squirrel (*Callosciurus notatus*). There were 110 independent sightings of the plantain squirrel across all the camera traps. As for Cameras 2 and 6, there were very few (<10) independent sightings each.

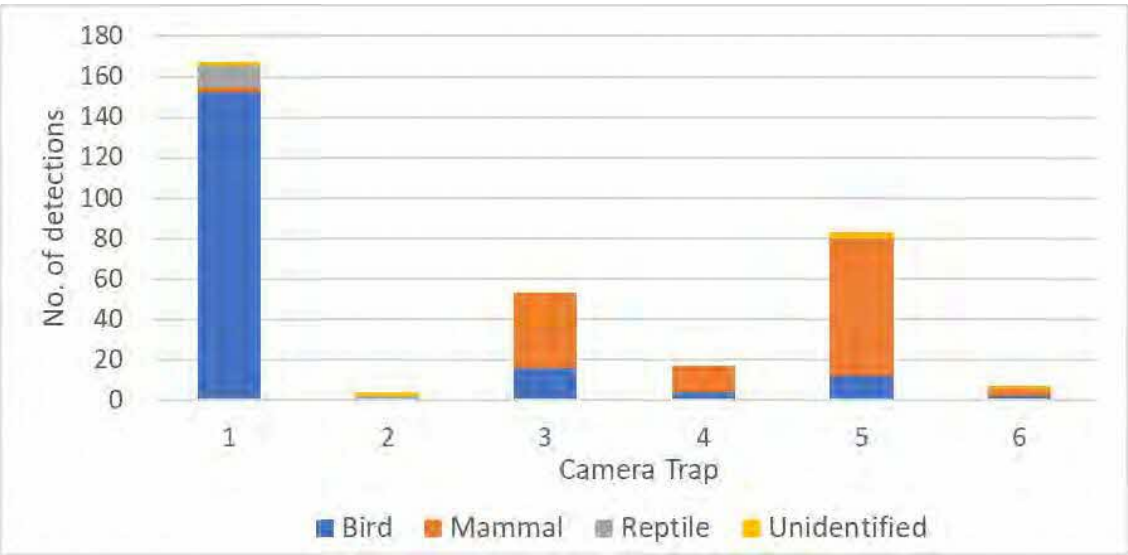


Figure 4.27. Number of detections based on taxonomic groups from each camera

Table 4.12. Number of sightings from each camera by species (*=locally threatened species)

Species	Cam 1	Cam 2	Cam 3	Cam 4	Cam 5	Cam 6
Banded woodpecker	0	0	0	0	1	0
Black-naped oriole	0	0	0	0	1	0
Black-throated laughingthrush	1	0	13	0	5	0
Common emerald dove	2	0	0	0	0	0
Common palm civet	0	0	0	0	1	0
Common Malayan treeshrew	0	0	0	0	1	4
Javan myna	0	0	1	0	0	0
Laced woodpecker	6	0	0	0	4	0
Malayan water monitor	10	1	0	0	0	0
Plantain squirrel	3	1	31	12	63	0
Red junglefowl*	1	0	0	0	1	0
Red-legged crake*	5	0	0	0	0	0
Spotted dove	121	0	0	0	0	0
Von Schrenck's bittern	1	0	0	0	0	0
White-breasted waterhen	1	0	0	0	0	1
White-crested laughingthrush	11	0	2	4	0	0
White-throated kingfisher	0	0	0	0	0	1
Unidentified animal	2	2	0	0	3	1

Species	Cam 1	Cam 2	Cam 3	Cam 4	Cam 5	Cam 6
Unidentified bird	3	0	0	0	0	0
Unidentified rodent	0	0	6	1	3	0
Total Number of Detections	**167**	**4**	**53**	**17**	**83**	**7**
Total Number of Identified Species	**11**	**2**	**4**	**2**	**8**	**3**

Interesting bird sightings from the camera traps include the red junglefowl and the red-legged crake (*Rallina fasciata*), which are listed as locally Endangered and locally Vulnerable respectively (Davison et al., 2008). The red-legged crake is an uncommon resident breeder and a winter migrant (Davison et al., 2008). It typically forages in riparian wet areas in secondary forests (Wang & Hails, 2007), which explains why it was only spotted in one of the camera traps, Camera 1, which was located next to a natural stream. Another migratory species found is the Von Schrenck's bittern (*Ixobrychus eurhythmus*), a rare migrant in Singapore (Davison et al., 2008).



Figure 4.28. Picture of a red-legged crake (*Rallina fasciata*), a locally Vulnerable species, captured by a camera trap



Figure 4.29. Picture of a migratory species, Von Schrenck's bittern (*Ixobrychus eurhythmus*), captured by a camera trap

During night-time, the camera traps typically recorded rodents (*Rattus* spp.) and a common palm civet (*Paradoxurus musangus*). The common palm civet is a native species that is mainly found in trees and nocturnal in nature (Baker & Lim, 2012).



Figure 4.30. Picture of a common palm civet (*Paradoxurus musangus*), a native species, captured by a camera trap

There were also sightings of the black-throated laughingthrush (*Pterorhinus chinensis*), a species not endemic to Singapore (BirdLife International, 2022).



Figure 4.31. Picture of two black-throated laughingthrushes (*Pterorhinus chinensis*), an introduced species, captured by a camera trap

The composition of species listed in Table 4-12 is plotted in Figure 4.30. Descriptions of the environmental setting of each camera trap have been included. Overall, camera traps in forested areas installed adjacent to a stream recorded a more species than the camera traps located in non-forested areas and those not adjacent to any streams.

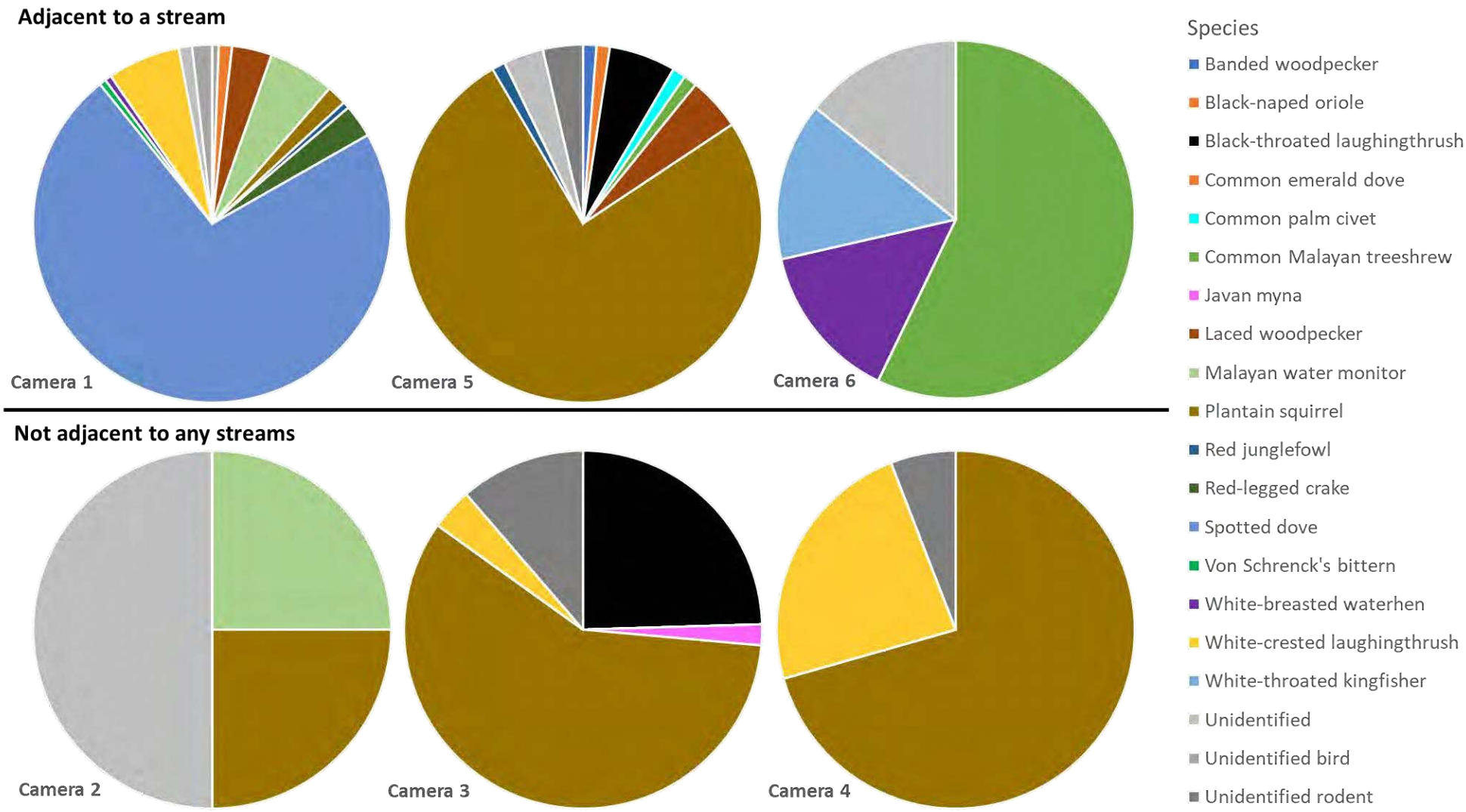


Figure 4.32. Composition of species from each camera trap

Summary of Species of Conservation Significance

In summary, 13 fauna species of local conservation value (defined as Vulnerable / VU and above) were found in this current survey. These include 11 bird species, one mammal and one mollusc species. Based on Tan et al. (2013), we have considered the apple snail (*Pila scutata*) as having conservation significance based on its rarity. All the reptiles, amphibians, butterflies, and odonates found in the current survey were either listed as Near Threatened or below or had no assessed conservation status. Together with an additional six species that were found from AECOM (2020) (five bird and one butterfly species), a total of 19 fauna species of local conservation significance are known in the current project site.

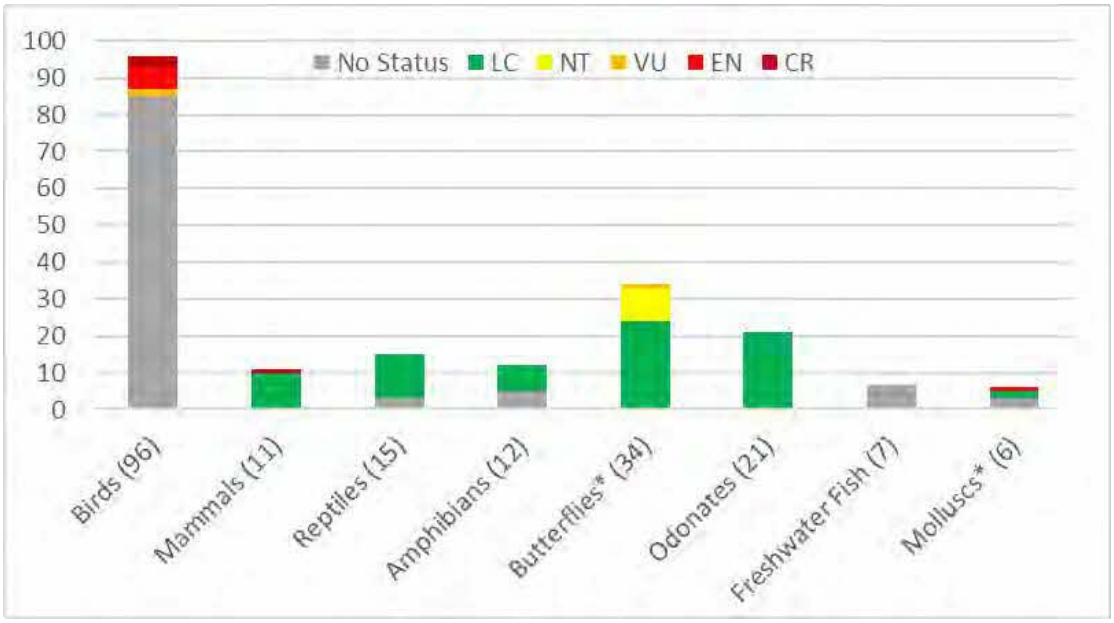


Figure 4.33. Local conservation status overview of species recorded within project study area
*For butterflies and molluscs, LC represents “Common”, NT “Moderately Common”, VU “Moderately Rare”, and EN “Rare”.

The surveys also recorded five bird species of global conservation significance (defined as Vulnerable / VU and above) based on the IUCN Red List (2020). All the mammals, reptiles, amphibians, butterflies, odonates, and aquatic fauna found in the current survey were either listed as Near Threatened or below or had no assessed conservation status. With one additional bird species and one freshwater fish species from AECOM (2020), a total of seven fauna species of global conservation significance are known in the overall area. In summary, seven fauna species of global conservation significance are known in the current project site. Fauna not identified to species level have been excluded from this analysis.

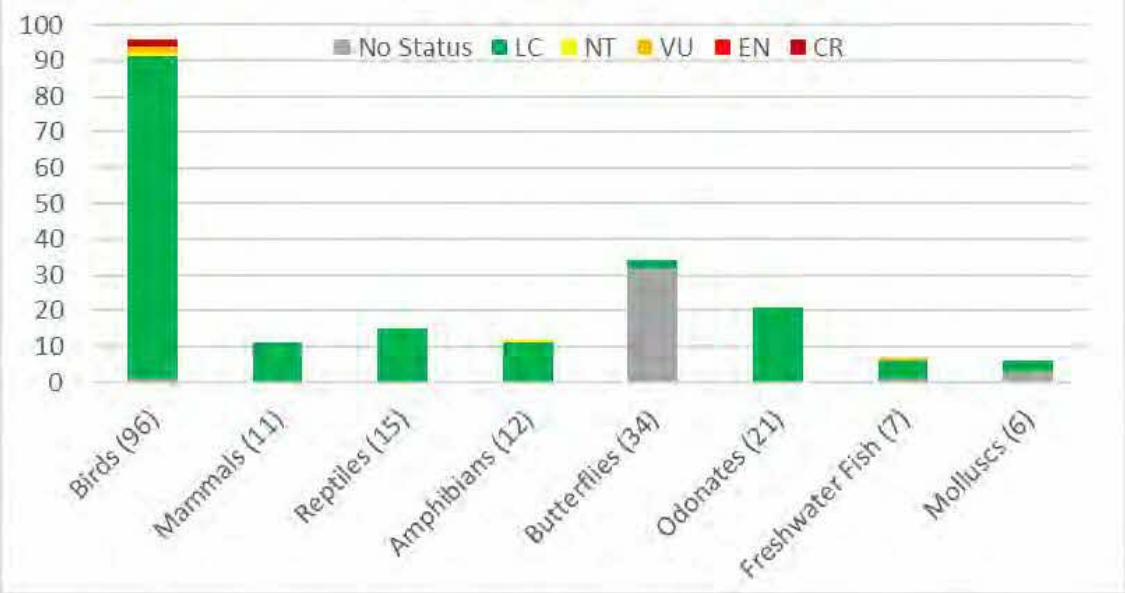


Figure 4.34. Global conservation status overview of species recorded within project study area

Overall locations of species of conservation values, both local and global, in relation to habitat types found in the project study area are presented in Figure 4.35.

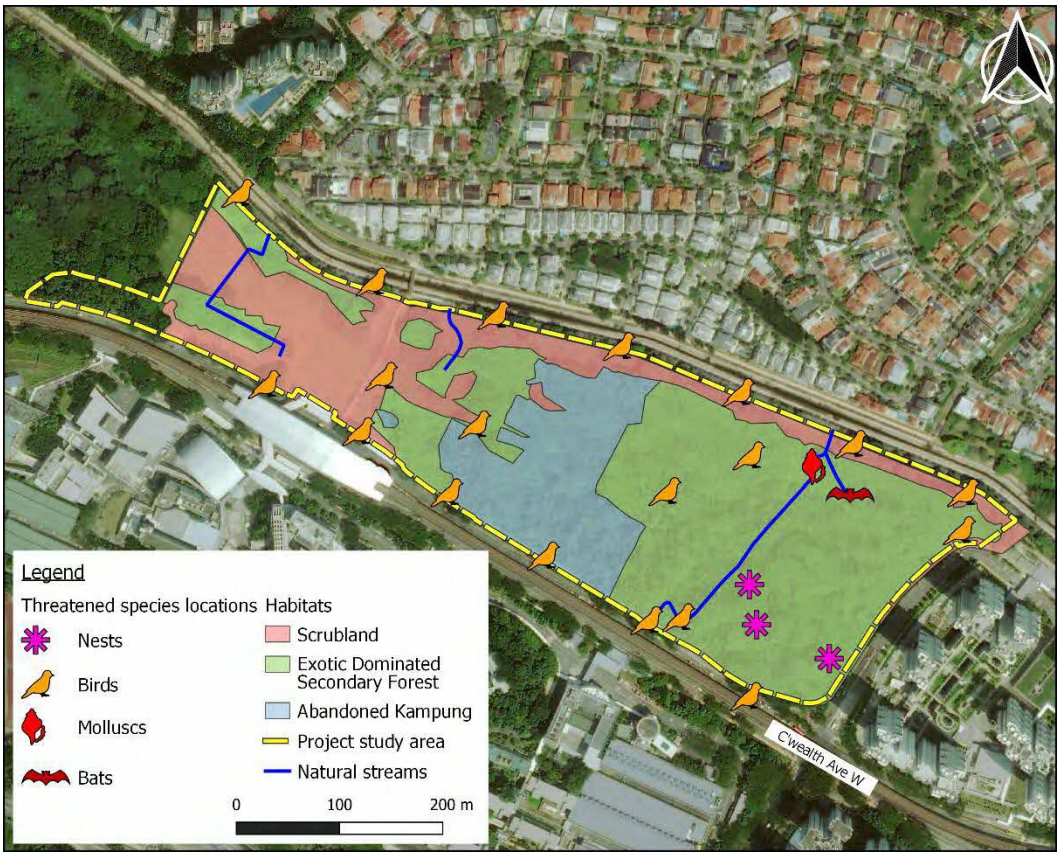


Figure 4.35. Location of species of local and global conservation value vis-à-vis habitat types

Most species of conservation value detected consists of bird species. This is likely due to the land use history of the site, where forest was cleared for multiple purposes through

the 20th century. Without direct connection to intact forest habitats, there is limited opportunity for the movement of rare or threatened terrestrial animals into the site.

However, there are several bird species of conservation value recorded from the site. These threatened species are forest-associated birds, and their presence in the site reflects its importance as refuge and habitat to such species. The presence of forest species and migratory birds also demonstrates the importance of this site as a stepping-stone to other forested parts of Singapore.

Large-scale deforestation has resulted in a loss of much of Singapore's forested areas (Corlett, 1992), and the remaining forests, such as the forests surrounding the project site, are important for continued protection of rare and threatened species in Singapore.

4.5.3 Summary of Flora and Fauna Baseline Results

The current study and past baseline study (AECOM, 2020) observed a total of at least 193 flora species and 202 fauna species (birds, mammals, reptiles, amphibians, butterflies, odonates, freshwater fish, and molluscs) within the project study area.

Overall, exotic-dominated secondary forest is the most common habitat type within the project study area. Scrubland is another relatively common habitat type, located close to the pedestrian linkway between Dover MRT Station and Holland Grove Drive. Patches of abandoned kampong can be found in between the Exotic-dominated secondary forest and Scrubland.

In terms of flora, Ulu Pandan East has relatively limited native flora diversity and limited occurrence of flora of conservation significance, likely due to the lack of connectivity to native flora germplasm sources. However, the clearance of study area will still affect a total of 11 Vulnerable, five Endangered and five Critically Endangered and one Data Deficient native flora species. In particular, areas of high conservation value include the areas around the critically endangered bamboo *Gigantochloa ligulata* and endangered *Ficus virens*. There are also areas with other conservation significant flora species such as *Horsfieldia polyspherula*, *Jasminum elongatum* and *Melicope lunu-ankenda*, which are species of conservation significance with few known localities in the west of Singapore.

The bamboo *Gigantochloa ligulata* is a notable finding as it was not recorded in the previous baseline study or other past studies. Other species of conservation significance include the *Ficus virens*, *Horsfieldia polyspherula*, *Jasminum elongatum* and *Melicope lunu-ankenda*, which have few known localities at west of Singapore.

In terms of fauna, this area consists of several threatened species across taxonomic groups, including the straw-headed bulbul (*Pyc nonotus zeylanicus*), the buffy fish owl (*Ketupa ketupu*), and the locally rare apple snail (*Pila scutata*). Many of these threatened species depend on specific habitat requirements for their continued survival. The forest provides suitable condition for birds to nest, such as the locally Endangered changeable hawk-eagle (*Nisaetus cirrhatus*) and locally Critically Endangered Oriental pied hornbill (*Anthracoceros albirostris*). The latter's nesting requires tall, large trees with wide

enough cavity (Ng et al., 2011). Both species were found to be currently nesting in study area.

Running through these habitats are three forested freshwater streams that provide vital habitats for aquatic fauna, such as the locally rare apple snail (*Pila scutata*) and the native Sunda swamp-eel (*Monopterus javanensis*). The Asian softshell turtle (*Amyda cartilaginea*) was previously recorded in the Ulu Pandan Canal next to the Ulu Pandan West, which is outside the current study area. It was not detected in Ulu Pandan East (current study area).

Comparing records in Ulu Pandan East from the previous and current studies, the current study recorded 44 new fauna species and 171 new flora species. Of the 171 new flora species, 116 species were not found in both Ulu Pandan East and Ulu Pandan West in the previous study.

The higher number of flora species could be attributed to the different methodology employed in the current study which focused on Ulu Pandan East. The previous study looked at line transects while the current study made use of MGPs which covered a larger percentage of land area in Ulu Pandan East. In addition, the plot design required frequent traversing within forested area while travelling to different subplots and quadrats (as compared to line transects where the surveyor might enter and exit the forest at the ends of the line transect), thus resulting in high ground track coverage with more chance of opportunistic flora records. The MGP method also required records of herbaceous flora in quadrats, while in past it was not mandatory. Overall, a combination of these factors led to higher number of flora species.

As for fauna species, the differences in species recorded are not unexpected as surveys typically do not record all the species present. While there are some differences in species, the species recorded in both studies are generally associated with the same types of habitats.

In general, due to this site's land use history and its relative distance from other natural areas, there is a relatively low diversity of native flora and fauna species in the site, with a high number of introduced species. However, the presence of Albizia trees and tree cavities, as well as stream habitats, provide habitat and nest sites for several threatened species across different taxonomic groups. Additionally, the presence of migratory bird species found on the site illustrates its role as a stepping-stone for bird migration.

4.6 Impact Assessment

The proposed development includes earthworks and infrastructure works within a vegetated area. The area within the project footprint will be hoarded. Within the hoarding, the understorey vegetation will be cleared and the trees on the site will be felled. After which, earthworks to level the site will be conducted, and infrastructure, including sewer pipelines and drains, will be constructed.

There are currently three streams running through the site. Stream 1 will be retained as parkland, along with a buffer of vegetation on each side of the stream. Stream 2 will be backfilled while Stream 3 will be channelled into a concrete bank.

4.6.1 Identification of Sources of Potential Impacts

The pre-construction, construction, and post-construction phases of the project may have impacts on the natural environment. The main activity that may impact the sensitive biodiversity receptors is vegetation clearance, which may result in species mortality (for both flora and fauna) and habitat loss (mainly for fauna). Earthworks to level the existing terrain will also result in species mortality and habitat loss. Sources of impacts during the different phases of the project are identified as the following:

Pre-construction / Construction Phase

- Vegetation clearance for site access, storage of equipment, setting up of temporary hoarding, and other forms of working space (temporary)
- Vegetation clearance for soil investigation works (temporary)
- Vegetation clearance and damage to habitats due to earthworks and construction of infrastructure (permanent)
- Earthworks (backfilling/excavation) (permanent)
- Heavy construction activities such as piling (temporary)
- Vibration and noise from pipe jacking (temporary)
- Generation of light and noise (temporary)
- Surface runoff into streams on the project site (temporary)

Post-construction Phase

- Loss of habitats from development (permanent)
- Increased light and noise due to increased human activity (permanent)

It is important to note that this Environmental Study is meant to address impacts from the earthworks and infrastructure works phase of the development and are not meant to address the building construction phase of the development. We recommend that the impacts from the building construction phase of this project are assessed separately.

4.6.2 Identification of Potential Impacts

This section summarises the potential impacts affecting biodiversity receptors that may take place during the pre-construction, construction, and post-construction phases.

Pre-construction / Construction Phase

The project involves the clearfelling of a patch of forested area, which will result in direct impacts to the species and habitats present within the area. The following section details these impacts.

Species Disturbance and Mortality

For the purpose of impact assessment, focus is given to species that are either rare or

globally/locally threatened according to the local and international databases. Section 4.4 and 4.5 discussed the composition of flora and fauna on the project site. The project site contains several species of conservation value, both flora and fauna. The impact of species mortality and disturbance will be direct and occur where vegetation needs to be cleared within working boundaries.

In particular, several rare or threatened bird species can be found on this site. Oriental pied hornbills and changeable hawk eagles were also observed to be nesting in the project area, but have since fledged. As these species tend to reuse the site, they will be particularly vulnerable if they are nesting and will be impacted if schedules of vegetation clearance do not consider the possibility of nesting birds.

Additionally, fauna species, particularly reptiles and amphibians, may become entrapped when navigating through the worksite, especially by getting stuck in ECM blankets or falling into pits.

The impact of species mortality will be direct, and most prominent within the project footprint, where 15.5 ha of vegetated area will be cleared for the earthworks. Approximately 1366 surveyed trees are likely to be affected by the construction, with 22 flora species of conservation value found within the development area (Table 4.13). More trees are expected to be affected as many trees fall outside the Modified Gentry Plots boundary and ad-hoc site clearance to accommodate various construction needs including but not limited to construction footprints, equipment storage, staging grounds, soil-levelling works, other ad-hoc site issues, etc. Should hoarding be improperly erected, more trees and vegetation may be affected outside the working area.

Table 4.13. List of locally threatened flora species in the project area

No.	Species Name	Common Name	Local Conservation Status[1]
1	*Ardisia elliptica*	Sea-shore Ardisia	Endangered
2	*Baccaurea motleyana*	Rambai	Critically Endangered
3	*Breynia androgyna*	Cekur Manis	Vulnerable
4	*Bridelia stipularis*	Kenidai	Vulnerable
5	*Cyperus brevifolius*	Shortleaf Spikesedge, Green Kyllinga	Vulnerable
6	*Cyperus* cf. *compressus*	Poorland Flatsedge	Vulnerable
7	*Cyrtococcum accrescens*	–	Vulnerable
8	*Cyrtococcum patens*	Bowgrass	Vulnerable
9	*Dimocarpus lichi*	Mata Kucing, Isau, Sau, Kakus	Data Deficient
10	*Elaeocarpus ferrugineus*	Rusty Oil Fruit	Vulnerable
11	*Ficus virens*	Grey Fig, Spotted Fig	Endangered
12	*Geophila herbacea*	Snake Pennywort	Endangered
13	*Gigantochloa ligulata*	–	Critically Endangered
14	*Glochidion zeylanicum* var. *zeylanicum*	–	Vulnerable
15	*Gnetum gnemon*	Belinjau	Critically Endangered
16	*Horsfieldia* cf. *polyspherula*	–	Vulnerable

No.	Species Name	Common Name	Local Conservation Status[1]
17	*Jasminum elongatum*	Common Malayan Jasmine	Endangered
18	*Macaranga griffithiana*	Mahang Bulan, Mahang Tutup	Vulnerable
19	*Melicope lunu-ankenda*	Tenggek Burong	Critically Endangered
20	*Millettia pinnata*	Seashore Mempari, Indian Beech	Endangered
21	*Oxyceros longiflorus*	Akar Berdara Laut	Vulnerable
22	*Sterculia parviflora*	Common sterculia	Critically Endangered

[1] (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)

Despite the project footprint occurring largely within exotic-dominated secondary forest and scrubland, mortality of plants of conservation value is still of concern. In particular, this forest is a new locality for Critically Endangered *Gigantochloa ligulata*, and one of the few known localities of *Melicope lunu-ankenda*, *Jasminum elongatum* and *Horsfieldia polyspherula* in the west of Singapore. Clearance of this forest without mitigations will contribute directly to population decline of these threatened species.

The project site contains several fauna species of conservation value (see Table 4.14). Significance should be placed on non-volant animals of conservation value.

Table 4.14. List of threatened fauna species in the project area

No.	Species name	Common Name	Local Status	Global Status
1	*Ardea cinerea*	Grey Heron	VU	LC
2	*Nisaetus cirrhatus*	Changeable Hawk-Eagle	EN	LC
3	*Psittacula alexandri*	Red-breasted Parakeet	–	NT
4	*Psittacula longicauda*	Long-tailed Parakeet	–	VU
5	*Loriculus galgulus*	Blue-crowned Hanging Parrot	EN	LC
6	*Chrysococcyx xanthorhynchus*	Violet Cuckoo	EN	LC
7	*Collocalia affinis*	Plume-toed swiftlet	CR	LC
8	*Copsychus saularis*	Oriental Magpie-Robin	EN	LC
9	*Acridotheres javanicus*	Javan Myna	–	VU
10	*Gallus gallus*	Red Junglefowl	EN	LC
11	*Anthracoceros albirostris*	Oriental Pied Hornbill	CR	LC
12	*Ketupa ketupu*	Buffy Fish Owl	CR	LC
13	*Pycnonotus zeylanicus*	Straw-headed Bulbul	EN	CR
14	*Cacatua sulphurea*	Yellow-crested Cockatoo	–	CR
15	*Rallina fasciata*	Red-legged crake	VU	LC
16	*Taphozous longimanus*	Long-winged Tomb Bat	CR	LC
17	*Zeuxidia amethystus amethystus*	Saturn	Moderately Rare	
18	*Oreochromis mossambicus*	Mozambique Tilapia	–	VU
19	*Pila scutata*	Apple Snail	Rare	LC

Most species of conservation value found on the project site are volant (able to fly). These include several bird species such as the endangered straw-headed bulbul and

changeable hawk eagle, and the Saturn butterfly. Given these species capability to fly, they are likely able to use other similar habitat in the area, including the forested patch on the west of Ulu Pandan and Holland Woods. However, with rapid developments in Singapore in recent years, the number of suitable habitats for such species are decreasing, and few studies have been done to show the carrying capacity of remaining patches of habitat for fauna species. Additionally, some of these bird species are particularly vulnerable while they are nesting and will be impacted if schedules of vegetation clearance do not consider the possibility of nesting birds.

Of the non-volant species, the only species of conservation significance is the locally rare *Pila scutata*. Several individuals of this snail were sighted within Stream 1. are plans to retain Stream 1 as part of a patch of parkland. Stream 1 was identified to be of highest conservation value amongst the three streams. The retention of Stream 1, along with a vegetated buffer, will minimise any direct impacts to the population of apple snails and other aquatic species found in the stream. Stream 2 will be backfilled, while Stream 3 will be channeled into a concrete bank.

Should there be nightworks within the area, this may create species disturbance from light. Alteration of natural cycles of light and dark by artificial light sources can negatively impact the ecosystem if not managed properly. Some fauna species, particularly nocturnal species which rely on their hearing for movement, communication, and foraging, are vulnerable to increased night-time noise levels.

Degradation/loss of Habitats and Connectivity between Habitats

As discussed in the previous section, there are plans to retain Stream 1, which had the highest aquatic biodiversity based on the baseline survey and is deemed as a habitat of conservation value. Impacts to the stream habitat may be observed should uncontrolled runoff of chemicals and sediment generated from the construction activities is allowed to either directly flow into the stream or enter the drainage network that flows into the stream, thus compromising the water quality and physical characteristics of the stream habitat.

Vegetation clearance leads to the loss of habitats for fauna species and reduction of foraging habitat, food sources, roosting, breeding, and nesting sites, and other resources needed for the continued survival of a species. The project area mostly consists of exotic-dominated secondary forests, abandoned kampong and scrubland habitat types with limited native flora diversity in understory regeneration. Such habitats are not considered rare, as they are found in many other forested patches in Singapore. However, this area also contains many species of conservation significance, which currently rely on the site, and as such, it is important to consider these species before proceeding with vegetation clearance. In particular, the lack of records of the locally rare *Pila scutata* in other parts of Singapore is also of concern, as the loss of this habitat may prevent the further propagation of this species.

As there is another forest patch (Ulu Pandan West) situated adjacent to the project site, it is expected that most terrestrial fauna species found on this site will be able to disperse to surrounding habitats not affected by the works. However, at least three streams are found within the project site. Streams 2 and 3, which are part of the project footprint, will

be affected during the proposed development. Stream 2 will be backfilled while Stream 3 will be channeled into a concrete bank. This will lead to the loss of stream habitat within the project area. However, during the baseline surveys, Stream 2 did not contain any aquatic species, while Stream 3 had low aquatic biodiversity. As such, impacts to aquatic fauna due to the backfilling of these streams are deemed to be limited.

Loss of connectivity between Ulu Pandan West and other forested areas in Singapore may lead to reduced movement between populations. Such fragmentation of populations can in turn lead to reduced gene flow and local extinctions of species. For the case of this project site, the site already lacks direct connectivity to other forested sites around Singapore. Also, given that the forested area west of this project area remains undeveloped, it is unlikely that there will be major impacts from loss of connectivity.

Edge Effects

Vegetation clearance may also have indirect impacts to ecology, including the creation of edge effects in the surrounding habitats, where forest edges are exposed to abiotic and biotic changes due to vegetation clearance. These changes include increased light intensity and temperature, increased soil nutrient content, and changes in air and soil moisture levels. The edge effect may lead to changes in microclimates, forest structure, and ecological interactions. Gradual deterioration of habitats and changes in flora and fauna communities in the areas adjacent to the proposed development due to edge effects may also occur.

Given that the forest patches in Ulu Pandan East and Ulu Pandan West are separated by scrubland, the perimeter of the forest patch in Ulu Pandan West would remain throughout the entire period of construction and no new forest edges would be created. Impacts related to edge effects on Ulu Pandan West are unlikely to occur. However, edge effects to Stream 1 due to the clearance of the project site are of concern, particularly if the vegetated buffer on each side of the stream are impacted by the works.

Changes in Soil and Topography

Vegetation plays an important role in soil stability. Where vegetation clearance has taken place, soil will be left vulnerable to erosion, particularly during rainy periods. Erosion may lead to siltation of waterbodies, and also the runoff of nutrients in topsoil, leading to lowered nutrient levels of the remaining soil on the site. Erosion or siltation, if uncontrolled, may also indirectly impact areas beyond the project footprint.

Where there are planned earthworks within the project footprint, impacts to habitats, including streams and other localised habitats, and species are likely to be felt. Impacts on the biodiversity may go beyond the actual footprint of working boundaries due to indirect impacts caused by associated works such as backfilling, compaction, and soil excavation.

Soil compaction from construction activities may result in reduced soil health, such as reduced nutrient availability, porosity and hydraulic conductivity, which may result in negative impacts to plant growth and mortality in these areas.

Concreting and sealing of surfaces could increase surface runoff which may result in increased soil erosion while facilitating the transport of any chemicals and nutrients from the concretised surface to the surrounding soil. The surface runoff may also contribute to increased nutrient, chemical levels or change in pH levels in the surrounding soils due to other substances on the concrete the surface runoff may collect. Additionally, sealing of surfaces could reduce groundwater recharge, thus affecting stream flow in adjacent streams.

Invasive Species

Invasive species have many impacts on biodiversity, including the displacement of native species (Peh, 2010), hybridisation of distinct populations (Peh, 2010; Vuillaume, et al., 2015), and degradation of ecosystem services (Çinar, 2014).

In the case of construction activities, invasive plants are sometimes introduced through seeds embedded in construction equipment and the boots of construction personnel. While the project site already has a large population of non-native and/or invasive species will be introduced if species with the ability to propagate locally without human assistance are planted in the future, such as rain trees (*Samanea saman*), trumpet tree (*Tabebuia rosea*), common lantana (*Lantana camara*), etc.

There are several non-native species currently found on project site, including the Mukhlesur's narrow-mouthed frog (*Microhyla mukhlesuri*), East Asian ornate chorus frog (*Microhyla fissipes*), and Gunther's frog (*Sylvirana guentheri*). The clearance of forest may allow such generalist non-native species to proliferate in the newly cleared environment.

Human–Wildlife Conflict

There is a presence of snakes and beehives within the project site, all of which may result in human-wildlife conflict during the construction phase. If measures are not taken to ensure that fauna species are not able to enter the working area, and that construction personnel are trained on actions to take when occurring wildlife, injury to construction personnel or these fauna species is possible during the construction phase. As of 26 September 2022, the beehive was found to have been naturally destroyed.

Potential Roadkill

The project site is bounded by two road networks – Ghim Moh Link to the east and Commonwealth Avenue West to the south. Commonwealth Avenue West is a major road with heavy traffic. During the construction phase, traffic volume is also likely to increase from construction vehicles accessing the site. If mitigation measures are not taken, animals are likely to run out of the forest, particularly during periods of high disturbance such as tree-felling. This may lead to an increased incidence of roadkill, which poses negative impacts on both the wildlife present on the site as well as drivers along the road.

Post-construction Phase

The main impacts from this project are likely to be felt during the construction phase. There might be some impacts from increase in light and noise levels from the cleared

area into the remaining forested areas.

Upon the completion of this project, building works for the upcoming residential developments are likely to commence. TAC recommends that the impacts from the building construction phase of this project are to be assessed separately.

Overall Impact

Based on the assessment above, some of the potential impacts on site's biodiversity are deemed to be permanent in nature while the others are short-term and reversible. Appropriate measures are to be proposed to mitigate these impacts to acceptable level.

Additionally, critical impacts of other physical parameters are discussed in the relevant chapters. Impacts of hydrology and surface water quality and hydrology on biodiversity are addressed in Chapter 5, impacts of noise are discussed in Chapter 6, impacts of air quality on biodiversity are discussed in Chapter 7, impacts of light on biodiversity are discussed in Chapter 9, and impacts of waste management are discussed in Chapter 10.

4.6.3 Evaluation of Potential Impacts

Table 4.15 summarises the impacts for all Areas with their corresponding Environmental Scores before and after the implementation of mitigation measures which are elaborated in the following section.

4.7 Mitigation Measures

Mitigation measures are to be implemented wherever significant negative impacts are predicted, in order to reduce the impacts of the works on the environment. Most of biodiversity mitigation measures are covered in this chapter. Additionally, mitigation measures related to other environmental aspects are covered in relevant chapters as well.

4.7.1 Pre-construction / Construction Phase

The project area consists of several flora species of conservation significance. Given the nature of the project, the clearance of threatened plant species within the area is unavoidable, and several Conservation Significant flora species will be affected. Except for a few large, conserved trees, most of the forest in Ulu Pandan East will be cleared, with potentially additional areas in range of 20 m may be cleared temporarily to cater for construction phase working area needs.

Plant Salvaging and Planting of Native Species

To remedy the adverse impact to biodiversity, it is recommended salvaging saplings and small individuals of plants of conservation value. We recommend the transplanting of 16 Conservation Significant species found within the project area: *Ardisia elliptica* (small tree), *Baccaurea motleyana* (tree*), Breynia androgyna* (shrub), *Bridelia stipularis* (climber), *Dimocarpus lichi* (tree), *Elaeocarpus ferrugineus* (tree), *Geophila herbacea*

(creeper), *Glochidion zeylanicum var. zeylanicum* (tree), *Gnetum gnemon* (tree), *Horsfieldia cf. polyspherula* (tree), *Jasminum* elongatum (shrub), Macaranga griffithiana (tree), *Melicope lunu-ankenda* (tree), *Millettia pinnata* (tree), *Oxyceros longiflorus* (shrub), and *Sterculia parviflora* (tree). Out of this species list, *Jasminum elongatum, Elaeocarpus ferrugineus, Geophila herbacea, Horsfieldia cf. polyspherula, Melicope lunu-ankenda* and *Macaranga griffithiana* are forest species unlikely from cultivated origin and should be prioritised for transplanting. As *Ficus virens* and *Gigantochloa ligulata* are too large to be transplanted, it would be best if these individuals of both species can be conserved on site. If conserving them is not feasible, the nursery may attempt to propagate the bamboo in the nursery.

Additionally, some more common native plants may also be targeted for translocation, including *Syzygium polyanthum* (tree), *Terminalia catappa* (tree), *Litsea elliptica* (tree), *Macaranga conifera* (tree).

Salvaged native species can be incorporated as far as reasonably practical as a nature-based component for replanting requirements such as for reinstatement, slope stabilising, or fauna connectivity purposes. Compared to conventional method of planting solely ornamental trees in residential estate with planting stocks ordered from local or overseas nurseries, using native plants salvaged in-situ at least partially for reinstatement works brings ecological and biodiversity benefits, as this demonstrates an effort to preserve and disperse native flora germplasm rather than introducing foreign species which might deter conservation of native flora germplasm. This will help to mitigate biodiversity loss and conserve certain degree of biodiversity. Should there be additional flora saplings of conservation significance, these could also be used to enhance Ulu Pandan West.

Flora Management Plan

The detailed plant salvaging and tree protection guidelines are provided in the CEMMP document, including the requirements of personnel qualification, specifications of nursery, transplanting, tree assessment, tree felling and so on. A summary of flora management plan is provided below.

Prior to any site clearance and plant salvaging processes, the Contractor is to liaise with NParks on plants they plan to salvage.

A tree assessment report recording tree information such as site and tree photos, species, height, girth, crown spread, tree health, form, structure, site observations and assessment for the trees affected by proposed development footprint is to be prepared and it should also include mitigation measures to reduce construction impact on trees. This tree assessment report will then serve as record of pre-development tree condition, and to be utilised when performing monthly monitoring for trees.

Any slope levelling work that may be required should also take into account any flora immediately upslope of the planned work area, especially trees, as their root zones would likely be affected by any excavation works that are carried out. Any waste material should also be disposed of properly, as the leaching of contaminants into the soil or wastewater could result in negative impacts south of the pipeline, which is downslope

and has a higher biodiversity compared to the area north of the road.

Trees identified for retention at the boundaries of the construction footprint of the working area should be demarcated by Tree Protection Zones (TPZs) determined by an ISA-certified Arborist. TPZ should be installed prior to construction zone, and monthly monitoring should be conducted by the Arborist to maintain records of tree health and TPZ integrity. If the tree needs to be pruned due to machinery access, the pruning will need to be carried out by landscape contractors with relevant qualifications under supervision of the Arborist.

Restricted Work Timings for Heavy Construction

Due to the sensitive nature of forest animals, particularly nocturnal animals, heavy construction works (including tree clearance, piling, and pipejacking) are to be limited to daylight hours (8 am – 6 pm). Should there be a need for construction activities to continue at night due to work exigencies, authorities' approval should be obtained. For such works, a detailed LMP shall be developed as part of the CEMMP. This is further elaborated in Section 9.3.1 of the chapter on light impacts.

Pre-felling Fauna Inspections

Mortality of fauna species of conservation value should be avoided. In general, most of the fauna of conservation value recorded include birds that are highly motile, hence the works should not greatly affect their survivability. However, several measures can be put in place to further decrease species mortality. Prior to any tree felling, the project site should be inspected for active bird nests or holes, and chicks should be allowed to fledge prior to tree felling. Where possible, tree hollows and burrows should also be inspected for mammal and bird species, and such species should be translocated prior to tree felling.

Directional Clearance and Wildlife Translocation

Trees should be felled in stages, in one direction. Such directional clearance will give time for less motile fauna to move into other forested areas. The details of the proposed directional tree felling plan will be further elaborated on in the CEMMP document. Commencement of tree felling works are also to avoid the peak nesting period of many birds (between the months of February and July).

Site Hoarding

Mortality from roadkill of highly motile fauna species such as common palm civets and monitor lizards should be avoided. Hoarding along the southern perimeter of the forest (along Commonwealth Avenue West), as well as phased clearance of trees in the direction away from Commonwealth Avenue West, could help to prevent animals from running onto the road. The full working area should be hoarded, with hoardings installed at a depth of 300 mm to prevent animals from digging under the hoarding. The hoarding line should be located a distance away from the forest edge to prevent the inadvertent damage of major roots of trees during installation, which may lead to the trees falling onto the site. Hoarding should be monitored regularly to ensure that no animals are entering the site either through gaps or by digging under the hoarding. Protocol in the case of animal encounter is elaborated in the CEMMP document.

All equipment should be store within hoarded areas. There should be no storage of equipment in vegetated areas.

Avoiding Impacts on Sensitive Habitats

Direct impacts on important habitats should be avoided and direct impacts to other habitats should be minimised where possible. Placement of working shafts, trenchwork, and all other working spaces should avoid Stream 1 and its vegetated buffer. Should any threatened native, mature tree species to be retained be affected by the working area, a slight shift of placement could help to prevent impacts on these species. The full working area should be hoarded. Details for the hoarding are described in the paragraphs above.

Species may also be affected by increased noise, light, and vibration disturbance. Noise barriers / sound proofing should surround all working areas to decrease the impact of noise to the surrounding fauna. Nightworks should be minimised. To reduce vibration impacts to fauna located in proximity to construction areas, machineries causing vibration may be placed on isolators. The details of these impacts are further elaborated upon in their respective chapters.

Indirect impacts to the important habitats should be avoided. These habitats include the native-dominated secondary forest, abandoned land forest, and fourth stream, all west of the project site, as well as Stream 1 and the vegetated buffer for the stream. Care must be taken to prevent soil erosion or sediment run-off into adjacent habitats, particularly waterbodies. As such, proper Earth Control Measures (ECM) Plan approved by PUB should be in place prior to start of (pre-)construction activities and effectively implemented throughout the duration of activities. The ECM tanks utilised for the project must have surplus capacities to avoid overflow and silty discharge. As far as possible, all hazardous / flammable chemicals to be used during construction shall be properly labelled, stored within bund containment, and under shelter.

Stream 1 should be regularly monitored during the construction phase, and for three months after the construction phase, to ascertain that the stream is not adversely impacted by the works. Details of regular monitoring recommendation can be found in the CEMMP document.

Management of Human–Wildlife Encounters

Mortality from roadkill of highly motile fauna species such as common palm civets and monitor lizards should be avoided. Hoarding along the road adjacent to the works should be erected to prevent animals from running onto the road.

To prevent other wild animals from scavenging on construction site, areas for food consumption, storage, and waste disposal should be demarcated and managed. The presence of snakes and bees may pose a threat to human health and safety. Prior to the commencement of works, beehives should be removed and relocated out of the construction site to reduce the risk of such encounters. As of 26 September 2022, the beehive was found to have been naturally destroyed.

The personnel should also be briefed on what to do should they encounter specific wild

animals. There should also be no eating of food and drink within forested areas. Should wildlife be encountered, the Wildlife Response and Rescue Protocol, which is elaborated upon in the CEMMP document, should be followed.

Minimising Fauna Entrapment

To prevent fauna mortality due to entrapment within the worksite, such as in ECM blankets or pits, daily site checks should be conducted to identify and rescue entrapped fauna. Moreover, only non-plastic, biodegradable ECM mats are to be installed throughout the site. These mats should minimise entrapment of wild animals like snakes and lizards.

In summary, the mitigation measures that should be implemented to mitigate the impacts on sensitive biodiversity receptors for the project site are as follows:

- Avoid heavy construction activities at night (i.e., limit heavy work activities to 8 am – 6 pm)
- Ensure project layout avoids targeted sensitive receptors and habitats, including Stream 1
- Identify plants of high conservation significance to be transplanted
- Establish Tree Protection Zones (TPZ) for trees to be retained
- Hoard up entire work site. Permanent hoarding is to be embedded along the perimeter of the working boundaries.
- As far as practicable, avoid the commencement of tree felling during the peak bird nesting period (February to July)
- Visually inspect trees and holes for nesting birds and species of conservation value prior to felling
- Replant new planting verges with native plant species
- Conduct phased /directional clearance of vegetation in the direction away from Ghim Moh Link as well as fauna translocation where required
- Conduct daily checks of ECM blankets and pits to rescue any entrapped fauna
- Implement proper ECMs to prevent impact to adjacent habitats
- Utilise inert construction material
- Ensure equipment, vehicles, and footwear are clean prior to commencing works
- Establish designated areas for food and waste disposal
- During the construction phase, conduct information sessions for workers on what to do upon encountering wildlife
- Conduct regular monitoring of trees and vegetation health during construction phase within project site

4.7.2 Post-construction Phase

No major further impacts are envisioned during the post-construction phase of this project, except for increased noise and light entering the remaining forested areas. Mitigation measures for the impact of noise and light during the operation phase are addressed in their respective chapters.

4.8 Residual Impacts

The residual impacts were evaluated using the RIAM method (Table 4.15) with due consideration that the recommended mitigation measures are implemented by Contractor. The residual impacts are likely to be in the band of no impact to minor negative.

The project involves the permanent clear-felling of most of the area, with the exception of Stream 1 and its vegetated buffer. With the implementation of mitigation measures, some minor negative impacts on habitats and potential roadkill, especially during the construction period.

Table 4.15. Environmental Scores of the identified impacts on site's biodiversity with corresponding mitigation measures for project area activities

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Ecology																
Pre-Construction	Flora and fauna species damage and mortality due to vegetation clearance for temporary working space	1	-2	2	2	2	-12	Slight negative	• Erect temporary hoarding • Identify plants to be transplanted • Avoid tree roots • Establish Tree Protection Zones (TPZ) for trees to be retained • Visually inspect trees and holes for nesting birds and animals prior to felling	1	-1	2	2	2	-6	No impact
	Loss of habitats due to vegetation clearance for temporary working space	1	-2	2	2	2	-12	Slight negative	• Erect temporary hoarding to limit vegetation clearance • Avoid placement of working areas in waterbodies • Reinstate habitats where possible upon completion of works	1	-2	2	2	2	-12	Slight negative
Construction	Impacts to flora and fauna due to illegal encroachment of vegetated areas by construction personnel	3	-2	2	2	2	-36	Minor negative	• Incorporate signs prohibiting entrance into vegetated areas • Erect fences to prevent illegal entry	3	-1	2	2	2	-18	Slight negative
	Impact on native species due to the introduction of invasive species	1	-2	3	3	2	-16	Slight negative	• Ensure equipment, vehicles, and footwear used are clean prior to commencing works • Use native plants for replanting of roadside verges • Periodic checks within hoarding boundary to ensure that no introduced plant species have spontaneously established	1	-1	3	3	2	-8	Slight negative
	Loss of habitats due to vegetation clearance for development of Ulu Pandan	3	-3	3	3	2	-72	Minor negative	• Ensure project layout avoids targeted sensitive habitats, including Stream 1 • Erect temporary hoarding to limit vegetation clearance • Reinstate habitats with native flora species where possible upon completion of works	3	-3	3	3	2	-72	Minor negative

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Construction	Flora and fauna species mortality due to vegetation clearance for development of Ulu Pandan	3	-3	3	3	3	-81	Moderate negative	• Erect temporary hoarding • Ensure project layout avoids targeted sensitive receptors where possible • Identify trees to be transplanted • Conduct phased, directional vegetation clearance along with fauna translocation where required • Conduct daily checks of ECM blankets and pits to rescue any entrapped fauna • Utilise only non-plastic, biodegradable ECM mats throughout the site. • Reinstate working areas with selected native species • As far as practicable, avoid commencement of tree felling during the peak bird nesting period (February to July) • Establish Tree Protection Zones (TPZ) for trees to be retained • Visually inspect trees for nesting birds and animals prior to felling	3	-2	3	3	3	-54	Minor negative
	Roadkill or road injury to fauna escaping from forested site	3	-3	3	3	2	-72	Minor negative	• Erect physical barriers to direct fauna movement into unaffected forested areas and prevent fauna from crossing the road • Erect speed bumps or signages to alert drivers about potential animal crossings • Enforce speed limit on the roads	3	-2	3	3	2	-48	Minor negative
	Impact on habitats including waterbodies due to soil erosion, runoff, and discharge of silty water	3	-3	3	2	3	-72	Minor negative	• Implement Earth Control Measures (ECMs) that are approved by PUB	3	-2	2	2	2	-36	Slight negative

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Construction	Indirect impact on habitats due to edge effect	3	-2	2	2	2	-36	Slight negative	• Avoid night works (i.e., limit construction activities to 8 am – 6 pm) • Construction lights (if any) should face inwards and away from the forest	3	-1	2	2	2	-18	Slight negative
Human Health and Safety																
Pre-construction / Construction	Attacks of construction personnel by animals including bees and snakes	3	-3	2	3	2	-63	Minor negative	• Establish designated areas for food and waste disposal • Install monkey-proof bins • Conduct information sessions on what to do upon encountering wildlife	3	-2	2	3	1	-36	Slight negative
	Injury caused by tree falls due to damaged roots	3	-4	2	3	2	-84	Moderate negative	• Establish Tree Protection Zones (TPZ) for trees to be retained • Regularly monitor health of trees on project site	3	-3	2	3	1	-36	Slight negative

5 HYDROLOGY AND SURFACE WATER QUALITY

5.1 Introduction

This Section describes the relevant laws and standard for water quality that are applicable to the project, the methodology and results for the baseline hydrological conditions and water quality at the study area. It also describes potential impacts on hydrology and water quality due to the construction works of the project, and recommendation for mitigation measures. A quantitative impact assessment approach was used for the assessment of impacts.

5.2 Relevant Environmental Legislation, Guidelines and Standards

The Sewerage and Drainage Act 2001 authorises PUB to construct, maintain and improve sewerage and drainage systems, to regulate the discharge into these systems, and to issue codes of practice or specifications.

Sewerage and Drainage (Surface Water Drainage) Regulation 2007 specifies a maximum discharge limit for total suspended solids (TSS) as 50 milligrams per liter (mg/L) of the discharge. This regulation also requires every contractor to comply with the Code of Practice (COP) on Surface Water Drainage.

Sewerage and Drainage (Trade Effluent) Regulation 2007 requires contractors to obtain approval from PUB for discharge of trade effluent into a public sewer. The nature or type of effluent discharge must be approved by PUB. Effluent quality must comply with those specified in the regulations, and if required by PUB, must be treated prior to discharge.

The discharge of wastewater into open drains, canals and rivers is regulated by the Environmental Protection and Management (EPM) Act 2002 and the EPM (Trade Effluent) Regulation 2008. The Act and its regulations prescribe allowable limits for trade effluent discharge to controlled watercourse and are administered by NEA.

COPs and guidelines relevant to public utilities and watercourse are listed below.

- COP for Environmental Control Officers;
- COP on Surface Water Drainage 2018;
- COP on Pollution Control (SS 593: 2013);
- Guidebook for Qualified Erosion Control Professional (QECP) 2006;
- Guidebook on Erosion and Sediment Control at Construction Sites 2018.

5.3 Hydrology Profile

5.3.1 Catchment Profile

The project study area is located within the catchment area of Pandan Reservoir (Figure 5.1), which was created by damming Sungei Pandan's mouth in 1974. The reservoir's main body covers an area of approximately 176 hectares. Pandan Reservoir is the largest service reservoir in Singapore providing non-potable water to the surrounding industrial areas. It is in the Western Region and is the only elevated reservoir in Singapore. The flow of the Ulu Pandan Canal was in the past reversed such that water

now drains toward Pandan Reservoir instead of Alexandra and Singapore Rivers.

Annual monthly rainfall over the last ten years at the project study area is shown in Figure 5.2, adapted from historical records at the Clementi weather station that represents the site.

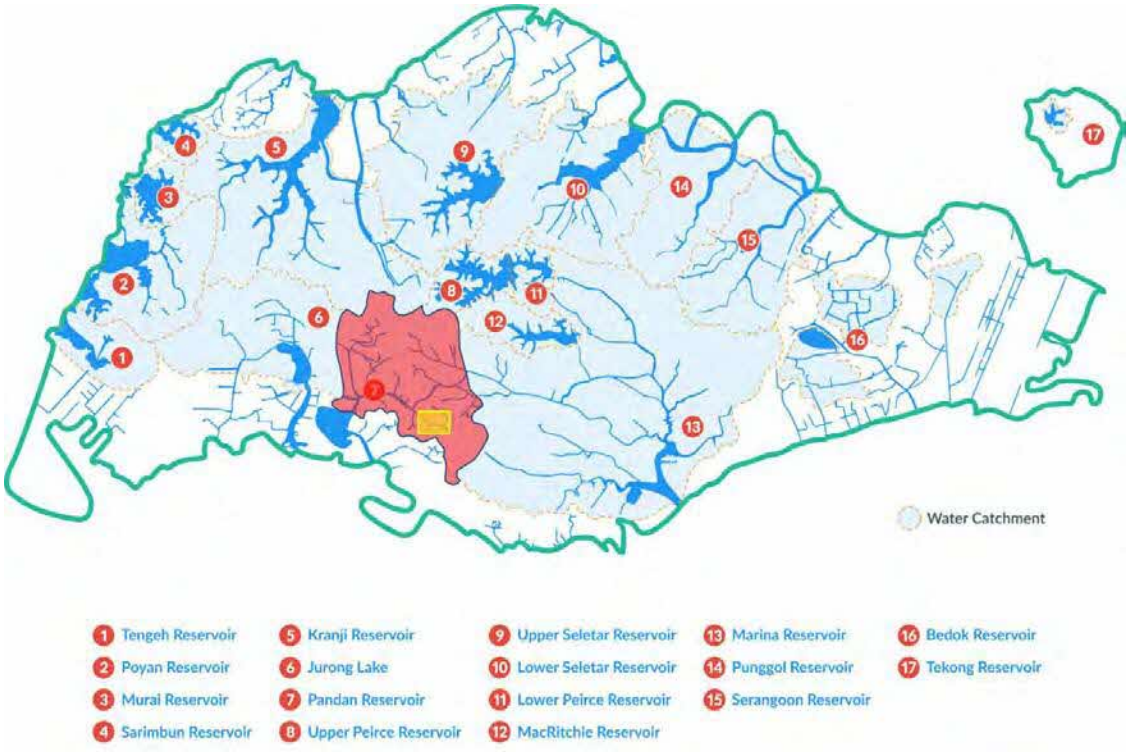


Figure 5.1. Catchment areas of Singapore (Public Utilities Board, 2019)
Approximate location of the project site is demarcated in the yellow box within the Pandan Reservoir catchment area (shaded red).

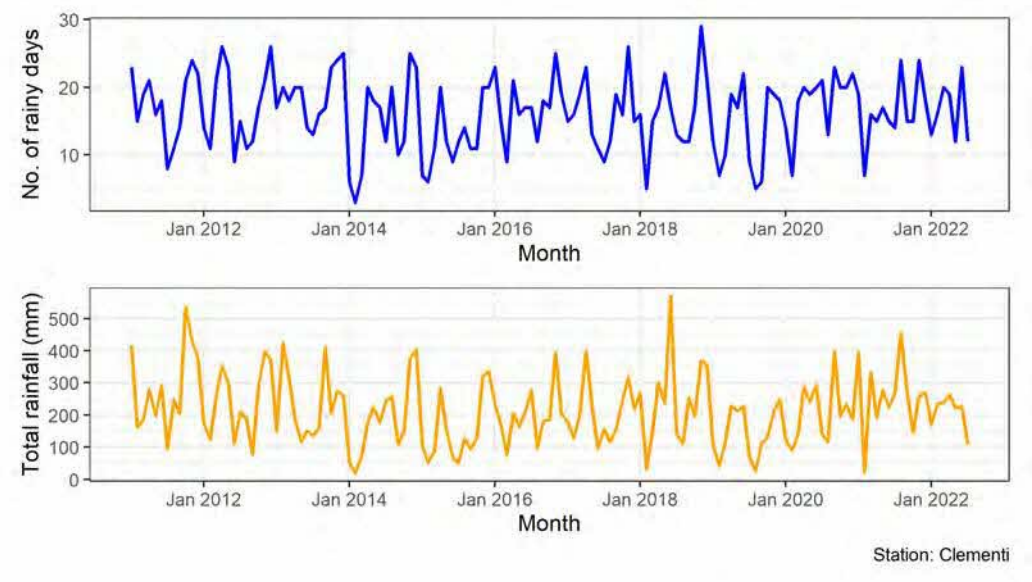


Figure 5.2. Annual monthly rainfall at the Clementi rain gauge station through 2011–2022

5.3.2 Drainage Profile

Based on the study by AECOM (2020), three streams were identified within the study area (Figure 5.3).



Figure 5.3. Location of culverts and natural streams in the project study area

The water source of Stream 1 and Stream 3 is the surface runoff from streets in the vicinity of the study area, while the source of Stream 2 is the naturally formed catchment within the study area. The probability of having a natural groundwater source within the study area is minimal (AECOM, 2020). During dry weather conditions, the observed flow in Stream 2 is minimal and due to the sub-surface flow after storm event or non-existent.

All three natural streams and drains flow to Ulu Pandan Canal through existing concrete culverts located at the downstream section.

Stream 1 originates from outside the study area. Upstream, water flows through a concrete structure, the midstream section has natural banks which consist of secondary forest (Figure 5.4) and swamp vegetation and downstream ends in a concrete structure. The midstream flow has stagnant water. The flow of water downstream was observed also during dry weather conditions (AECOM, 2020).

Stream 2 originates from within the study area. The bank of the stream at the upstream section is delineated by secondary forest, and grasslands characterise the downstream area (Figure 5.4). The stream was observed to be flowing during dry weather conditions

(AECOM, 2020)

Lastly, Stream 3 originates from outside the study area. The upstream area is characterised by riparian vegetation, mid-stream runs along managed grasslands (Figure 5.4) and secondary forest vegetation flanks the downstream portion. Flowing water in Stream 3 was observed during dry weather (AECOM, 2020).



Figure 5.4. Photographs showing streams within project study area

5.4 Natural Stream Characterisation

There are a total of three streams within the study area. This section provides approach as well as findings of stream characterisation survey.

5.4.1 Stream Characterisation Approach

The stream characterisation survey covered details such as substrate type, riparian vegetation composition, wetted width and depth, and flow velocity of streams as

explained below. The survey locations were selected based on coverage of the stream profile variations, site conditions and safe access.



Figure 5.5. Location map of stream characterisation survey points

Wetted depth and width

The depths and widths of the stream channels were measured using a scale ruler as well as a metric transect tape depending upon site conditions.

Canopy cover

To measure the canopy cover at each measuring point, a photo of the canopy was taken parallel to the ground at eye-level. The percentage of canopy cover derived is an estimate of the total area covered by vegetation over the entire frame of in the taken canopy photo.

Substrate type

The soil substrate on the banks of the stream and in the waterbody were determined using visual assessment as well as the “texture by feel” method (Thein, 1979). The “texture by feel” method involves picking up roughly 25 g of moistened soil and shaping it into a ball, which is then squeezed between the thumb and index finger upwards beyond the fingers and allowed to break from its own weight. The length of the resultant ribbon is measured to determine the soil substrate. Following that, a pinch of the soil was wet and rubbed to determine the soil texture and composition. Table 5.1 shows the soil substrate types that can be determined based on the soil textures and ribbon length.

Table 5.1. Classification of substrate types **(Thein, 1979)**

Ribbon Length	Soil Texture	Soil Substrate
No ribbon	NA	Loamy sand
2.5cm or less	Gritty	Sandy loam
	Smooth	Silt loam
	Neither gritty nor smooth	Loam
2.5 to 5cm	Gritty	Sandy clay loam
	Smooth	Silty clay loam
	Neither gritty nor smooth	Clay loam
More than 5cm	Gritty	Sandy clay
	Smooth	Silty Clay
	Neither gritty nor smooth	Clay

Subsequently, sandy substrates were further categorised visually according to their estimated particle size in Table 5.2 using the "texture by feel" method as well as by placing a sample of the soil and spreading is across a scale card.

Table 5.2. Classification of sand particle sizes **(Wentworth, 1922)**

Sand Particle Type	Particle Size
Fine sand	≤ 0.5 mm
Coarse sand	> 0.5 mm and ≤ 2 mm
Fine gravel	≤ 4 mm
Coarse gravel	> 4 mm and ≤ 32 mm
Cobble	≤ 256 mm

Riparian vegetation

The species of plants that are immediately next to, within or overhead each measuring point were identified by an International Society of Arboriculture (ISA)-certified Arborist.

Flow velocity

To measure the flow velocity of steams, the float and measure method was employed with the use of a ping pong ball as a float, a metric transect tape to set the travel distance, and a stopwatch to measure the duration of travel. To begin the measurement, the transect tape is laid down parallel to the stream flow, and the start and end points determined. When the float enters the start point of the stretch, the stopwatch would start timing, and when the float passes the end point of the stretch, the stopwatch would stop timing and the duration is recorded. Each measurement was taken 3 times and then averaged out in order to obtain the more accurate approximate time taken for the float to cover the predetermined stretch.

To calculate the flow velocity using the recorded data, the formula below is used:

$$Flow\ Velocity = \frac{Distance}{Time}\ x\ Friction\ Correction$$

Friction correction refers to the numerical factors used in order to factor in the difference in flow due to the channel surfaces, where 0.9 is used for smooth surfaces (e.g., drains,

canals, and sandy bottoms) and 0.85 is used for rough surface rock bottoms. Since the top of a stream typically flows faster than the bottom due to friction against the stream bed, applying friction correction evens out the flow velocity (Harrelson et al., 1994). The unit used for flow velocity is meter per second (m/s).

5.4.2 Stream Characterisation Results

Characterisation of Stream 1

Stream 1 is identified as one of the major streams that cuts through the east side of the project study area, with man-made inlets feeding its source, and a man-made outlet directing the flow out of the project study into a canal through a culvert. The stream has been observed to transport a significant amount of discharge in both wet and dry weather conditions and have significantly varying wetted widths and depths throughout its course through the side, which has been observed to be generally consistent with the terrain and its physical characteristics. For instance, nearer to the source where the stream flowed along a steeper profile, the shape of the channel was deeper with a narrower wetted width and faster flow velocity, while at the points where the slope profile is significantly gentler, the wetted widths were much wider with lower flow velocities. Towards the northeast border of the project study area, this stream also contains a minor tributary stream that joins the main channel just before flowing out through the culvert.



Figure 5.6. Pictures of the man-made inlet (left) and outlet (right) of Stream 1

Table 5.3 provides the results of stream 1 characterisation survey.

Table 5.3. Results of stream 1 characterisation survey

Survey Point ID	Stream Cross-Section & Canopy Photograph	Wetted Width & Depth (m)	Soil Substrate	Flow Velocity (m/s)	Riparian Vegetation	Associated Fauna
SC1-1	Overview:	Dry weather Width: 0.35m	Stream: Silty Clay	Dry weather 0.210m/s Wet weather	*Ficus fistulosa, Adiantum latifolium, Syngonium angustatum, Elaeis guineensis,*	Guppy, Southern Platy, Acute Bladder Snail, Mosquitofish, Apple Snail,

Survey Point ID	Stream Cross-Section & Canopy Photograph	Wetted Width & Depth (m)	Soil Substrate	Flow Velocity (m/s)	Riparian Vegetation	Associated Fauna
	 Cross-Section:  Canopy: 90% 	Depth: 0.065m <u>Wet weather</u> Width: 0.4m Depth: 0.10m	Bank: Silty clay with fine sand	0.194m/s	*Aphanamixis polystachya*	Sunda Swamp-eel, Malayan Trumpet Snail, Mayan Cichlid,
SC1-2	Overview:  Cross-Section:	<u>Dry weather</u> Width: 3.35m Depth: 0.34m <u>Wet weather</u> Width: 3.8m Depth: 31cm	Stream: Loamy sand; Gravel to medium sand, some cobbles Bank: Sandy clay loam, predominantly clay with some fine to medium sand	<u>Dry weather</u> 0.0163m/s <u>Wet weather</u> 0.0400m/s	*Syngonium angustatum, Elaeis guineensis, Piper sarmentosum, Flagellaria indica, Dieffenbachia seguine, Aphanamixis polystachya*	-

Survey Point ID	Stream Cross-Section & Canopy Photograph	Wetted Width & Depth (m)	Soil Substrate	Flow Velocity (m/s)	Riparian Vegetation	Associated Fauna
	 Canopy: 90% 					
SC1-3	Overview:  Cross-Section:  Canopy: 80%	<u>Dry weather</u> Width: 2.5m Depth: 0.39m <u>Wet weather</u> Width: 2.77m Depth: 0.43m	Stream: Large cobble and debris (i.e., fallen branches) Bank: Loamy sand (with clay and coarse sand)	<u>Dry weather</u> 0.0361m/s <u>Wet weather</u> 0.0577m/s	*Dieffenbachia seguine, Colocasia esculenta, Persicaria chinensis, Aphanamixis polystachya, Ptychosperma macarthurii*	Guppy, Mosquitofish, Apple Snail, Southern Platy

Survey Point ID	Stream Cross-Section & Canopy Photograph	Wetted Width & Depth (m)	Soil Substrate	Flow Velocity (m/s)	Riparian Vegetation	Associated Fauna
						
SC1-4	Overview:  Cross-Section:  Canopy: 85% 	<u>Dry weather</u> Width: 1.8m Depth: 0.12m <u>Wet weather</u> Width: 1.2m Depth: 4.5m	Stream: Loamy sand Bank: Loamy sand (with clay and very fine sand)	NA, stagnant during both wet and dry weather	*Pandanus amaryllifolius, Dioscorea bulbifera, Averrhoa bilimbi, Colocasia esculenta, Aphanamixis polystachya, Thelypteris sp., Nephrolepis biserrata*	Guppy, Acute Bladder Snail, Southern Platy, Mosquitofish, Apple Snail

Survey Point ID	Stream Cross-Section & Canopy Photograph	Wetted Width & Depth (m)	Soil Substrate	Flow Velocity (m/s)	Riparian Vegetation	Associated Fauna
SC1-5	Overview:  Cross-Section:  Canopy: 85% 	<u>Dry weather</u> Width: 0.75m Depth: 0.05m <u>Wet weather</u> Width: 0.8m Depth: 0.06m	Stream: Cobble (with coarse gravel to fine sand) Bank: Whitish red clay (with very fine sand)	<u>Dry weather</u> 0.163m/s <u>Wet weather</u> 0.469m/s	*Persicaria chinensis, Elaeis guineensis, Clinacanthus nutans, Dieffenbachia seguine*	Guppy, Acute Bladder Snail, Southern Platy, Pond Snail, Dark-sided chorus frog
SC1-6	Overview:  Cross-Section:	<u>Pipe diameter</u> 1m	NA	<u>Dry weather</u> 0.021m/s <u>Wet weather</u> 0.048m/s	NA	-

Survey Point ID	Stream Cross-Section & Canopy Photograph	Wetted Width & Depth (m)	Soil Substrate	Flow Velocity (m/s)	Riparian Vegetation	Associated Fauna
						

Characterisation of Stream 2

Stream 2 is a less established stream in a water-logged environment, with ephemeral streams forming after incidents of wet weather, and some streams that exist in both wet and dry weather conditions. In general, the channels in this stream have narrow wetted widths and depths. Beyond the middle of the project site, the stream appears to merge with the swampy marsh-like environment as a surface flow. It appears to have no clear flow direction and can no longer be observed as a flowing stream. Further to the south of the project site, the stream appears to merge with the swampy marsh-like environment as a surface flow and can no longer be observed as a stream.

Table 5.4 provides the results of stream 2 characterisation survey.

Table 5.4. Results of stream 2 characterisation survey

Survey Point ID	Stream Cross-Section & Canopy Photograph	Wetted Width & Depth (m)	Soil Substrate	Flow Velocity (m/s)	Riparian Vegetation	Associated Fauna
SC2	Overview:  Cross-Section:	<u>Dry weather</u> Width: 1.0m Depth: 0.07m <u>Wet weather</u> Width: 0.95m Depth: 0.17m	Stream: Loamy sand (with very fine sand) Bank: Loamy sand (with very fine sand)	<u>Dry weather</u> NA <u>Wet weather</u> NA	*Caryota mitis, syngonium species, Aphanamixis polystachya, Syngonium angustatum, Leea indica, Ptychosperma macarthurii, Caryota mitis, Andira inermis, Piper sarmentosum*	Dark-sided chorus frog, Mukhlesur's Narrow-mouthed Frog

Survey Point ID	Stream Cross-Section & Canopy Photograph	Wetted Width & Depth (m)	Soil Substrate	Flow Velocity (m/s)	Riparian Vegetation	Associated Fauna
	 Canopy: 85% 					

Characterisation of Stream 3

Stream 3 also has its source coming from a man-made culvert feeding into the site from the southwest part of the project study area. The stream then continues as an earth stream throughout the project site towards the northeast direction, forming significantly wide and deep channels nearer to the northern border of the project study area. Finally, the stream flows out of the site via another man-made culvert, leading into the canal adjacent to the park connector.



Figure 5.7. Pictures of the man-made inlet (left) and outlet (right) of Stream 3

Table 5.5 provides the results of stream 3 characterisation survey.

Table 5.5. Results of stream 3 characterisation survey

Survey Point ID	Stream Cross-Section & Canopy Photograph	Wetted Width & Depth (m)	Soil Substrate	Flow Velocity (m/s)	Riparian Vegetation	Associated Fauna
SC3-1	Overview:  Cross-Section:  Canopy: 90% 	<u>Dry weather</u> Width: 2.1m Depth: 0.45m <u>Wet weather</u> Width: 2.2m Depth: 0.49m	Stream: Cobble, coarse gravel and sand Bank: Loamy sand (With clay)	<u>Dry weather</u> NA <u>Wet weather</u> 0.0234m/s	*Caryota mitis, Elaeis guineensis, Bambusa sp.*	Sunda Swamp-eel, Greenhouse Frog, Dark-sided Chorus Frog, Mosquitofish, Green Molly, Malayan Trumpet Snail, Guppy, Pond Snail, Damselfly Nymph
SC3-2	Overview:  Cross-Section:	<u>Dry weather</u> Width: 2.3m Depth: 0.36m <u>Wet weather</u>	Stream: Bedrock and clay debris, with some gravel and coarse sand	<u>Dry weather</u> 0.0238m/s <u>Wet weather</u> 0.0323m/s	*Musa acuminata, Aphanamixis polystachya, Carica papaya, Pandanus amaryllifolius, Colocasia esculenta, Sorghum propinquum,*	Sunda Swamp-eel, Malayan Trumpet Snail, Mosquitofish, Guppy, Malayan Giant Frog, Mukhlesur's Narrow-mouthed

Survey Point ID	Stream Cross-Section & Canopy Photograph	Wetted Width & Depth (m)	Soil Substrate	Flow Velocity (m/s)	Riparian Vegetation	Associated Fauna
	 Canopy: 35% 	Width: 2.2m Depth: 0.49m	Bank: Clay (with fine sand)		*Samanea saman*	Frog, Green Molly, Pond Snail, Tadpole

5.5 Surface Water Quality

5.5.1 Baseline Methodology

Sampling was conducted at six accessible points covering all three identified natural streams (Figure 5.8, Figure 5.9). The SINGLAS-accredited AStar Laboratory Pte Ltd was utilised to conduct surface water quality sampling and analyse the collected samples. One round of water quality monitoring was carried out for dry weather and wet weather each. The dry weather samples were collected on 13 April 2022, while the wet weather samples were collected on 4 May 2022 (Table 5.6). The secondary water quality data from previous reports from surveys carried out in the vicinity of the project area, as well as data collected by various government agencies, if available, were reviewed and utilised.

Table 5.6. Coordinates and dates of surface water quality sampling location

ID	Coordinates		Date of Sampling	
			Dry Weather	Wet Weather
WS1-1	1.309952	103.781747	13/4/2022	4/5/2022
WS1-2	1.310677	103.782683		
WS1-3	1.311238	103.783077		
WS2	1.312054	103.779878		
WS3-1	1.312240	103.778430		
WS3-2	1.313085	103.778285		



Figure 5.8. Sampling for surface water quality sampling

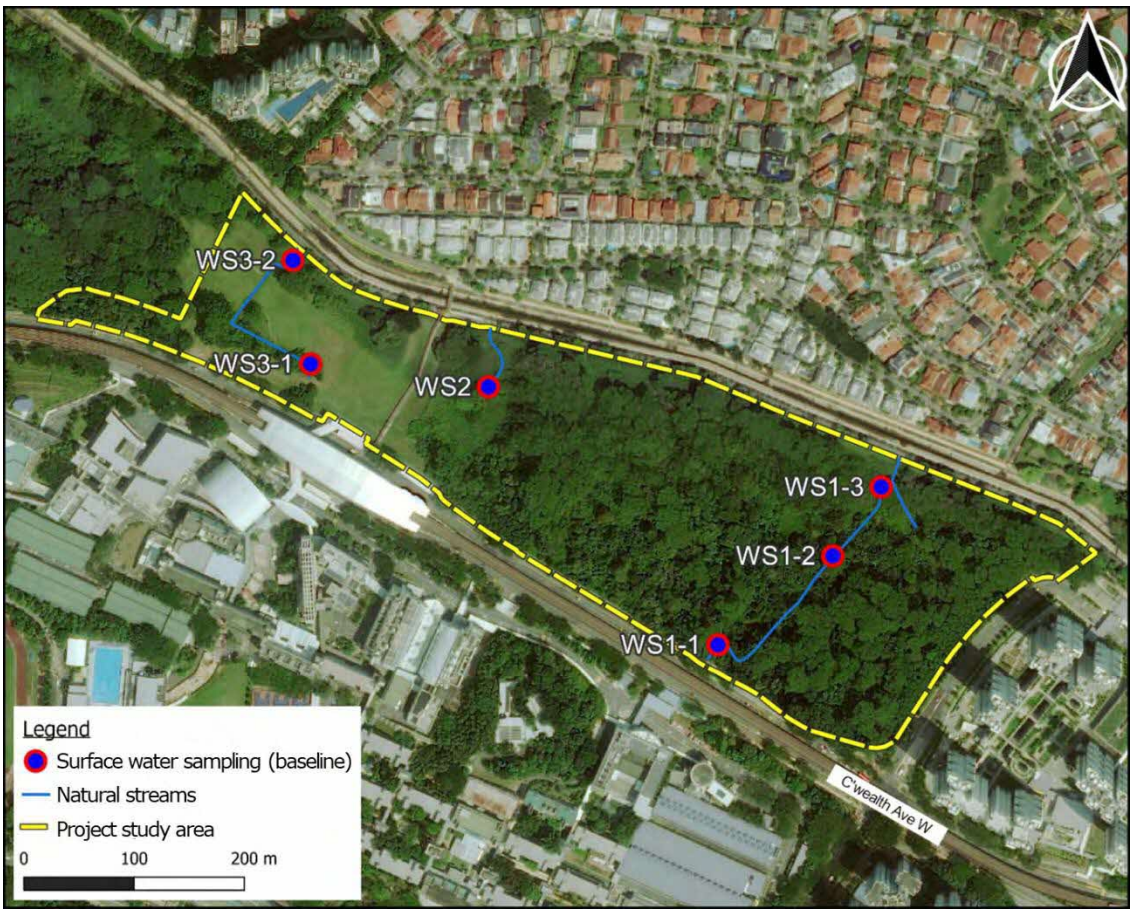


Figure 5.9. Location of surface water quality sampling points in project study area

The following parameters were tested using their respective testing method for each surface water quality sample (Table 5.7), where APHA is a standard method for Determination of Water and Wastewater (APHA, 2017).

Table 5.7. Surface water quality parameters tested in the laboratory

Parameter	Unit	Threshold Limit	Test Method
In-situ			
Temperature	°C	45 [1]	APHA 2550 B
pH @ 25°C	pH unit	6-9 [1]	APHA 4500-H-B
Turbidity	NTU	-	APHA 2130 B
Conductivity	µS/cm	-	APHA 2510 B
Dissolved Oxygen	mg/L	≥ 4 [2]	APHA 4500-O-G
Total Dissolved Solids	mg/L	-	APHA 2540 C
Ex-situ			
Total Suspended Solids	mg/L	50 [1]	APHA 2540 D
Total Organic Carbon (TOC)	mg/L	-	APHA 5310 B
Total Nitrogen	mg/L	-	SOP-WAT-048
Total Phosphorus	mg/L	5 [1]	HI93713/HI801
Nitrate (NO_3)	mg/L	-	HI93713/HI801
Phosphate (PO_4)	mg/L	5 [1]	HI93713/HI801
Ammoniacal Nitrogen	mg/L	1 [2]	APHA 4500-NH_3-E
Arsenic (As)	mg/L	0.1 [1]	APHA 3120 B
Cadmium (Cd)	mg/L	0.1 [1]	APHA 3120 B
Copper (Cu)	mg/L	0.1 [1]	APHA 3120 B
Lead (Pb)	mg/L	0.1 [1]	APHA 3120 B
Zinc (Zn)	mg/L	1 [1]	APHA 3120 B
Nickel (Ni)	mg/L	1 [1]	APHA 3120 B
Iron (Fe)	mg/L	10 [1]	APHA 3120 B
Chromium (Cr)	mg/L	1 [1]	APHA 3120 B
Mercury (Hg)	mg/L	0.05 [1]	VGA/ICPOES
Enterococcus	cfu/100mL	40,000 [3] / 200,000 [4]	APHA 9230 C

[1] NEA's Allowable Limits for Trade Effluent Discharge to Watercourse guideline

[2] Vietnam's National Technical Regulation on Surface Water Quality for Protection of Aquatic Lives (QCVN 38: 2011/TTBTNMT) (2011)

[3] Values for dry weather sample in Australian Guideline for Urban Stormwater Management (2000)

[4] Values for wet weather sample in Australian Guideline for Urban Stormwater Management (2000)

5.5.2 Baseline Results

The main standard used for surface water quality comparison was the Allowable Limits for Trade Effluent Discharge under EPM (Trade Effluent) Regulation (NEA, 2020). Furthermore, the values of parameters not regulated by Singapore standards were compared with relevant standards from other countries in the region. Hence, Dissolved Oxygen values were compared with the limit in Vietnam's National Technical Regulation QCVN 38:2011/TTBTNMT on Surface Water Quality for Protection of Aquatic Lives (2011), while Enterococcus values were compared with the Australian Guideline for Urban Stormwater Management (2000).

Previous Study

Surface water quality sampling was conducted by the previous Environmental Baseline Study (EBS) (AECOM, 2020) at the locations shown in Figure 5.10. Their results are summarised in Table 5.8.

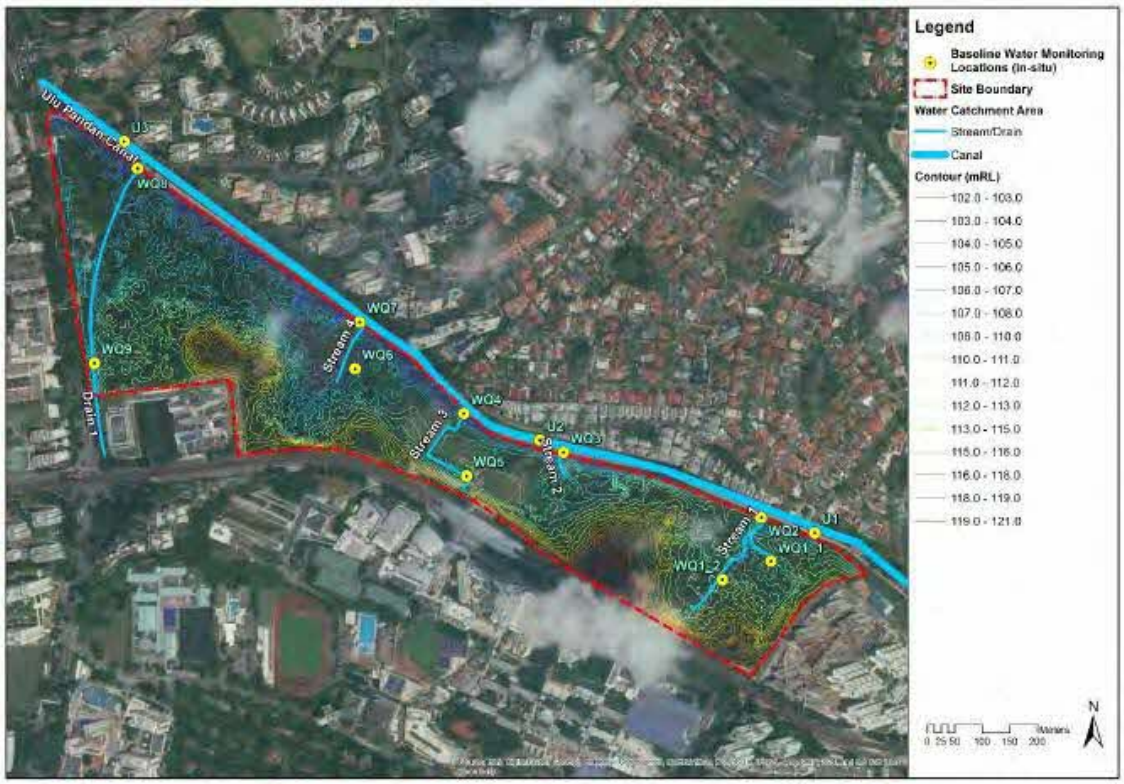


Figure 5.10. Location of surface water quality sampling points, adapted from AECOM **(2020)**

Table 5.8. In-situ surface water quality results by the previous EBS **(AECOM, 2020)**

Parameter	Unit	Threshold	WQ1_1	WQ1_2	WQ2	WQ3	WQ4	WQ5
Dry weather								
Temperature	°C	45 [1]	26.10	26.22	26.50	26.68	27.11	27.12
Conductivity	µS/cm	–	291.00	191.54	133.83	114.43	275.87	306.24
pH	pH unit	6–9 [1]	6.53	7.24	7.86	7.30	7.83	7.86
Dissolved Oxygen	mg/L	≥ 4 [2]	**2.64**	**1.37**	7.35	7.06	5.81	5.35
Total Dissolved Solids	mg/L	–	189.00	123.24	85.01	72.62	175.42	194.91
Wet weather								
Temperature	°C	45 [1,2]	25.40	25.50	25.85	25.90	26.75	26.70
Conductivity	µS/cm	–	131.50	110.50	93.00	69.50	149.00	194.50
pH	pH unit	6–9 [1]	6.73	7.24	7.84	7.23	8.05	7.88
Dissolved Oxygen	mg/L	≥ 4 [2]	**1.95**	**2.44**	7.76	7.93	7.38	7.01
Total Dissolved Solids	mg/L	–	85.50	71.00	59.50	44.50	96.00	128.50

Note: Values in Bold denote non-conformity to the respective water quality standard.

[1] NEA's Allowable Limits for Trade Effluent Discharge to Watercourse guideline (2020)

[2] Vietnam's National Technical Regulation on Surface Water Quality for Protection of Aquatic Lives (QCVN 38:2011/TTBTNMT) (2011)

Table 5.8 summarises the parameters from the previous surveys (AECOM, 2020) that are comparable to the present surveys. While ex-situ surface water quality was analysed, the raw results were not stated in the previous study's report (AECOM, 2020) and hence is not compared in this report.

Current Study

In this study, the results of surface water quality analysis in comparison with the relevant standards are tabulated in Table 5.9 and Table 5.10 respectively for the dry weather sampling and wet weather sampling. The laboratory analysis reports are provided in **Appendix E**.

Table 5.9. Result of dry weather period surface water quality samples

Parameter	Unit	Threshold	WS1-1	WS1-2	WS1-3	WS2	WS3-1	WS3-2
In-situ								
Temperature	°C	45 [1]	28.4	27.1	27.0	26.3	27.3	29.0
pH @ 25°C	pH unit	6-9 [1]	7.7	6.6	6.4	6.3	7.6	7.4
Turbidity	NTU	-	1.5	7.2	13	55	5.7	6.1
Conductivity	µS/cm	-	85.0	149	128	207	428	278
Dissolved Oxygen	mg/L	≥ 4 [2]	5.97	**3.06**	**1.73**	**0.99**	6.10	7.32
Total Dissolved Solids	mg/L	-	43	75	64	103	214	139
Ex-situ								
Total Suspended Solids	mg/L	50 [1]	1.0	5.0	10.5	**146**	2.7	4.7
Total Organic Carbon (TOC)	mg/L	-	1.44	1.89	2.17	3.68	3.41	3.94
Total Nitrogen	mg/L	-	2.1	0.7	0.5	0.4	6.7	1.6
Total Phosphorus	mg/L	5 [1]	1.01	1.24	0.55	1.08	0.26	0.36
Nitrate (NO_3)	mg/L	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Phosphate (PO_4)	mg/L	5 [1]	1.01	1.24	0.55	1.08	0.26	0.36
Ammoniacal Nitrogen	mg/L	1 [2]	**1.93**	0.65	0.49	0.40	**6.49**	**1.58**
Arsenic (As)	mg/L	0.1 [1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium (Cd)	mg/L	0.1 [1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Copper (Cu)	mg/L	0.1 [1]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lead (Pb)	mg/L	0.1 [1]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)	mg/L	1 [1]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel (Ni)	mg/L	1 [1]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron (Fe)	mg/L	10 [1]	0.19	0.71	0.60	**25.6**	0.41	0.20
Chromium (Cr)	mg/L	1 [1]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury (Hg)	mg/L	0.05 [1]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Enterococcus	cfu/100mL	40,000 [3]	<1	169	156	19	600	480

Note: Values in **bold** and shaded grey denote non-conformity to the respective water quality standard.

[1] NEA's Allowable Limits for Trade Effluent Discharge to Watercourse guideline

[2] Vietnam's National Technical Regulation on Surface Water Quality for Protection of Aquatic Lives (QCVN 38: 2011/TTBTNMT) (2011)

[3] Values for dry weather sample in Australian Guideline for Urban Stormwater Management (2000)

Table 5.10. Result of wet weather period surface water quality samples

Parameter	Unit	Threshold	WS1-1	WS1-2	WS1-3	WS2	WS3-1	WS3-2
In-situ								
Temperature	°C	45 [1]	27.6	26.3	26.3	26.4	27.4	27.6
pH @ 25°C	pH unit	6-9 [1]	7.6	7.0	6.7	6.5	8.2	7.6
Turbidity	NTU	-	37	85	100	360	33	37
Conductivity	µS/cm	-	222	140	81	110	256	236
Dissolved Oxygen	mg/L	≥ 4 [2]	5.86	5.07	4.12	**3.22**	5.32	6.35
Total Dissolved Solids	mg/L	-	111	70.0	40.0	54	128	118
Ex-situ								
Total Suspended Solids	mg/L	50 [1]	4	9.0	**54.0**	**357**	17	14
Total Organic Carbon (TOC)	mg/L	-	4.87	9.28	9.04	19	6.55	5.91
Total Nitrogen	mg/L	-	2.5	3.2	1.6	3.3	2.4	3.6
Total Phosphorus	mg/L	5 [1]	0.31	<0.10	1.00	0.2	<0.10	0.6
Nitrate (NO_3)	mg/L	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Phosphate (PO_4)	mg/L	5 [1]	0.31	<0.10	1.00	0.2	<0.10	0.6
Ammoniacal Nitrogen	mg/L	1 [2]	**2.32**	**3.00**	**1.45**	**3.02**	**2.1**	**3.33**
Arsenic (As)	mg/L	0.1 [1]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium (Cd)	mg/L	0.1 [1]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Copper (Cu)	mg/L	0.1 [1]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lead (Pb)	mg/L	0.1 [1]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)	mg/L	1 [1]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel (Ni)	mg/L	1 [1]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Iron (Fe)	mg/L	10 [1]	<0.10	1.46	1.68	8.32	0.55	0.47
Chromium (Cr)	mg/L	1 [1]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury (Hg)	mg/L	0.05 [1]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Enterococcus	cfu/100mL	200,000 [3]	8	5	7	100	7	26

Note: Values in **bold** and shaded grey denote non-conformity to the respective water quality standard.

[1] NEA's Allowable Limits for Trade Effluent Discharge to Watercourse guideline (2020)

[2] Vietnam's National Technical Regulation on Surface Water Quality for Protection of Aquatic Lives (QCVN 38:2011/TTBTNMT) (2011)

[3] Values for wet weather sample in Australian Guideline for Urban Stormwater Management (2000)

In general, the surface water quality of streams within the project study area complied with the applicable standards (National Environment Agency, 2020; Ministry of Natural Resources and Environment of Vietnam, 2011; Agriculture and Resource Management Council of Australia and New Zealand, 2000). There were, however, instances where the readings were outside the threshold limits.

Dissolved Oxygen (DO) concentrations were lower than the threshold at WS1–2, WS1–3 and WS2 during dry weather and at WS2 during wet weather. Their values were under 4 mg/L, which is below the threshold considered ideal for the survival of aquatic life

(Ministry of Natural Resources and Environment of Vietnam, 2011). Although DO is lower than the threshold in Stream 1, the aquatic surveys have shown that a variety of freshwater fishes and molluscs can survive and thrive in that habitat. However, the species found in this stream (including the locally rare apple snail *Pila scutata*) are known to exist in disturbed habitats.

Total Suspended Solids (TSS) values exceeded the threshold at WS2 during dry weather, and at WS1-3 and WS2 during wet weather. During site visits, it was observed that WS2 was stagnant at multiple instances. This could have allowed sediments to remain at the same location, hence accumulating more suspended solids at a relatively more stagnant stream (Stream 2) than at flowing streams (Streams 1 and 3).

Ammoniacal Nitrogen concentrations exceeded the threshold at WS1-1, WS3-1, and WS3-2 during dry weather, and at all six sampling points during wet weather. This can be potentially explained by certain human activities (e.g., waste accumulation, fertilising) happening outside the study area and polluting the upstream portion of this water body.

Iron (Fe) concentrations were higher than the threshold at WS2 only during dry weather, which is likely due to a local accumulation of iron in the soil.

Most of the parameters tested in the previous EBS complied with NEA standards (2020). In the previous study (AECOM, 2020), two samples from Stream 1 (WQ1_1 and WQ1_2) were shown to have low concentrations of dissolved oxygen during both dry and wet weather. This is similar to our present surveys which also found low concentrations of dissolved oxygen near midstream and downstream of Stream 1.

According to the whole of the survey results, the existing water bodies within the study area are generally in good condition, except for the parts of streams with the stagnant water conditions. These results provide the short-term trend based on current surveys. An extended period of water quality monitoring can help to define the water quality of these streams more accurately based on long-term trend.

5.6 Hydrological Modelling

5.6.1 Approach and Methodology

Hydrological Model

The purpose of the hydrological model is to identify water bodies (drainage network/natural earthen stream), catchment/sub-catchment boundaries, baseline flow conditions (dry and wet weather), and to establish a design discharge. This was done based on available data such as topographical information, CAD drawings, site visits, flow measurement at the site, and other public sources of information. In order to develop a hydrological model for this site, both HEC-HMS and QGIS open-source software were used.

HEC-HMS

The Hydrologic Modeling System (HEC-HMS) is designed to simulate the complete hydrologic processes of dendritic watershed systems. It is a product of the Hydrological

Engineering Center (HEC) within the U.S. Army Corps of Engineering and is a widely used open-source software. The software includes many traditional hydrologic analysis procedures such as event infiltration, unit hydrographs, and hydrologic routing. HEC-HMS is used for watershed and stream delineation and flow analysis for the study.

QGIS

QGIS (or Quantum GIS) is a free and open-source geographic information system (GIS), widely used in a wide range of academic and applied fields. GIS allows for the combination of tabular data with geographical boundaries and much more applications. For this study, QGIS is used for data conversions and visualisation purposes.

Watershed and Stream Delineation

The topographical data (within study boundary, see Figure 5.13) provided by the client, open-source elevation data (SRTM, 30m DEM for outside study boundary), and other publicly available data were used for the watershed analysis. Using the topographical data points (Figure 5.13), an appropriate digital elevation model (DEM) of 10 cm grid resolution was developed using QGIS software and shown in Figure 5.14. From the DEM map, a slope map was prepared and presented in Figure 5.15. For the outside study area, Shuttle Radar Topography Mission (SRTM) DEM data was used and shown in Figure 5.16.

Using the SRTM DEM, an approximate watershed boundary was delineated beyond the study area to get an overview of the catchment size (see Figure 5.17). Figure 5.18 shows the fine resolution of the watershed (catchment/sub-catchment) boundary within the study area for each stream. Based on these datasets, Figure 5.19 was generated to show the catchment/sub-catchment boundary including an upstream sub-catchment that contributes flow into the main natural stream (Stream 1) in the study area. Finally, Figure 5.20 shows the subbasins (or sub-catchments) with the corresponding area (m^2) and drain network for the natural stream (Stream 1) that is important for this Environmental Study.

Flow measurement and estimation

While flow depth and rate measurements were carried out within the constraints of the site, the measurements are at best approximates and should only be used for indicative references, as accurate measurement of flow rate along a natural stream is not practical. As the dry weather flows are minimal and the natural channels of the streams have irregular dimensions, it is difficult to measure with the sensors available in the market. In the context of the study site, the best method is to use the float method to estimate the surface velocity of the flow and measure the depth and dimension of the cross section during the flow measurement, which was the method that was deployed for this study.

The measurement locations were selected based on first site visit and depicted in Figure 5.11:

- SC1-1 located in the upstream part of the stream
- SC1-3 located in the downstream part of the main stream before branch stream connecting point

- SC1-4 located in the upstream part of the branch stream that connects to the midstream of main stream
- SC1-5 located in the downstream part of the branch stream that joins with main stream
- SC1-6 located in the outlet point of the main stream discharged into Ulu Pandan canal (outside the study boundary)

On each measurement day, three flow measurements were taken using float method and the average value will be derived for the final flow measurement. Cross-sectional and flow depth details were also noted at the same measurement points. These measurements were conducted at two dry weather events and two wet weather events on separate days, within the short period available for the study.

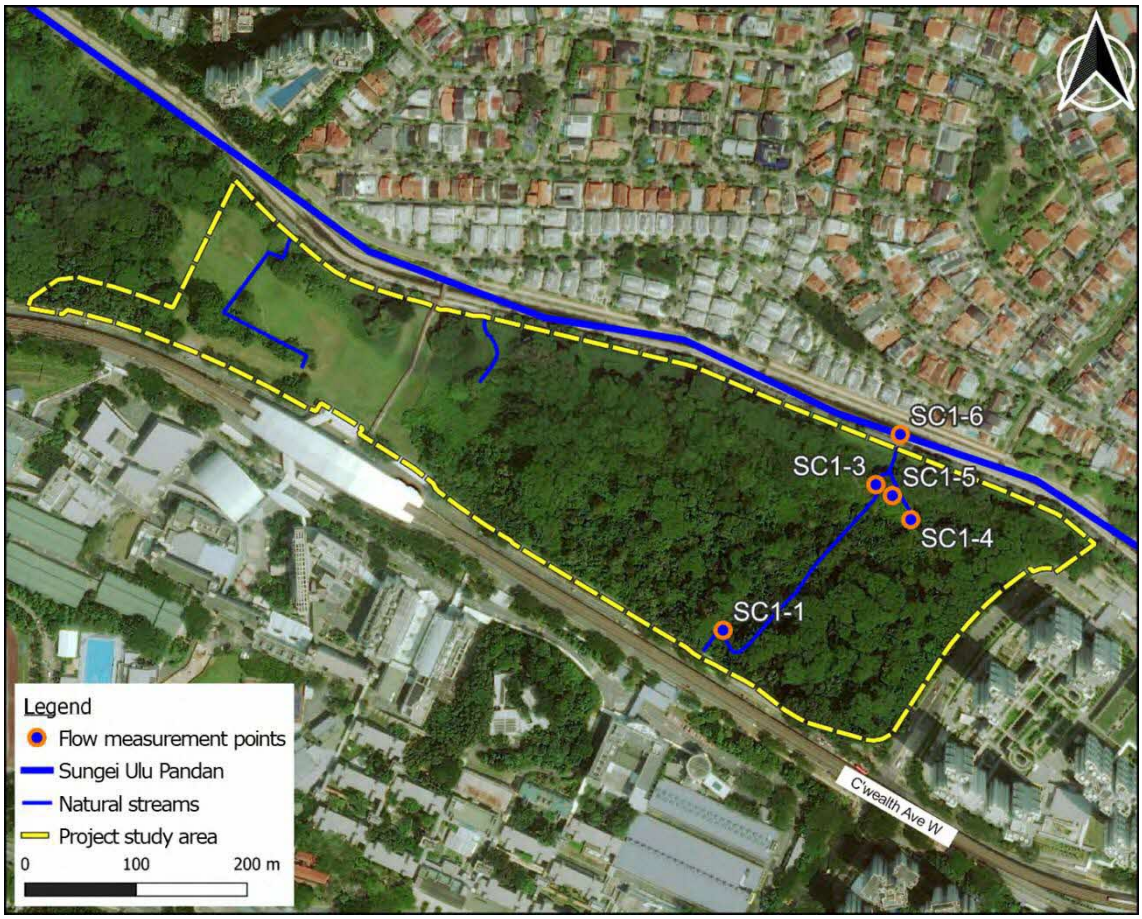


Figure 5.11 Flow measurement points within a natural stream (Stream 1)

The daily rainfall data corresponding to the measurement date was extracted from NEA website (Figure 5.12) for the Clementi rain gauge location. The daily rainfall values were tabulated in Table 5.11.



Figure 5.12 Rain gauge locations across Singapore from NEA website

Table 5.11 Daily rainfall data from Clementi station (Source: http://www.weather.gov.sg/climate-historical-daily/)

Date	Daily rainfall (mm)	Remarks	Measurement points
11/04/2022	52.8	Dry & Wet Weather	SC1-1, SC1-4, SC1-5, SC1-3, SC1-6
18/04/2022	22.8	Wet Weather	SC1-1, SC1-4, SC1-5, SC1-3
22/04/2022	0.0	Dry Weather	SC1-1, SC1-4, SC1-5
28/04/2022	13.0	Dry Weather	SC1-1, SC1-4, SC1-5, SC1-3, SC1-6
29/04/2022	0.0	Dry Weather	SC1-3, SC1-6
25/05/2022	30.8	Wet Weather	SC1-6
16/06/2022	NA	Wet Weather	SC1-6

Float Method

The float method is popularly used when other methods are not feasible for a channel/stream. Michelle et al. (2009) compared different stream gauging techniques for low flow measurements in two streams. The study reveals that the float method exhibited the highest accuracy in the field study and comparable to current meter values especially for low flows.

For natural streams with high roughness with natural banks and vegetations, the velocity measurements are expected to be much less than the lowest range of design velocity, 1 m/s. Public Utilities Board Code of Practice (PUBCOP) (Public Utilities Board (PUB), 2018) document highlighted that the maximum design velocity for concrete drain is about 3 m/s whereas for natural stream it is limited to 1.5 m/s (half of the concrete drain design velocity). The lowest design velocity for concrete drain is highlighted as 1 m/s.

Wherever float method is not possible due to site constraints, a container filling method is adapted, where the particular capacity of the container will be filled and time to fill the container will be recorded to get the direct discharge value for the location as an approximation. This method is adapted to SC1-6 where float method is not possible due to restricted site access, safety concerns during heavy rain, and measurement difficulty at site. However, this method also has limitations in being able to cover entire flow into the container and may result more flow bypassing the container while filling, leading to poor measurement accuracy. Due to this accuracy issue, the readings from SC1-6 through container method is not included for flow analysis. Instead, a critical flow formula is used for a circular pipe outlet to get an equivalent critical flow value for the observed flow depth considering the flow is reaching critical flow before free outfall.

5.6.2 Results

Hydrological Model

The results of the hydrological modelling conducted using available data sources and methodology stated in Section 5.6.1 are as below.

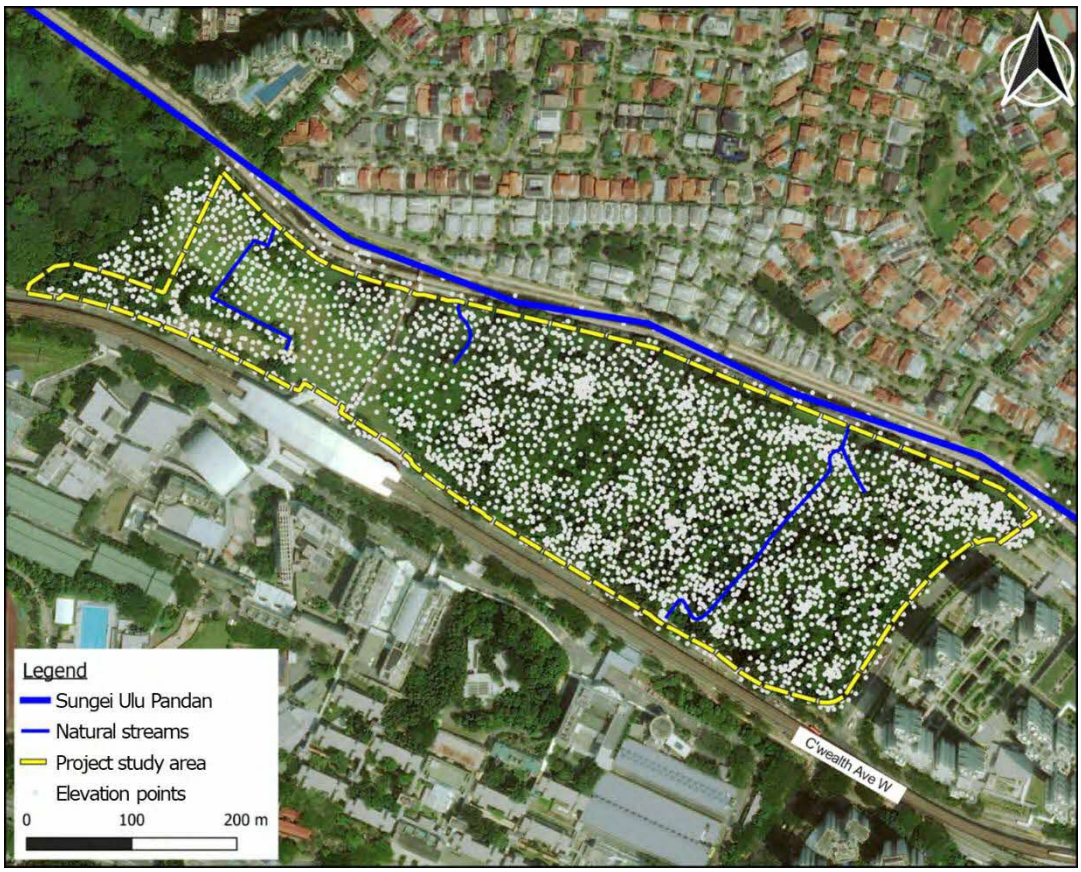


Figure 5.13. Map of the elevation data points

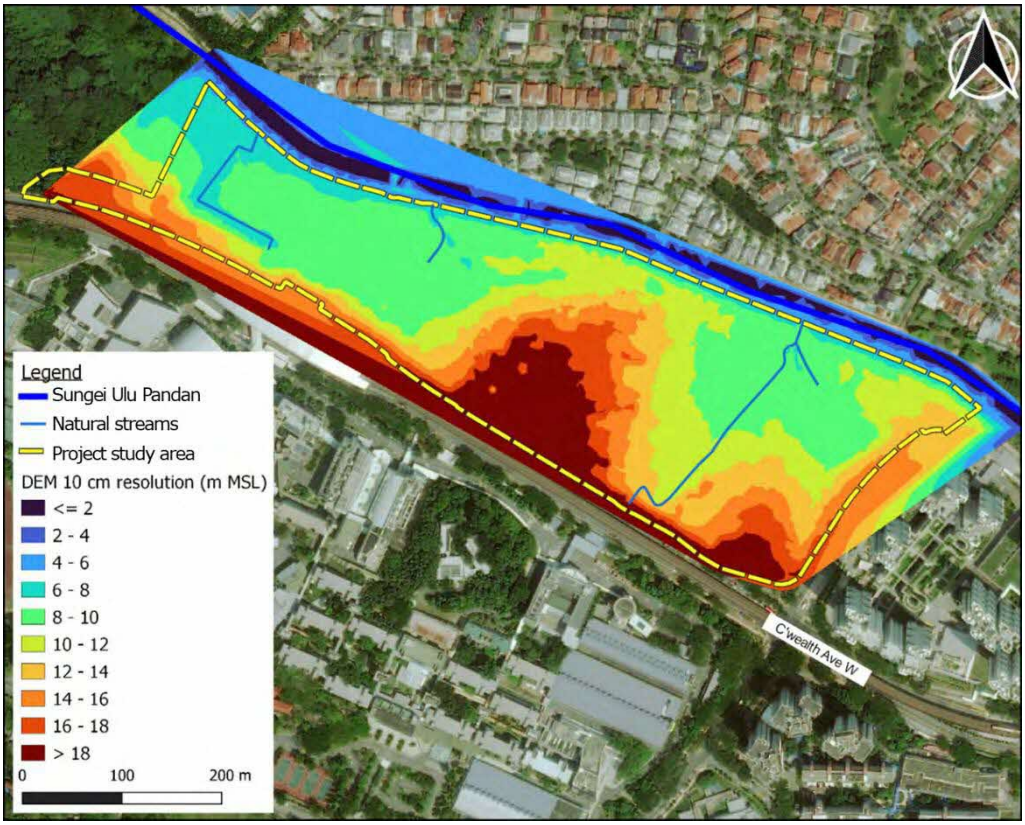


Figure 5.14 DEM for the study boundary

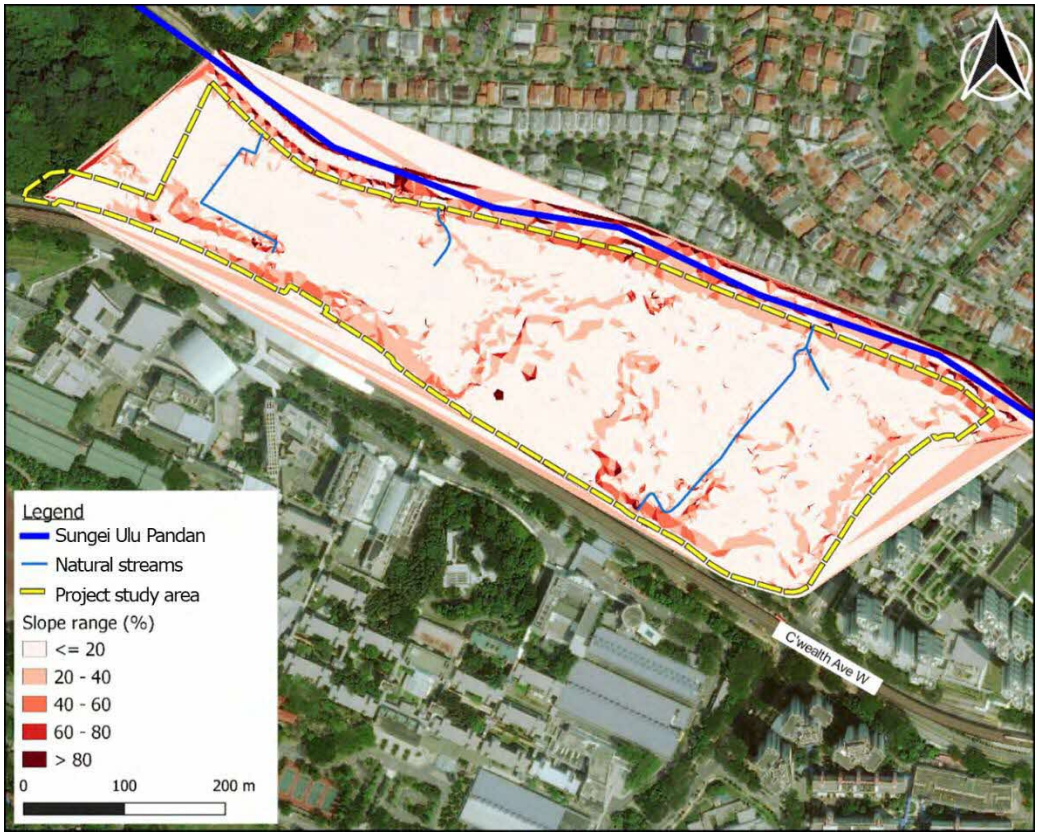


Figure 5.15 Slope map for the study boundary

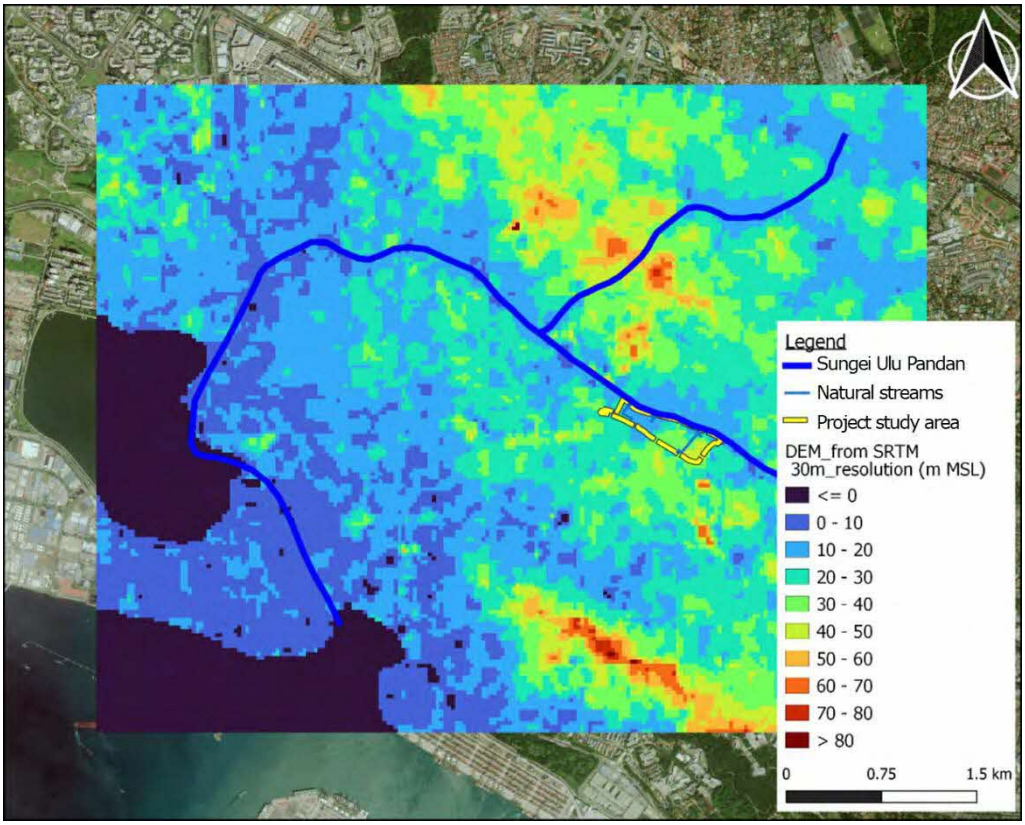


Figure 5.16 DEM from SRTM data (30m resolution) beyond the study boundary

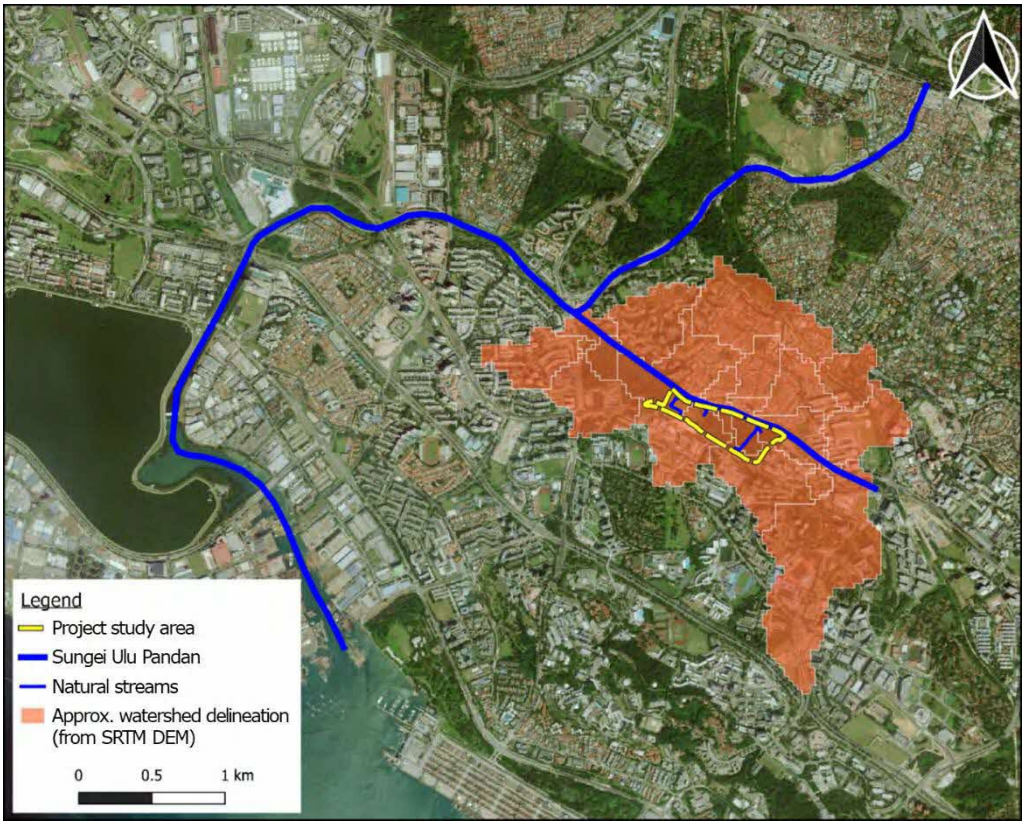


Figure 5.17 Approximate watershed delineation using SRTM DEM data beyond the study area

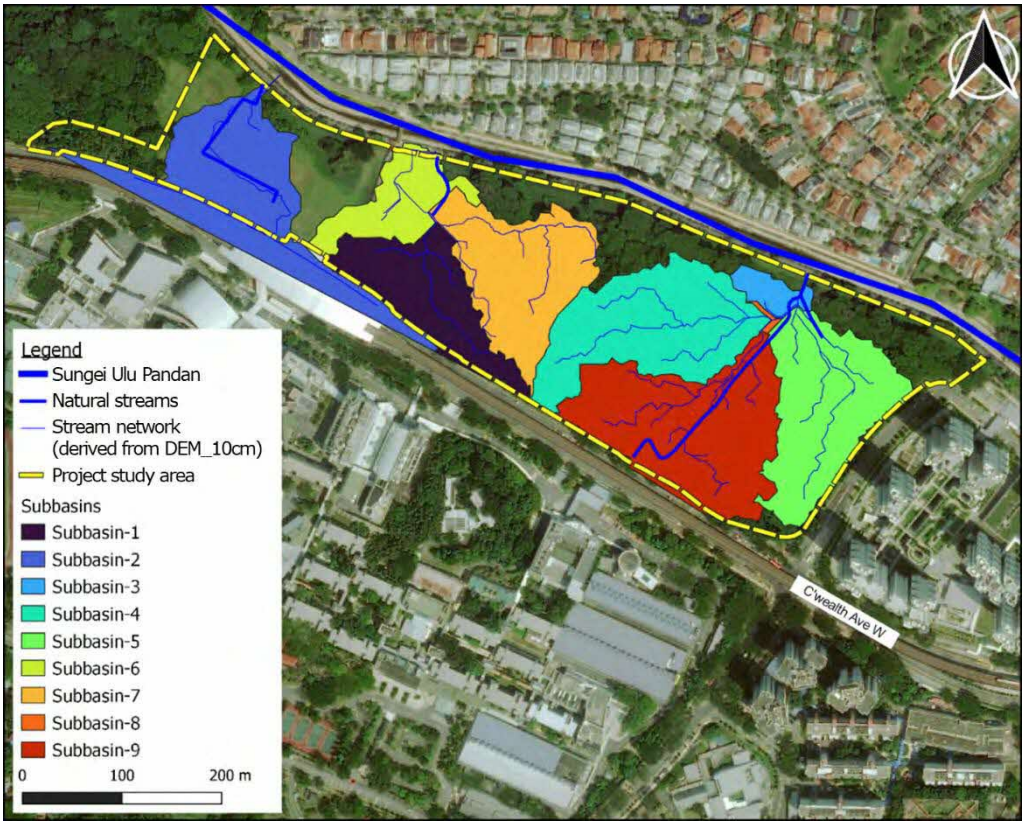


Figure 5.18 Subbasins (sub-catchments) and drain network using DEM within the study area

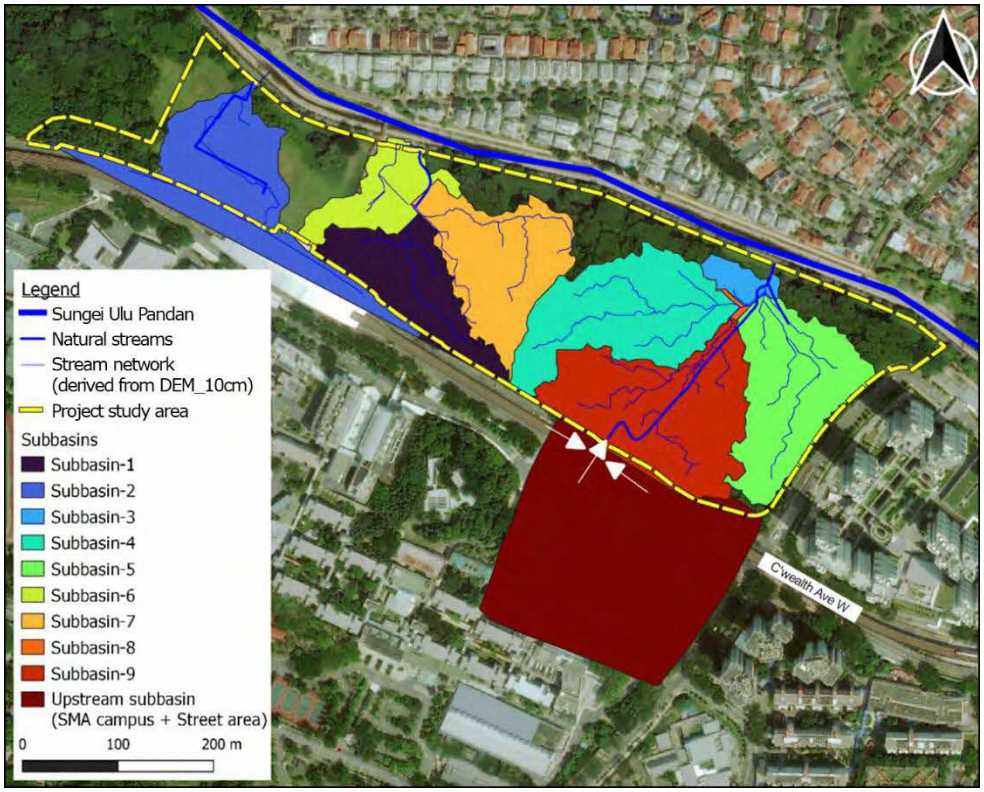


Figure 5.19 Subbasins (sub-catchments) and drain network including the upstream SMA campus and street area that discharge into the natural stream beyond the study area



Figure 5.20 Subbasins (sub-catchments), area (m^2) and drain network for the natural stream (Stream 1)

Dry Weather Flow Estimations

Table 5.12 Dry weather flow estimations

Date	Location (from upstream to downstream)	Velocity, V (m/s)	Wetted Area, A (m^2)	Discharge, Q = AV (m^3/s)	Remarks
22/04/2022	SC1-1	0.210	0.0114	0.002	Cross section is equivalent to a triangle section
28/04/2022	SC1-3	0.0433	0.712	0.031	Equivalent to a trapezoidal cross-section
22/04/2022	SC1-4	NA	NA	NA	Stagnant (ponded) water; Wider cross-section
22/04/2022	SC1-5	0.195	0.025	0.005	Equivalent to a trapezoidal cross-section
28/04/2022	SC1-6	NA	NA	NA	Pipe Outlet. Flow measurement through container filling method is ignored.
	SC1-3 + SC1-5	-	-	0.036 (0.031 + 0.005)	Total flow downstream
28/04/2022	SC1-1	0.185	0.012	0.002	Cross section is equivalent to a triangle section
29/04/22	SC1-3	0.0288	0.731	0.021	Cross section is equivalent to a trapezoidal section
28/04/22	SC1-4	NA	NA	NA	Stagnant (ponded) water;

Date	Location (from upstream to downstream)	Velocity, V (m/s)	Wetted Area, A (m^2)	Discharge, Q = AV (m^3/s)	Remarks
					Wider cross-section
28/04/22	SC1-5	0.131	0.028	0.004	Equivalent to a trapezoidal cross-section
29/04/22	SC1-6	NA	NA	NA	Pipe Outlet. Flow measurement through container filling method is ignored.
	SC1-3 + SC1-5	-	-	0.025 (0.021 + 0.004)	Total flow downstream
11/4/2022	SC1-6	NA	NA	0.021	Dry weather flow before rain starts. Based on circular pipe outlet, critical flow formula, from depth of 8 cm observed.

The float method shows the Dry Weather Flow (DWF) at the downstream point (SC1-3+SC1-5, and SC1-6) as 0.021 to 0.036 m^3/s based on field measurements.

Wet Weather Flow Estimations

During wet weather flow, larger water surface area and levels are observed and potentially act as a storage effect within the drain network before discharge into Ulu Pandan Canal. While the wet weather flow is not the main concern for sustainability of the natural stream, it is still of interest to know the flood impacts in the stream catchment.

Table 5.13 Wet weather flow estimations

Date	Location (from upstream to downstream)	Velocity, V (m/s)	Wetted Area, A (m^2)	Discharge, Q = AV (m^3/s)	Remarks
11/04/2022	SC1-1	0.194	0.02	0.004	Cross section is equivalent to a triangle section
11/04/2022	SC1-3	0.0321	0.871	0.028	Equivalent to a trapezoidal cross-section
11/04/2022	SC1-4	NA	NA	NA	Stagnant (ponded) water; Wider cross-section
11/04/2022	SC1-5	0.546	0.036	0.02	Equivalent to a trapezoidal cross-section
11/04/2022	SC1-3 + SC1-5	-	-	0.048 (0.028 + 0.02)	Total flow downstream
18/04/2022	SC1-1	0.217	0.0363	0.008	Cross section is equivalent to a triangle section
18/04/2022	SC1-3	0.0833	0.594	0.050	Equivalent to a trapezoidal cross-section
18/04/2022	SC1-4	NA	NA	NA	Stagnant (ponded) water; Wider cross-section
18/04/2022	SC1-5	0.391	0.042	0.016	Equivalent to a trapezoidal cross-section
18/04/2022	SC1-3 + SC1-5	NA	NA	0.066	Total flow downstream

Date	Location (from upstream to downstream)	Velocity, V (m/s)	Wetted Area, A (m^2)	Discharge, Q = AV (m^3/s)	Remarks
				(0.050 + 0.016)	
25/05/2022	SC1-6	NA	NA	NA	Pipe Outlet Flow measurement through container filling method is ignored.
16/06/2022	SC1-6	NA	NA	0.048	Pipe Outlet. Flow measurement through container filling method is ignored; Based on circular pipe, critical flow formula, from depth of 12 cm observed.

The wet weather flow in the downstream point is estimated as 0.048 to 0.66 m^3/s (SC1-3+SC1-5, and SC1-6) from the field measurements.

5.6.3 Summary

The hydrological conditions of the site are characterised by a general flow in the northeast direction (upstream to downstream), where the established streams have man-made culverts providing the source of discharge at the upstream segments of the stream, which then create naturalised channels through the site until the discharge exits again via man-made culverts into a canal outside of the study boundary. Throughout the study site, temporary streams and ponding occur frequently, with low velocity or stagnant flows, especially after rainfall events.

The main sub-catchment (subbasin 1) of Stream 1 receives a regular dry weather flow (during non-rainy days) from the upstream catchment (subbasin 5) that constitutes SMA campus and street area, which is outside the project area. As such, as long as the flow is not channelled into new drains from the upstream area, the post-development flow is not expected to be impacted by the upcoming development.

The impact assessments of the construction on the hydrological baseline of the site, as well as the mitigation measures to address them will be covered in Section 5.7 below.

5.7 Impact Assessment

5.7.1 Identification of Potential Impacts

Pre-construction / Construction Phase

The Environmental Study area comprises of secondary forest and three natural streams. Activities planned during pre-construction (building construction phase is not part of the impact assessment) in this area include, site clearance, streams backfilling, pipejacking for the installation of sewer pipelines, and earthworks.

Based on these activities, the following potential impacts on hydrology and surface water quality are identified:

Disturbance to Local Hydrological Pattern

Three natural streams are located within or nearby the project direct footprint namely Streams 1, 2 and 3 (see Figure 5.3). These natural streams are habitats for aquatic fauna and construction activities altering the streams will cause degradation and loss of the riparian habitats (Stream 2, 3). The streams within the study area will be affected by the proposed pre-construction phase to various degrees. Stream 2, including the swampy areas, will be backfilled to cater for the construction of new infrastructure and facilities, while Stream 3 will be channeled to a concrete bank.

While the intention is for Stream 1 to be retained post-development, Stream 1 may be slightly affected by the proposed development due to the location of the proposed drain that will interfere with the stream's flow. The main sub-catchment (subbasin 1) of Stream 1 receives a regular dry weather flow (during non-rainy days) from the upstream catchment (subbasin 5) that constitutes SMA campus and street area. The flow from subbasin 5 (SMA campus) is likely to have come from the overflow and sub-surface flow contributed from an existing small pond within the campus and other rainwater harvesting structures in the campus. In order to retain the natural stream after the development, the upstream flow from subbasin 5 should be maintained. However, due to the location of the newly proposed drain (Drain No. 2) that is connected to the upstream of Stream 1 in subbasin 1, it is possible that the flow could be diverted away from the natural stream (Stream 1) into the proposed drain (Drain No. 2), which will negatively impact the naturally channelised riparian environments and its associated flora and fauna along Steam 1. It is therefore important to ensure that the source of the flow is maintained in Stream 1 in order to minimise the impact of the development on the stream. More on mitigation measures for the development of this stream will be covered in the Section 5.8 below.

Soil Erosion and Surface Run-off

Construction run-offs may cause physical, biological, and/or chemical impacts to the water streams within study area during the pre-construction phase. The sources of pre-construction run-offs include:

- Land clearance and site preparation of construction work areas
- Run-off from exposed soil surface and earth working areas.
- Soil investigation works

The physical effects include potential blockage of drainage channels and increased concentrations of suspended solids in the drainage channels. Adverse impacts to drainage pattern may occur from soil erosion and sediment transport during storm events. Impacts would be greatest in areas with exposed, disturbed soil. This impact could worsen if there are soil stockpiles left unprotected in the construction area and no mitigation measures in place. Run-offs containing particulates will increase concentrations of suspended solids, sediments, and other contaminants and thus create additional burdens on the existing drainage system in the project site.

Significant amounts of silt discharge into water streams may affect the local ecology if proper mitigation measures are not implemented.

Trade Effluent

Activities such as piling works and soil investigation are expected to generate trade effluent, which include processed wastewater such as slurry, concrete washout, and excess grouting materials from construction activities. If trade effluent contains significant amount of concrete and cement-derived materials, it may cause primary chemical effects such as increasing turbidity, discoloration, elevation in pH, and accretion of solids. A number of secondary effects may also result in intoxication of water biota due to elevated pH value, and reduced decay rate of microorganisms and photosynthetic rate due to the decreased light penetration.

Hence, this trade effluent from pre-construction site shall not be discharged to any receiving watercourse without prior treatment. It must be treated separately from surface runoff before being discharged. The treated trade effluent from construction activities must have written approval from NEA if it will be discharged into public storm water or PUB if it will be discharged into public sewers. The trade effluent must also be treated to levels prescribed by NEA if it will be discharged into the public drain or PUB if it will be discharged into the public sewer.

Fuel & Chemical Spillage and Waste Disposal

The pre-construction activities may require on-site storage and handling of potential polluting material such as fuel, lubricant, cement, as well as packaging materials. The following sources can affect the water quality within project area.

- Fuel and lubricants from maintenance of vehicles and equipment;
- Illegal dumping of debris and rubbish (such as packaging, construction materials, and waste); and
- Accidental spillage of liquids stored on-site; e.g., oil/grease, solvents.

No hazardous chemicals as specified under EPM (Hazardous Substances) regulations are expected to be used in the construction activities in this area.

Sewage Discharge

The onsite sanitary facilities within pre-construction work areas may generate sewage. The discharge of sewage into the surrounding Ulu Pandan Canal either directly or indirectly could adversely impact the water quality of the receiving streams. It is expected that the Contractor will deploy adequate portable toilets for construction personnel. These toilets shall be cleaned and maintained by approved sanitary waste collector. Hence, no impact is expected from sewage discharge on surface water quality.

The impacts and effects on water quality from the pre-construction activities is expected to be controlled with the implementation of a well-designed temporary drainage system within work area and proposed mitigation measure provided in the next Section.

Post-Construction Phase

At the post-construction phase, Stream 1 is expected to be retained in the development,

while Stream 2 will be backfilled, and Stream 3 will be channeled into a concrete bank. Impacts to water quality and hydrology for this development mainly include sedimentation in water courses due to silty runoff from exposed soil.

Upon the completion of this project, building works for the upcoming residential developments are likely to commence. TAC recommends that the impacts from the building construction phase of this project are to be assessed separately.

5.7.2 Evaluation of Potential Impacts

Table 5.14 summarises the impacts with their corresponding Environmental Scores before and after the implementation of mitigation measures, which are elaborated in the following section.

5.8 Mitigation Measures

5.8.1 Pre-construction / Construction Phase

In order to mitigate impacts to hydrology and water streams from development activities, the following measures are recommended.

Disturbance to Local Hydrological Pattern

Due to the importance of Stream 1 to be retained as a habitat for aquatic fauna, the planned project should ensure that the flow of that stream is not affected by the development activities. The edges of the stream could also be further enhanced with native riparian vegetation to increase the resilience of the stream habitat to impacts from changes due to the proposed development. The dry weather flow of Stream 1 is to be maintained by discharge coming from the small pond in the SMA campus located in subbasin 5. This is the lifeline of the ecosystem sustaining the natural stream in the study area.

To ensure that mitigation measures are effective in protecting the stream habitat, regular monitoring of Stream 1 is to be conducted. Details of the specific monitoring requirement will be provided in the CEMMP document.

Other mitigation measures for changes to the local hydrological pattern include:

- Hoarding to be erected around the retained stream area
- Ensure that no site investigation boreholes are located within 10 m of Stream 1.
- The minimum dry weather flow to be maintained in the natural stream for sustainability.
- In case of flood risk and avoiding too much ponding during wet weather, the upstream flow from the SMA campus can be diverted or bypassed (only during heavy rain events) during the design of the drainage system in the study area.
- To do the diversion during extreme event and also to have consistent dry weather flow within the natural stream, the proposed open sump (Figure 5.19) has to be designed appropriately in the study site.
- Construction vehicles to use the main road and avoid cutting through the retained stream area.

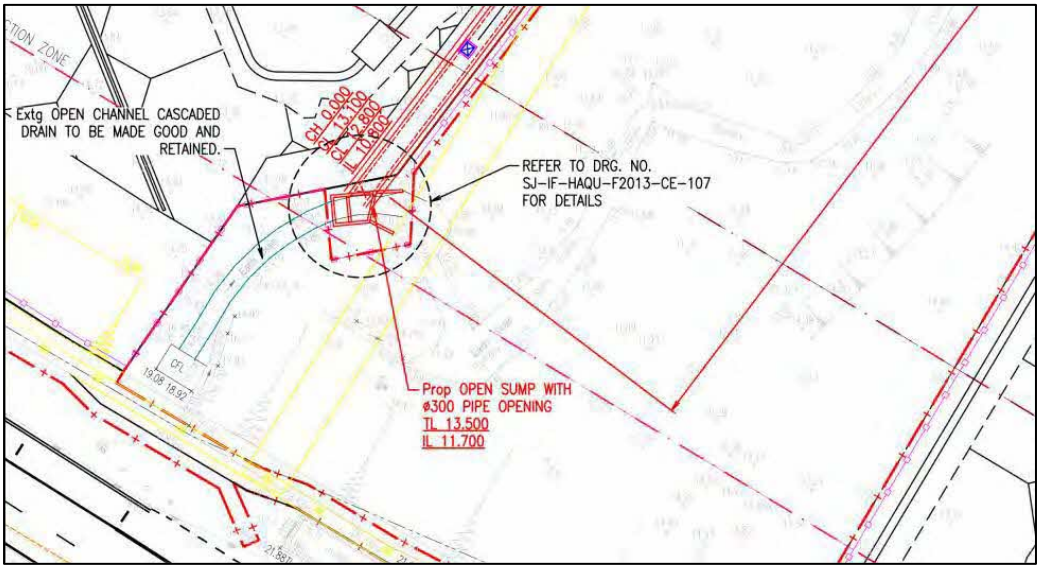


Figure 5.21 Open Sump proposed in the upstream part of the natural stream, obtained from Contractor

Implementation of Earth Control Measures (ECM)

An appropriate ECM plan is to be prepared and endorsed by a Qualified Erosion Control Professional (QECP) before the commencement of construction works in all Areas. Moreover, the ECM plan should cover the following items:

- Contractor to engage QECP to prepare the ECM plan and PUB's approval to be obtained for ECM plan.
- ECM plan to be implemented by the Contractor before staring the work.
- ECM tanks utilised for the project must have surplus capacities to minimise overflow and silty discharge.
- Proper sediment control measures designed to capture and retain silt are to be implemented which may include perimeter cut-off drains, perimeter silt fence, silt traps and silt treatment systems.
- QECP to review ECM plan implementation regularly during the construction period to ensure that the measures put in place remain effective.
- Regular monitoring of ECM treatment plant performance is to be carried out by the Environmental Control Officer (ECO).
- Regular maintenance of ECM is to be carried out.
- The Contractor shall access weather forecast from the NEA website to take ECM actions before rain events.
- After rain events, earth control measures in the Area are to be inspected and maintained over the course of construction.
- To ensure that site discharges are treated to comply with respective allowable limits (e.g., 50 mg/L of TSS for discharges processed through ECM and 30 mg/L of TSS for trade effluent) before discharging into a public drain.
- Exposed earth areas shall be reduced by phasing earth works and effective scheduling of construction activities to minimise bare surfaces, planning of site layout and effective site drainage systems to facilitate flow. Measures may include the use of paving, biodegradable erosion control blankets, and canvas

covers.

- ECM should only be removed after completion of the works. The QECP should authorise removal of the ECM.

Oil, Fuel & Chemical Spillage and Waste Disposal Management

- All slurry preparation activities are to be conducted within a designated area that has adequate containment measures.
- To ensure that slurry water, including slurry, is contained within the working area and does not enter any watercourses or surface water drains.
- Storage tanks for slurry and supply lines should be located as far as possible from surface water drains or watercourses.
- Micropile storage tanks for slurry should have secondary containment.
- Waste bins to be provided within the construction work area for proper disposal of construction debris and rubbish. Foreign material should not be illegally disposed at the water bodies but removed from site by a licensed waste collector.
- All liquids should be properly labelled and stored in appropriate containers at safe location on site (i.e., under a shelter with kerb surrounding). Personnel handling these liquids should also be suitably trained.
- Vehicle fuelling and major maintenance to be minimised within the project area.
- Appropriate concrete wash bays should be provided and should not be performed in or near any water body.
- Water used for dust control should not be allowed to cause erosion within the work area or to run offsite.
- Excess loose soil and rock to be contained prior to the commencement of works.
- Regular water quality monitoring is to be conducted according to the proposed Environmental Monitoring Plan during construction and post-construction stage.
- Foreign material should not be illegally disposed at the water bodies but removed from site by a licensed waste collector.
- To ensure that diesel has stopped leaking from the hose before removing it.
- To ensure that the inside of the hose is cleared after refueling.
- Emergency spill kits should be provided by contractor on site in the event of any chemical spillages. Emergency response team should also be trained in the use of these spill kits.

Trade Effluent Management

- Contractor to provide storage tanks of adequate size and sufficient numbers to temporarily store trade effluent before treatment and disposal.
- Contractor to provide sampling point and inspection for collection of trade effluent to be tested for parameters stipulated in the Regulations, depending on the discharge point (i.e., sewer, watercourse, controlled watercourse).
- Regular water quality monitoring is to be conducted according to the proposed Environmental Monitoring Plan during construction and post-construction stage.
- Contractor should install and maintain trade effluent treatment facilities (e.g., slurry treatment plant, grease trap and suspended solid settling tank) as per NEA's requirements.
- Area where trade effluent is being transported out to be kerbed to minimise spills

5.8.2 Post-Construction Phase

As Stream 1 will be retained in the site post-construction, there is a need to ensure that the source of the flow coming from the SMA campus is maintained for Stream 1, as it is the lifetime of the ecosystem sustaining the stream. It should also be ensured that the discharge of process effluent or release of pollutants through this outlet into the stream should not be allowed to avoid adverse impact on the ecosystem due to water quality degradation. In the case where there is suspicion of discharge or pollutants to this stream, water quality checks can also be conducted.

5.9 Residual Impacts

The residual impacts were evaluated using the RIAM method (Table 5.14) with due consideration that the recommended mitigation measures are implemented by the Contractor. The residual impacts are in the band of slight negative and considered acceptable.

Table 5.14. Environmental Scores of the identified impacts on site's hydrology & water quality with corresponding mitigation measures

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Ecology																
Pre-construction / Construction	Degradation and loss of stream habitats	2	-3	3	3	2	-48	Minor negative	• The minimum dry weather flow to be maintained in the natural stream for sustainability • Design and incorporate open sump (Figure 5.21) • Ensure that none of the site investigation boreholes are located within 10 m of the natural streams • Regular water quality monitoring is to be conducted according to the proposed Environmental Monitoring Plan during construction and post-construction stage • Design appropriately to ensure that stormwater flow can be controlled during heavy rain period • Hoarding to be erected around the retained stream area • Construction vehicles to use the main road and avoid cutting through the retained stream area	2	-2	3	3	2	-32	Slight negative
	Impact to water quality due to sediment runoff and trade effluent	2	-3	2	2	2	-42	Minor negative	• Contractor to provide sufficient storage tanks of adequate size to temporarily store trade effluent before treatment and disposal. • Area where trade effluent is being transported out to be kerbed to minimise spills • Contractor to provide sampling point and inspection for collection of trade effluent to be tested for parameters stipulated in the Regulations, depending on the discharge point (i.e., sewer, watercourse). • Regular water quality monitoring is to be conducted according to the proposed	2	-2	2	2	2	-24	Slight negative

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
									Environmental Monitoring Plan during construction and post-construction stage. • Contractor should install and maintain trade effluent treatment facilities (e.g., slurry treatment plant, grease trap and suspended solid settling tank) as per NEA's requirements. • Appropriate concrete wash bays should be provided and should not be performed in or near any water body.							
Pre-construction / Construction	Impact to water quality due to accidental spillage of construction materials, fuel, and solvents	2	-2	2	2	3	-28	Slight negative	• To ensure that slurry is contained within the working area and does not enter any watercourses or surface water drains. • Micropile storage tanks for slurry should have secondary containment. • Foreign material should not be illegally disposed at the water bodies but removed from site by a licensed waste collector. • Waste bins to be provided within the construction work area for proper disposal of construction debris and rubbish. • Vehicle fuelling and major maintenance to be minimised within the project area/ No vehicle fuelling and maintenance to be allowed within the project area. • Excess loose soil and rock to be contained prior to the commencement of the works. • Diesel/ fuel tanks are to be located away from water bodies. • To ensure that diesel has stopped leaking from the hose before removing it • To ensure that the inside of the hose is cleared after refuelling	2	-1	2	2	2	-12	Slight negative

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
									• Appropriate concrete wash bays should be provided and should not be performed in or near any water body. • Emergency spill kits should be provided by contractor on site in the event of any chemical spillages. Emergency response team should also be trained in the use of these spill kits.							
Post-Construction	Impact to drainage pattern and water quality in Stream 1	2	-3	3	3	2	-48	Minor negative	• Ensure that the source of the flow is maintained in Stream 1 in order to minimise the impact of the development on the Stream 1. • Design and incorporate open sump • No discharge of process effluent or release of pollutants through this outlet to the stream. • Flow rate of discharge is to be regulated to prevent erosion within receiving stream. • Water quality checks if there is suspicion of discharge of pollutant to the stream.	2	-2	2	2	2	-24	Slight negative
Human Health and Safety																
Pre-construction / Construction	Impact to water quality due to accidental spillage of construction materials, fuel, and solvents	2	-2	2	2	3	-28	Slight negative	• Contractor to provide storage tanks of adequate size and sufficient numbers to temporarily store trade effluent before treatment and disposal. • Contractor to provide sampling point and inspection for collection of trade effluent to be tested for parameters stipulated in the Regulations, depending on the discharge point (i.e., sewer, watercourse, controlled watercourse). • Contractor should install and maintain trade effluent treatment facilities (e.g., slurry treatment plant, grease trap and suspended solid settling tank) as per NEA's requirements	2	-1	2	2	2	-12	Slight negative

6 NOISE

6.1 Introduction

The project study area is largely forested areas with a scrubland in between, located southwest of Singapore. Main source of noise comes from the transit at Dover MRT station, the traffic in Ghim Moh Link to the east, and Commonwealth Avenue West to the south, with occasional source being the activities conducted by residents in the nearby residential areas.

This section describes the relevant standard for the ambient noise that are applicable to the construction activities, the methodology and results for the baseline noise study. It also described potential noise impacts from construction works, and recommendation for mitigation measures. A quantitative impact assessment approach is being used for assessment of impacts.

6.2 Relevant Environmental Legislation, Guidelines and Standards

The Environmental Protection and Management (Control of Noise at Construction Sites) Regulation 2008 prescribes the maximum noise levels permissible at construction sites for different days of the week, different periods of the day, and different types of premises affected. The permissible levels are listed in Table 6.1.

Table 6.1. Maximum permissible noise levels from construction sites (source: SSO)

Types of affected buildings	Leq	7 am – 7 pm	7–10 pm	10 pm – 7 am
Mondays–Saturdays				
(a) Hospitals, schools, institutions of higher learning, homes for aged sick, etc.	Leq 12 hrs	60 dB(A)	50 dB(A)	
	Leq 5 mins	75 dB(A)	55 dB(A)	
(b) Residential buildings located less than 150 m from the construction site	Leq 12 hrs	75 dB(A)	-	
	Leq 1 hr	-	65 dB(A)	55 dB(A)
	Leq 5 mins	90 dB(A)	70 dB(A)	55 dB(A)
(c) Buildings other than those in (a) and (b) above	Leq 12 hrs	75 dB(A)	65 dB(A)	
	Leq 5 mins	90 dB(A)	70 dB(A)	
Sundays and Public Holidays				
(a) Hospitals, schools, institutions of higher learning, homes for aged sick, etc.	Leq 12 hrs	60 dB(A)	50 dB(A)	
	Leq 5 mins	75 dB(A)	55 dB(A)	
(b) Residential buildings located less than 150m from the construction site	Leq 12 hrs	75 dB(A)	-	
	Leq 5 mins	75 dB(A)	55 dB(A)	
(c) Buildings other than those in (a) and (b) above	Leq 12 hrs	75 dB(A)	65 dB(A)	
	Leq 5 mins	90 dB(A)	70 dB(A)	

No Work Rule on Sundays and Public Holidays

In addition to the setting of the permissible noise limits, NEA has also implemented a rule prohibiting work on Sundays and Public Holidays (PH) for construction sites located within 150 m away from residential premises and noise sensitive premises as follows:

a) Construction Work Commenced on or after 1st September 2011
   - No work allowed from 10 pm on Saturday/eve of Public Holiday to 7 am on the following Monday/day after the Public Holiday

Correction Factor for Baseline Background Noise Exceeding the Regulations

In certain areas, the baseline background noise levels may already exceed permissible noise levels outlined in Table 6.1. As such, the maximum permissible noise levels during the construction activities will be adjusted according to a correction factor. The value of this factor is subject to the difference between the background noise level and permissible noise level, as shown in Table 6.2 below. This correction factor is added to the higher of the two noise levels to produce a new permissible value during the construction activities.

Table 6.2. Value of correction factor accounting for baseline noise level exceedance

Difference between Permissible and Baseline Background Noise Levels (dB(A))	Correction Factor to be Added to the Higher of the Two Noise Levels (dB(A))
< 2	3
2 ≤ difference < 4	2
4 ≤ difference < 10	1
≥ 10	0

The EPM (Control of Noise at Construction Sites) Regulation 2008 is aimed to manage noise impacts on humans, rather than animals including birds, which have different hearing ranges.

6.3 Baseline Methodology

6.3.1 Sensitive Receptors Identification

Noise can lead to annoyance due to interference with communication or disturbance to receptors involved in leisure activities, as well as sleep disturbance. The effects of noise may vary with the individual receptor and is dependent on many factors such as the activity that the receptor is engaged in, as well as the duration of noise exposure.

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

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

The sensitive receptor potentially affected by the proposed project have been identified (Table 6.3) through a combination of desktop study and visual surveys at the study areas.

Table 6.3. List of identified noise-sensitive receptors

Type	Description	Approximate Distance*
Workers	People working on the site (e.g., construction workers, consultants)	Within Study Area
Flora and Fauna	Flora and fauna living within project study area	Within Study Area
Flora and Fauna	Flora and fauna in Ulu Pandan West	10m from Study Area

Type	Description	Approximate Distance*
Residential building	People at Holland Grove View	30m from Study Area
Residential building	People at Blocks 28 to 33 HDB Ghim Moh Link	40m from Study Area
Institution of higher learning	People at T11A, T11B, T1A, and W1 of Singapore Polytechnic	80m from Study Area

*Approximate distance from the nearest project work area

6.3.2 Baseline Field Survey

Baseline ambient noise levels were monitored at four locations for a week (24 hours x 7 days) duration. Monitoring locations were chosen based on the factors such as sensitive receptor, relevance to construction activity, site access and equipment security. Type 1 noise level meter Rion NL-52 was installed at each location to record the sound pressure level (Leq) with 5-minute sampling intervals for seven consecutive days, yielding the data of Leq 12 hrs, Leq 1 hr, and Leq 5 mins.

The applicable noise limits follow Environmental Protection and Management (Control of Noise at Construction Sites) Regulation 2008 which prescribes the maximum noise levels permissible at construction sites for different periods and types of premises affected. The permissible levels are listed in Table 6.1 above. Table 6.4 summarises the coordinates of monitoring stations, applicable noise limit that corresponds to the receptors the station represents, and short description of the location of each station.

Table 6.4. Location of baseline noise monitoring stations

Station ID	Monitoring Period	Latitude	Longitude	Noise Limit Type	Description of Location
N1	15-22 Jun 2022*	1.310752	103.782631	(c)	In the middle of the forested area, next to the main body of Stream 1
N2	14–21 Apr 2022	1.310935	103.779993	(a)	Forest edge next to the pavement of Commonwealth Avenue West, adjacent to the Dover MRT station and ~90 m across the Food Innovation & Resource Centre of Singapore Polytechnic
N3	7–14 Apr 2022	1.312880	103.778101	(c)	Open grass field in the west side of project area, ~95 m from the nearest residential building at Holland Grove View
N4	7–14 Jun 2022**	1.312044	103.781829	(b)	On the grass patch next to Ulu Pandan Park Connector Network (PCN), ~30 m from the nearest residential building at Holland Grove View

*N1 originally monitored on 14–21 Apr 2022 but re-monitored due to technical difficulties.

**N4 originally monitored on 7–14 Apr 2022 but re-monitored due to technical difficulties.

Figure 6.1 shows the photographs of on-site monitoring equipment setup and Figure 6.2 the location map of the noise monitoring stations. The baseline noise monitoring data are available as **Appendix F** of this report.



Figure 6.1. Photos of the on-site baseline noise monitoring equipment



Figure 6.2. Locations of the baseline noise monitoring stations within project study area

6.4 Baseline Results and Discussion

Table 6.5 and Figure 6.3 show the baseline noise level monitored by Station N1, most of which fell within the noise limit of type (c) except for a few instances such as on Monday early morning (20 June, 2 am - 3 am).

Table 6.5. Summary of the baseline Leq 5 mins noise monitoring results at Station N1

Date	Monitoring Period	Monitored Noise Level (dBA)			Type (c) Noise Limit Leq 5 mins (dB(A))
		Min. Leq 5 mins	Median Leq 5 mins	Max. Leq 5 mins	
Wed, 15/6/2022	[11 am] – 7 pm	41.9	49.5	71.3	90
	7 pm – 7 am (+1	41.2	45.65	60.3	70
Thu, 16/6/2022	7 am – 7 pm	45.1	50	71.5	90
	7 pm – 7 am (+1)	40.8	46.55	55.8	70
Fri, 17/6/2022	7 am – 7 pm	45.1	50	62.6	90
	7 pm – 7 am (+1)	41.4	47.75	58.4	70
Sat, 18/6/2022	7 am – 7 pm	43.7	49.75	71.3	90
	7 pm – 7 am (+1	40.8	48.05	56.1	70
Sun, 19/6/2022	7 am – 7 pm	43.9	50.05	63.1	90
	7 pm – 7 am (+1)	43	54.95	**78.1**	70
Mon, 20/6/2022	7 am – 7 pm	46.7	54.35	79.3	90
	7 pm – 7 am (+1)	41.4	49.55	69.3	70
Tue, 21/6/2022	7 am – 7 pm	45.5	51.55	75.2	90
	7 pm – 7 am (+1)	42.5	49.25	**71.5**	70
Wed, 22/6/2022	7 am – [2 pm]	46.7	51.3	65.8	90

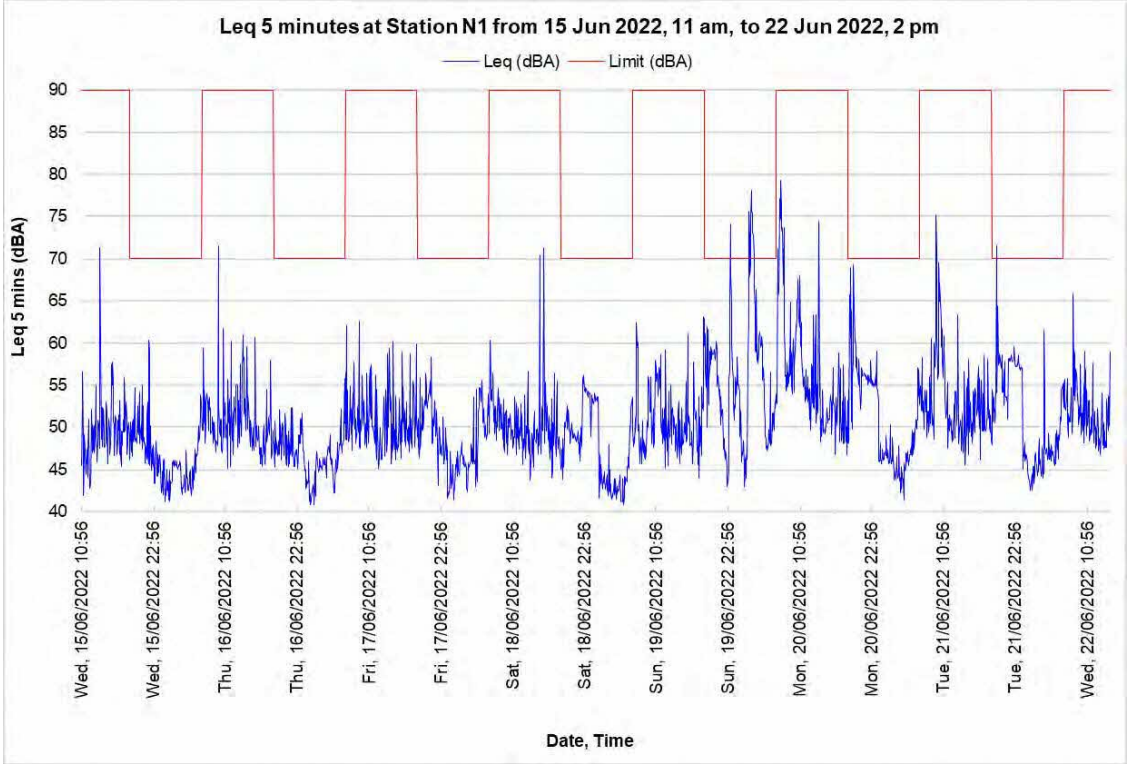


Figure 6.3. Baseline Leq 5 mins monitoring results at Station N1 over one-week period

Table 6.6 and Figure 6.4 show the baseline noise level monitored at Station N2. While the day-time noise levels in mostly complied with the noise limit for type (a) aside from a few spikes, its night-time noise levels exceeded the noise limit. Such records may be attributed to constant traffic noise from Commonwealth Avenue West and Dover MRT station, which are located adjacent to the Station.

Table 6.6. Summary of the baseline Leq 5 mins noise monitoring results at Station N2

Date	Monitoring Period	Noise Level (dBA)			Type (a) Noise Limit Leq 5 mins (dBA)
		Min. Leq 5 mins	Median Leq 5 mins	Max. Leq 5 mins	
Thu, 14/4/2022	[3 pm] – 7 pm	67.8	70.1	71.7	75
	7 pm – 7 am (+1	**56**	**64.85**	**74.8**	55
Fri, 15/4/2022	7 am – 7 pm	66.1	69.9	**76.5**	75
	7 pm – 7 am (+1)	**57**	**65.75**	**78**	55
Sat, 16/4/2022	7 am – 7 pm	64.2	68.9	**85.4**	75
	7 pm – 7 am (+1	51.9	**63.7**	**68.4**	55
Sun, 17/4/2022	7 am – 7 pm	63.8	67.8	**80.4**	75
	7 pm – 7 am (+1)	**56.9**	**66.8**	**73.5**	55
Mon, 18/4/2022	7 am – 7 pm	66.2	68.4	74.3	75
	7 pm – 7 am (+1)	53.8	**62.8**	**69.5**	55
Tue, 19/4/2022	7 am – 7 pm	65.2	68.25	**76.1**	75
	7 pm – 7 am (+1)	54.4	**63.3**	**71**	55
Wed, 20/4/2022	7 am – 7 pm	65.7	67.9	70.8	75
	7 pm – 7 am (+1)	53.6	**62.85**	**68.9**	55
Thu, 21/4/2022	7 am – [3 pm]	66.2	69.1	**77.3**	75

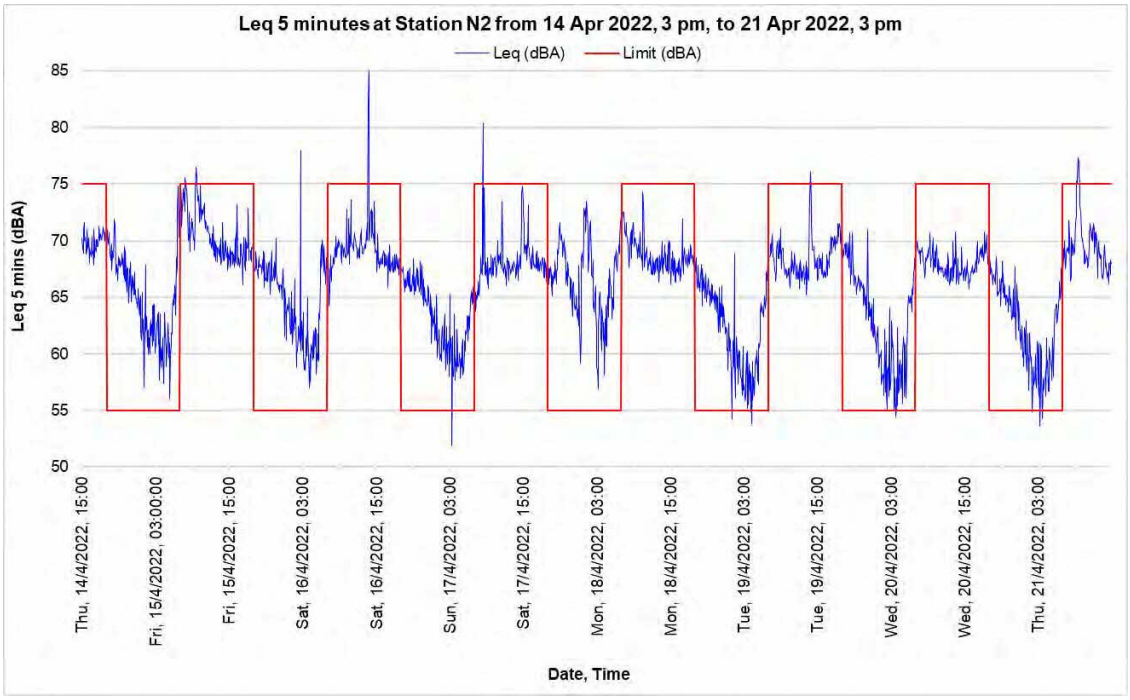


Figure 6.4. Baseline Leq 5 mins monitoring results at Station N2 over one-week period

Table 6.7 and Figure 6.5 show the baseline noise level monitored by Station N3, all of which fell within the noise limit of type (c).

Table 6.7. Summary of the baseline Leq 5 mins noise monitoring results at Station N3

Date	Monitoring Period	Monitored Noise Level (dBA)			Type (c) Noise Limit Leq 5 mins (dBA)
		Min. Leq 5 mins	Median Leq 5 mins	Max. Leq 5 mins	
Thu, 7/4/2022	[3 pm] – 7 pm	51.8	53.9	55.2	90
	7 pm – 7 am (+1	50	55.1	59.7	70
Fri, 8/4/2022	7 am – 7 pm	51.1	54.55	67.5	90
	7 pm – 7 am (+1)	48.4	52.75	61.1	70
Sat, 9/4/2022	7 am – 7 pm	51.8	53.9	60	90
	7 pm – 7 am (+1	50	52.95	58.3	70
Sun, 10/4/2022	7 am – 7 pm	50.7	52.7	64.5	90
	7 pm – 7 am (+1)	47.3	52.15	56.6	70
Mon, 11/4/2022	7 am – 7 pm	52.3	55.8	82.8	90
	7 pm – 7 am (+1)	50	53.8	64.1	70
Tue, 12/4/2022	7 am – 7 pm	52.1	54.9	66.1	90
	7 pm – 7 am (+1)	49.3	53.8	68	70
Wed, 13/4/2022	7 am – 7 pm	51.7	55.2	68.6	90
	7 pm – 7 am (+1)	47.6	53.6	69.3	70
Thu, 14/4/2022	7 am – [3 pm]	41.81	55.3	66.1	90

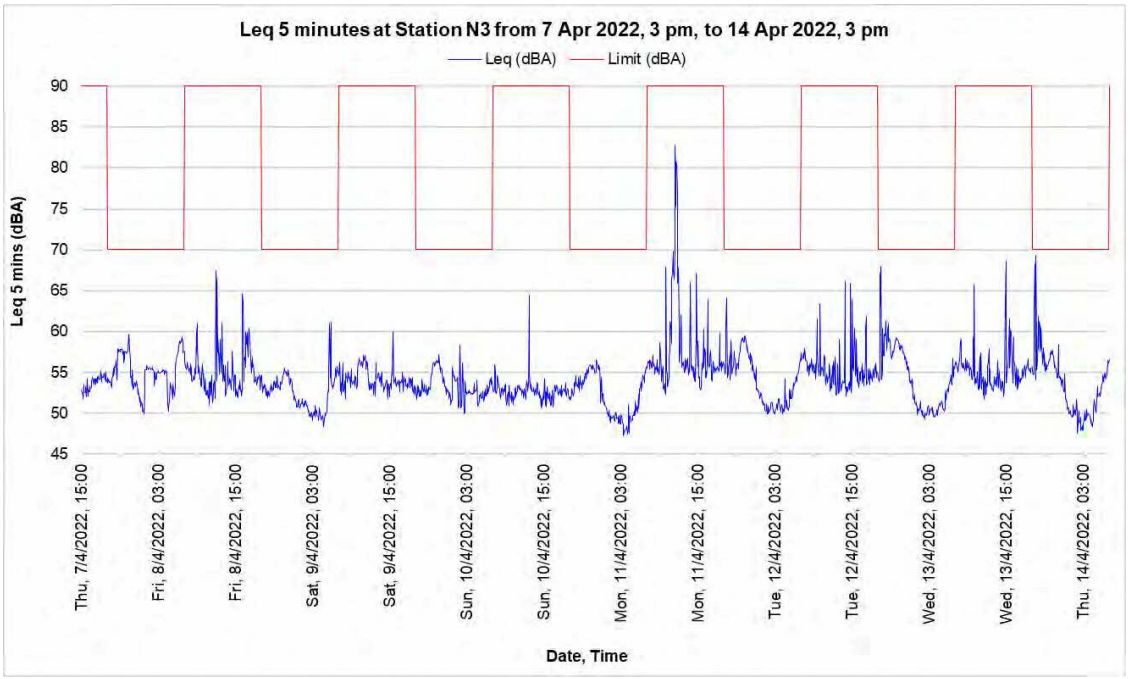


Figure 6.5. Baseline Leq 5 mins monitoring results at Station N3 over one-week period

Table 6.8 and Figure 6.6 show the baseline noise level monitored by Station N4. While the day-time noise level generally complied with the limit for type (b), there were night-time levels (10 pm to 7 am on the next day) which exceeded the noise limit and may be attributed to users of Ulu Pandan PCN track and residents on the nearby Holland Grove View. Nevertheless, their median levels were still within the applicable noise limit.

Table 6.8. Summary of the baseline Leq 5 mins noise monitoring results at Station N4

Date	Monitoring Period	Noise Level (dBA)			Type (b) Noise Limit Leq 5 mins (dBA)
		Min. Leq 5 mins	Median Leq 5 mins	Max. Leq 5 mins	
Tue, 7/6/2022	[12 pm] – 7 pm	44.1	48.2	82.0	90
	7 pm – 10 pm	45.8	47.8	55.8	70
	10 pm – 7 am$^{(+1)}$	43.4	46.4	60.4	55
Wed, 8/6/2022	7 am – 7 pm	42.6	48.1	68.1	90
	7 pm – 10 pm	44.3	55.0	57.6	70
	10 pm – 7 am$^{(+1)}$	45.4	47.6	**65.8**	55
Thurs, 9/6/2022	7 am – 7 pm	43.0	48.8	70.6	90
	7 pm – 10 pm	45.1	47.8	51.8	70
	10 pm – 7 am$^{(+1)}$	44.3	47.1	54.3	55
Fri, 10/6/2022	7 am – 7 pm	43.7	50.3	73.6	90
	7 pm – 10 pm	46.0	49.5	56.9	70
	10 pm – 7 am$^{(+1)}$	46.2	52.1	**73.7**	55
Sat, 11/6/2022	7 am – 7 pm	44.3	49.5	62.2	90
	7 pm – 10 pm	46.6	53.0	63.7	70
	10 pm – 7 am$^{(+1)}$	45.3	47.8	**61.4**	55
Sun, 12/6/2022	7 am – 7 pm	42.5	49.1	66.6	75
	7 pm – 7 am$^{(+1)}$	40.1	46.2	**62.1**	55
Mon, 13/6/2022	7 am – 7 pm	44.4	50.4	72.5	90
	7 pm – 10 pm	48.1	51.6	55.2	70
	10 pm – 7 am$^{(+1)}$	44.0	46.7	**57.6**	55

Date	Monitoring Period	Noise Level (dBA)			Type (b) Noise Limit Leq 5 mins (dBA)
		Min. Leq 5 mins	Median Leq 5 mins	Max. Leq 5 mins	
Tues, 14/6/2022	7 am – [12 pm]	39.5	48.7	70.2	90

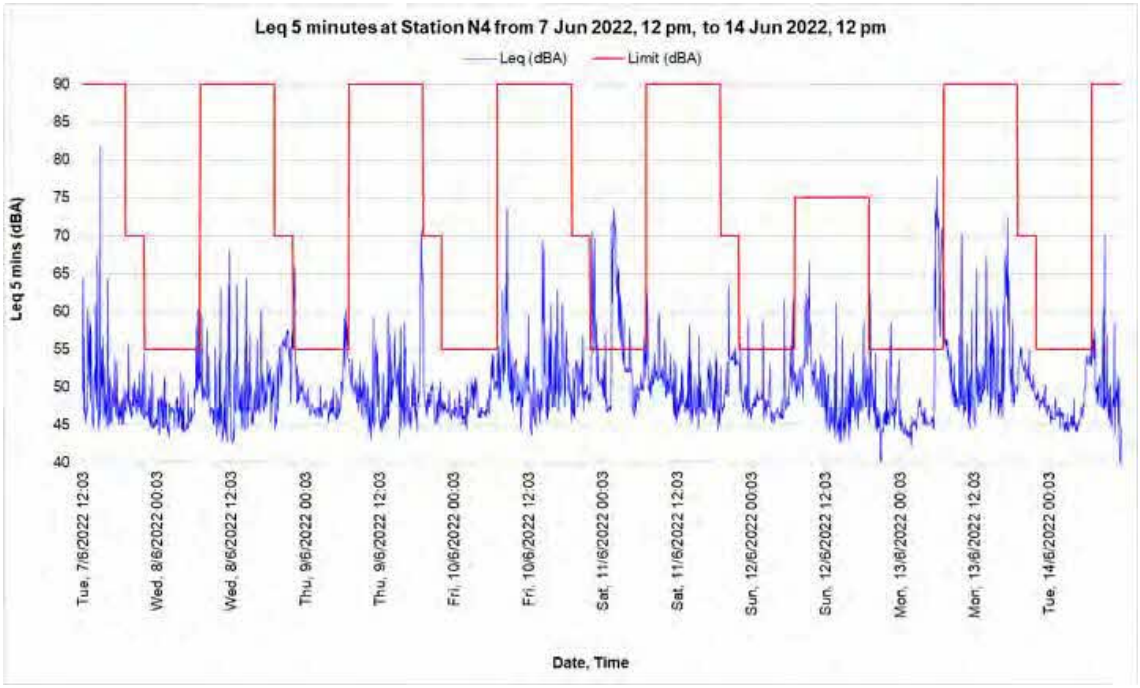


Figure 6.6. Baseline Leq 5 mins monitoring results at Station N4 over one-week period

6.5 Impact Assessment

6.5.1 Identification of Potential Impacts

The following activities are identified as potential sources of noise during the pre-construction and construction phases of Ulu Pandan:

- Site clearing, earthworks, and general construction activities;
- Stockpiling and materials handling;
- Vehicle movement in and out of construction work areas; and
- Use of high-impact stationary and mobile equipment such as pile drivers, mobile cranes, excavators, dozers, etc. leading to variable and sporadic noise levels, typically repeating over time.

Specifically, the potential main sources of noise emission during construction within Ulu Pandan are:

- Vibro hammer for installing and removing sheet piles (temporary retaining walls);
- Bored Piling rigs to be used to pre-bore the ground for casting of the piles;
- Excavators for earth handling and tree-clearance;
- Shaft construction and Micro Tunnel Boring Machine (MTBM) during pipe jacking method; and
- Generators for equipment and machinery

The project site is inhabited by some fauna species (see Chapter 4) which may be sensitive to noise. Some of these species, particularly nocturnal species such as bats and frogs which rely on their hearing for movement, communication, and foraging, are likely to be impacted by increased noise levels. Chronic and frequent noise such as traffic noise interferes with animals' abilities to detect important sounds, whereas intermittent and unpredictable noise such as piling, honking from vehicles and machinery and shouting is often perceived as a threat (Francis & Barber, 2013) This can alter species' behaviour and impair their ability to forage and avoid predation, leading to decreased survivability.

The effects of noise on fauna are poorly understood since both stimuli and responses can vary.

6.6 Mitigation Measures

6.6.1 Pre-construction / Construction Phase

It is recommended to use noise barrier (STC 20) of 2.4 m to 6 m height at the construction work boundary as part of mitigation strategy to reduce noise impacts. The noise barrier is considered to be implemented around the project area, along the forested and grass patch areas. Noise barriers should be erected at a height of 2.4 m along Ghim Moh Link and Commonwealth Avenue West, as well as along the pedestrian linkway. Noise barriers should be erected at a height of 6 m along the Park Connector, at the edge facing Ulu Pandan West, and along both sides of Stream 1.

This section aims to provide additional mitigation measures / best site practices to further reduce the excessive noise impacts from the project. The following recommendations should be implemented during pre-construction and construction stage.

- For soil investigation works, to use acoustic enclosures on rig engines and install a silencer at the exhaust pipe of the engines throughout the drilling operations and to erect portable hoarding around drilling rigs.
- Heavy construction works within project area are to be limited to daylight hours (8 am – 6 pm). Should there be any nightworks, a Lighting Management Plan (LMP) should be developed and submitted to NParks for approval.
- Avoid piling where possible. Where the installation of concrete footing is feasible as an alternative to piling, this should be considered.
- Use of silent piler for sheet piling work where possible.
- Use hydraulic and electric tools in place of pneumatic equipment such as concrete breakers where possible.
- Acoustic enclosures to be considered for where necessary specific plant such as compressors, generators, drilling tools etc.
- Means of improving the sound reduction for any exhaust systems in bulldozers, dump trucks and excavators should be considered.
- All noise and acoustic barriers should be able to achieve at least 10dB(A) noise reduction from source noise levels.
- Construction personnel to be trained in noise-reduction behaviours such as reducing the drop height of materials. Daily toolbox briefings should include reminders on the need to implement noise-reduction behaviours.

- To communicate with sensitive receptors about the proposed construction works including the proposed working hours, and the expected level and duration of noise.
- Where alternatives are available, only equipment and vehicles that emit lower noise levels are to be used.
- Care shall be taken when loading or unloading vehicles, dismantling, or moving materials to reduce impact noise.
- Start-up plant and vehicles sequentially rather than all together;
- Intermittently used vehicles and machinery are to be shut down between work periods or be throttled down to a minimum noise level emission.
- Where possible, vehicles and machinery known to emit high levels of noise in one direction are to be orientated away from sensitive receptors.
- Ensure machinery utilised are well-maintained.
- Conduct noise level monitoring throughout all phases to ensure that the construction noises remain within acceptable limits.
- Maintain a complaints procedure to log and track response to complaints received from residents.
- Personnel are to wear appropriate Personal Protective Equipment (PPE) all the time while on the construction site.

Effective implementation of these mitigation measures should be able to reduce the noise impacts from project on sensitive receptors to acceptable levels.

6.6.2 Post-construction Phase

No impacts on noise are expected to be generated during post-construction phase of the project. Nonetheless, it is important to note that this Environmental Study is meant to address impacts from the earthworks and infrastructure works phase of the development and are not meant to address the building construction phase of the development. Upon the completion of this project, building works for the upcoming residential developments are likely to commence. TAC recommends that the impacts from the building construction phase of this project are to be assessed separately.

6.6.3 Evaluation of Potential Impacts

Table 6.9 summarises the impacts with their corresponding Environmental Scores before and after the implementation of mitigation measures, which are elaborated in the above section.

6.7 Residual Impacts

The residual impacts were evaluated using the RIAM method (Table 6.9) with due consideration that the recommended mitigation measures are implemented by the Contractor. The residual impacts are likely to be in the band of slight negative and considered acceptable.

Table 6.9. Environmental Scores of the identified noise impacts with corresponding mitigation measures

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Ecology																
Pre-construction / Construction	Disturbance to fauna species in and around the project site	2	-3	2	2	2	-36	Slight negative	• No heavy nightworks (i.e., limit heavy construction activities to 8 am – 6 pm), • Develop and implement LMP • Noise barrier with 6 m height as hoarding • Quieter equipment and vehicles with low noise levels to be used • For piling work, to consider the use of quieter piling methods • Acoustic enclosures to be considered for compressors, generators, drilling tools etc. • Noise level monitoring throughout all phases to ensure that the construction noises remain within acceptable limits	2	-2	2	2	2	-24	Slight negative
Human Health and Safety																
Pre-construction / Construction	Impact to construction workers due to exposure to high noise levels of construction activities	2	-2	2	2	2	-24	Slight negative	• Personnel are to wear appropriate Personal Protective Equipment (PPE) at all times while on the construction site • Quieter equipment and vehicles with low noise levels to be used. • All noise and acoustic barriers to be able to achieve at least 10 dB(A) noise reduction from source noise levels.	2	-1	2	2	2	-12	Slight negative

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Pre-construction / Construction	Impact to NSR due to noise pollution from construction activities	2	-2	2	2	2	-24	Slight negative	• No heavy nightworks (i.e., limit heavy construction activities to 8 am – 6 pm), • Noise barrier with 6 m height as hoarding • To consider erection of temporary acoustic barriers around piling equipment • Acoustic enclosures to be considered for compressors, generators, drilling tools etc. • Noise level monitoring throughout all phases to ensure that the construction noises remain within acceptable limits	2	-1	2	2	2	-12	Slight negative

7 AMBIENT AIR QUALITY

7.1 Introduction

The main air pollution in Singapore comes from stationary sources (e.g., power stations, industries, and refineries) and mobile sources (e.g., motor vehicles and visiting marine vessels). As part of NEA's efforts to monitor air quality in Singapore, pollutant concentrations are continuously measured across the nation. These concentrations can be used to calculate a Pollutant Standards Index (PSI), which indicates the ambient air quality in Singapore (NEA, 2022). For each pollutant, their annual concentrations are presented later in this Section.

During the baseline environmental surveys in April 2022, there were no stationary sources of air pollution observed in the forested area within the project study area. The nearest source of air pollution outside the project study area includes movement of vehicles within the area and exhaust emissions from vehicular traffic along Commonwealth Avenue West and Ghim Moh Link. The project study area's natural setting, and the presence of forested area contribute to the relatively good prevailing air quality of the area.

This Section describes the relevant standard for the ambient air quality that are applicable to the construction activities, the methodology, and the data used for the baseline ambient air quality study. It also describes potential air quality impacts from construction works, and recommendation for mitigation measures. A qualitative impact assessment approach is being used for assessment of impacts.

7.2 Relevant Environmental Legislation, Guidelines and Standards

Singapore ambient air quality targets are provided in Table 7.1.

Table 7.1. Applicable Singapore Ambient Air Quality Targets **(NEA, 2021)**

c	Long Term Targets (WHO Final)
Sulphur Dioxide (SO_2)	24-hour mean: 20 µg/m^3
Nitrogen Dioxide (NO_2)	Annual mean: 40 µg/m^3 1-hour mean: 200 µg/m^3
Particulate Matter (PM_{10})	Annual mean: 20 µg/m^3 24-hour mean: 50 µg/m^3
Particulate Matter ($PM_{2.5}$)	Annual mean: 10 µg/m^3 24-hour mean: 25 µg/m^3
Carbon Monoxide (CO)	8-hour mean: 10 mg/m^3 1-hour mean: 30 mg/m^3
Ozone (O_3)	8-hour mean: 100 µg/m^3

7.3 Baseline Methodology

7.3.1 Sensitive Receptors Identification

The Air Sensitive Receptors (ASR) potentially affected by the proposed project have been identified (Table 7.2) through a combination of desktop study and visual surveys at the study areas.

Table 7.2. List of identified air-sensitive receptors

ID	Type	Description	Approximate Distance*
ASR1	Workers	People working on the site (e.g., construction workers, consultants)	Within Study Area
ASR2	Flora and Fauna	Flora and fauna living within project study area	Within Study Area
ASR3	Residential building	People at Holland Grove View	30m from Study Area
ASR4	Residential building	People at Block 30 HDB Ghim Moh Link	40m from Study Area
ASR5	Residential building	People at Ghim Moh Edge	50m from Study Area
ASR6	Institution of higher learning	People at T11A, T11B, T1A, and W1 of Singapore Polytechnic	80m from Study Area

*Approximate distance from the nearest project work area

7.3.2 Baseline Ambient Air Quality Data

NEA monitors ambient air quality across five regions in Singapore using 22 air monitoring stations. Six parameters are continuously monitored: Particulate Matters with diameters of less than 10 and 2.5 microns (PM_{10} and $PM_{2.5}$), Sulphur Dioxide (SO_2), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), and Ozone (O_3).

The annual mean for each parameter was obtained from the Singapore Department of Statistics (Singapore Department of Statistics (DOS), 2022). An average of the past 5 years of data (i.e, 2017 to 2021) was calculated and presented in Section 7.4.

7.4 Baseline Results and Discussion

Table 7.3 compares Singapore's long-term targets to the annual means of each pollutant in the past 5 years (i.e, 2017 to 2021). The values are bolded where the results exceeded the long-term targets.

Table 7.3. Annual ambient air quality in Singapore measured by NEA **(DOS, 2022)**

Parameter	Data Series	2021	2020	2019	2018	2017	Avg*	Targets
SO_2 ($\mu g/m^3$)	Max. 24-hour mean	**89**	**30**	**57**	**65**	**59**	**61**	20
NO_2 ($\mu g/m^3$)	Annual mean	25	20	23	26	25	24	40
	Max. 1-hour mean	123	118	156	147	158	137	200
PM_{10} ($\mu g/m^3$)	Annual mean	**28**	**25**	**30**	**29**	**25**	**27**	20
	99th percentile 24-hour mean	**51**	43	**90**	**59**	**57**	**53**	50

Parameter	Data Series	2021	2020	2019	2018	2017	Avg*	Targets
$PM_{2.5}$ ($\mu g/m^3$)	Annual mean	**12**	**11**	**16**	**15**	**14**	**13**	10
	99th percentile 24-hour mean	**28**	24	**62**	**32**	**34**	**30**	25
CO (mg/m^3)	Max. 8-hour mean	1.2	1.2	1.7	2	1.7	2	10
	Max. 1-hour mean	1.3	1.6	2.3	2.5	2.3	2	30
O_3 ($\mu g/m^3$)	Max. 8-hour mean	**176**	**145**	**125**	**150**	**191**	**166**	100

*Average readings from 2017, 2018, 2020, and 2021. It excluded data from 2019 as it was a haze year.

Of the 6 pollutants monitored, it was observed that concentrations of Sulphur Dioxide (SO_2), Particulate Matters (PM_{10} and $PM_{2.5}$), and Ozone (O_3) from 2017 to 2022 have consistently exceeded Singapore's long-term ambient air quality targets. The high concentrations may be attributed to emissions from refineries, power stations, and motor vehicles (NEA, 2021). Other possible sources may be the occasional periods of haze from forest fires in neighbouring countries. As haze is an uncommon event, data from haze years (e.g., 2019) were not included in the air quality baseline. The remaining 2 pollutants, Carbon Monoxide (CO) and Nitrogen Dioxide (NO_2), had concentrations well within the target levels.

7.5 Impact Assessment

7.5.1 Identification of Potential Impacts

Pre-construction / Construction Phase

Construction activities in the site include vegetation clearance, earthworks, construction of drains, sewers and sumps as well as temporary shafts, pipe jacking by slurry machine and/or hand shield, and other related activities. The new sewerage alignment along the Ulu Pandan PCN will be constructed by means of the pipe jacking method.

Based on these activities, the following potential impacts on ambient air quality are identified:

Fugitive Dust Emissions from Construction Works

The following construction works are expected to create dust emission:

- Site clearance, earthworks, and general construction activities;
- Soil investigation work;
- Temporary stacking of excavated soil within project site;
- Erection of temporary (e.g., site office) structures;
- Bored piling work;
- Cutting and grinding work for pile head;
- Construction of the new infrastructures; and
- Vehicle movements on access roads

Fugitive dust emissions from construction activities are unavoidable to be generated during vehicle movement within the project site on unpaved surfaces. These fugitive dust emissions are expected to have a moderate and direct impact on local air quality

and affect air sensitive receptors located near dust generating construction activities (e.g., construction workers and residents).

Additionally, deteriorated ambient air quality also has negative impacts on biodiversity. For example, particulate matter settling on leaves may cause leaf injury through abrasion or chemical interactions. Dust particles entering stomata may also reduce photosynthetic functions. Dust landing directly on soil may affect nutrient cycling processes (Grantz, Garner, & Johnson, 2003).

The existing literature on the effect of construction dust on birds in particular is limited, with most studies examining effects of air pollution on wildlife in general, rather than the effect of construction dust on birds specifically. Since the avian respiratory system, unlike the mammalian respiratory system, is characterised by unidirectional airflow and cross-current gas exchange, this makes them more susceptible to high concentrations of pollutants in the air. Studies have shown that birds exposed to urban air pollution may exhibit a build-up of cellular and mineral debris leading to characteristic conditions of pneumonia (Sanderfoot & Holloway, 2017).

The impact duration of fugitive emissions of construction dust is anticipated to be short-term and expected to vary significantly from day to day depending upon the duration of dust-generating construction activities within project site. Actual fugitive dust emissions concentrations from construction site will depend on effectiveness of control measures, length of operation, and ambient weather condition (e.g., rainfall, wind speed, and wind direction). Extent of fugitive emissions is considered to be local, within the project as forested area around project study area will act as barrier for further dispersion. Also, the impacts are reversible when dust-generating construction activities stop.

Exhaust Emissions from Construction Machinery and Heavy Vehicles

Construction activities are anticipated to use fuel-burning (i.e., mainly diesel) machinery such as piling rig, road roller machine, generator sets, mobile cranes, and other heavy vehicles such as grader, dozer, excavator, front-end loader, and haul truck that may cause exhaust emission. These exhaust emissions can cause direct and negative effects on local air quality by potentially increasing the concentrations of CO, NO_2, SO_2, O_3, PM_{10} and $PM_{2.5}$. This could cause the local air quality to deteriorate.

The impact is expected to be short-term depending on the duration of operation of machinery and heavy vehicles. The geographical extent of exhaust emissions is considered to be local, within the project site, even its dispersion will be affected by a number of factors such as ambient weather and wind direction. Ambient air quality impacts due to exhaust emissions of fuel burning machinery and vehicles are reversible when they stop operating.

Odour Emissions

During construction works, it is anticipated that odours generated at the project site would be minimal. The potential impact is anticipated to be short term, indirect and insignificant as it would be assumed to be managed by suitable waste management mitigation measures discussed in Chapter 10.

Overall, potential air quality impacts on ASR are expected to be of slight negative nature, direct, and local. Duration is anticipated to be short term and reversible as the impact will cease upon completion of the air pollution generating construction activities. As such, mitigation measures are recommended to further reduce the potential impacts.

Post-Construction Phase

No impacts on ambient air quality are expected to be generated during post-construction phase of site of the project. Nonetheless, it is important to note that this Environmental Study is meant to address impacts from the earthworks and infrastructure works phase of the development and are not meant to address the building construction phase of the development. Upon the completion of this project, building works for the upcoming residential developments are likely to commence. TAC recommends that the impacts from the building construction phase of this project are to be assessed separately.

7.5.2 Evaluation of Potential Impacts

Table 7.4 summarises the impacts covering the project area with their corresponding Environmental Scores before and after the implementation of mitigation measures, which are elaborated in the following section.

7.6 Mitigation Measures

7.6.1 Pre-construction / Construction Phase

The combined mitigation measures are proposed covering the study area:

For site dust control, the contractor shall prepare and implement the dust control plan covering following dust suppression measures:

- Use of hoarding at project boundary within work areas to minimise dust generation by attenuating wind forces.
- To avoid stockpiles of soil and dusty materials at project site within work areas as far as possible.
- If unavoidable, stockpiles of soil should be located away as far as possible from sensitive receptors (i.e., adjacent flora and fauna as well as residents of Holland Grove View and Ghim Moh Link).
- Provide additional dust screen at project boundary near sensitive receptors (i.e., flora and fauna as well as residents of Holland Grove View and Ghim Moh Link).
- Any soil or stockpiles of dusty material should be properly stored, covered entirely with impervious sheeting or dampened with water to maintain entire surface wet by contractor.
- Soil stockpiles shall not be higher than 0.6 times the nearest hoarding height.
- Excavations should be backfilled or reinstated as soon as practicable following completion of the construction work.
- Material transport of inert solids (excavated materials) should be enclosed using impervious sheeting, minimising the visual dust impacts as well.
- Use of regular watering to reduce dust emissions from exposed site surfaces, particularly during dry weather on open areas.

- Open burning of construction and other wastes are not allowed at the worksite as this is an offence under the Environmental Pollution Control regulation.
- Personal protective equipment such as mask shall be worn during the severe air pollution and/or dust exposure periods by construction personnel.
- Avoid soil disturbing works during dry and/or windy conditions.
- Stabilise/cover all stockpiled materials for longer than one month by turfing, erosion blanketing or other method.
- Vehicle on-site speed restrictions should be imposed to prevent dust being stirred up by vehicle movement.

Other mitigation measures that need to be taken by the contractor include:

- Provide vehicle washing facilities before the construction site exit.
- Pave the area between construction site exit and the vehicle washing facilities.
- Maintain road surface in the construction site wet (e.g., using sprinkler).
- Proper maintenance of construction vehicles and fuel burning equipment.
- Intermittently used vehicles and machinery are to be shut down between work periods to minimum exhaust emission.

The recommended measures above, when implemented effectively, shall mitigate the potential impacts on the ambient air quality of the site to acceptable levels.

7.6.2 Post-construction Phase

No impacts on ambient air quality are expected to be generated during post-construction phase of the project. Hence, no further recommendations for air quality are given.

7.7 Residual Impacts

The residual impacts were evaluated using the RIAM method (Table 7.4) with due consideration that the recommended mitigation measures are implemented by the Contractor. The residual impacts are likely to be in band of no impact and considered acceptable.

Table 7.4. Environmental Scores of the identified impacts on site's ambient air quality with corresponding mitigation measures

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Ecology																
Pre-construction / Construction	Impact to biodiversity due to generation of fugitive dust	1	-2	2	2	2	-12	Slight negative	• To implement dust suppression plan • Use of hoarding at project boundary to minimise dust generation by attenuating wind forces. • To avoid stockpiles of soil and dusty materials at project site within forested area as far as possible. • Stockpiles of dusty material should be properly stored, covered entirely with impervious sheeting • Use of regular watering to reduce dust emissions from exposed site surface	1	-1	2	2	2	-6	No Impact
Human Health and Safety																
Pre-construction / Construction	Impact on construction workers due to generation of fugitive dust and exhaust emissions from construction machineries	1	-2	2	2	2	-12	Slight Negative	• To implement dust suppression plan • Personal protective equipment i.e., face mask to be worn during dust exposure • Stockpiles of dusty material to be properly stored, covered entirely with impervious sheeting, or dampened with water • Use of regular watering to reduce dust emissions from exposed site surfaces • Proper maintenance of construction vehicles and fuel burning equipment • Intermittently-used vehicles and machinery are to be shut down between work periods	1	-1	2	2	2	-6	No Impact
	Impact on ASR (i.e., nearby residents) due to generation of fugitive dust	1	-2	2	2	2	-12	Slight Negative	• To implement dust suppression plan • Provide dust screen at project boundary near residential community	1	-1	2	2	2	-12	No Impact

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
									• Stockpiles of dusty material to be properly stored, covered entirely with impervious sheeting, or dampened with water • Use of regular watering to reduce dust emissions from exposed site surface							
	Impact due to generation of odour	1	-1	2	2	2	-6	No Impact	• Refer to Section 10.4	1	-1	2	2	2	-6	No Impact

8 GROUND-BORNE VIBRATION

8.1 Introduction

This Section describes the relevant standard for the ground-borne vibration that are applicable to the construction activities, the methodology and results for the baseline ground vibration study. It also described potential ground vibration impacts from construction works, and recommendation for ground vibration mitigation measures. A qualitative impact assessment approach is being used for assessment of impacts.

8.2 Relevant Environmental Legislation, Guidelines and Standards

As there is no specific laws and standard in Singapore presently that describe the assessment criteria for ground vibration, the following international standards are used as reference for ground vibration assessment criteria associated with human annoyance.

1. BS 5228-2 Code of Practice for Noise and Vibration Control on Construction and Open Sites.
2. United States Federal Transit Authority (FTA) Transit Noise and Vibration Impact Assessment Manual.

The baseline ground vibration data obtained are compared with the ground-borne vibration limits stated in the BS 5228-2 Code of Practice for Noise and Vibration Control on Construction and Open Sites (Table 8.1).

Table 8.1. BS 5228 Part 2 Guidance on Human Response to Vibration Levels

Sr No.	Vibration Level	Effect	Description
1	0.14 mm/s	Threshold of Perception	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
2	0.3 mm/s	Just Perceptible	Vibration might be just perceptible in residential environment.
3	1.0 mm/s	Likely Complaint	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if warning and explanation is given to residents
4	10 mm/s	Likely Intolerable	Vibration is likely to be intolerable for any more than a brief exposure at this level

According to BS 5228-2, human beings are known to be very sensitive to vibration, the threshold of perception being typically in the PPV range of 0.14 mm·s−1 to 0.3 mm·s−1. Vibrations above these values can disturb, startle, cause annoyance or interfere with work activities. At higher levels they can be described as unpleasant or even painful. In residential settings, vibrations may cause anxiety in residents that some structural mishap may occur.

8.3 Baseline Methodology

8.3.1 Sensitive Receptors Identification

The sensitive receptor identification criteria are based on the United States Federal Transit Authority (FTA) Transit Noise and Vibration Impact Assessment Manual. The criteria are listed below:

- Category 1 (High Sensitivity) covers manufacturing as well as vibration-sensitive research, hospitals with vibration-sensitive equipment, and university research operations.
- Category 2 (Residential) covers residential land uses and any buildings where people sleep, such as hotels and hospitals.
- Category 3 (Institutional) covers institutional land uses with primarily daytime use e.g., schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference.
- Special Buildings: This category includes concert halls, TV studios, recording studios, auditoriums, and theatres.

The Vibration Sensitive Receptors (VSRs) potentially affected by the proposed project have been identified (Table 8.2) through a combination of desktop study and visual surveys at the study areas.

Table 8.2. List of identified vibration sensitive receptor

Type	Description	Approximate Distance*
Workers	People working on the site (e.g., construction workers, consultants)	Within Study Area
Flora and Fauna	Flora and fauna living within project study area	Within Study Area
Residential building	People at Holland Grove View	30m from Study Area
Residential building	People at Blocks 28 to 33 HDB Ghim Moh Link	40m from Study Area
Residential building	People at Ghim Moh Edge	50m from Study Area
Institution of higher learning	People at T11A, T11B, T1A, and W1 of Singapore Polytechnic	80m from Study Area

*Approximate distance from the nearest project work area

The impacts of anthropogenic-derived vibration on fauna are poorly understood. However, some animals, particularly amphibians, are sensitive to vibrations, as increased vibrations may affect their ability to communicate, and may reduce their reproductive success (Caorsi, et al., 2019).

8.3.2 Baseline Field Survey

Ground-borne vibration level monitoring was conducted for approximately one day (24 hours) to generate the baseline condition. The monitoring locations were chosen based

on factors such as the presence of sensitive receptors, relevance to construction activity, site access, and equipment security. Ground-borne vibration levels were monitored using one (1) unit of Minimate Plus manufactured by Instantel Inc., with a trigger level of approximately 0.13 mm/s (i.e., vibration levels as low as 0.13 mm/s will be recorded). The monitoring locations are described in Table 8.3.

Table 8.3. Location of vibration monitoring stations

Station	Monitoring Period	Latitude	Longitude	Description of Location
V1	21/4/2022, 09:25 to 25/4/2022, 09:52	1.310904	103.783301	In the middle of the forested area, next to the branch of Stream 1
V2	19/4/2022, 09:47 to 20/4/2022, 09:48	1.310777	103.780149	Forest edge next to the pavement of Commonwealth Avenue West, adjacent to the Dover MRT station and ~90 m across the Food Innovation & Resource Centre of Singapore Polytechnic
V3	20/4/2022, 09:55 to 21/4/2022, 09:55	1.313270	103.777916	Open grass field in the west of project area, ~75 m from the nearest residential building at Holland Grove View

Figure 8.1 shows photographs of the on-site monitoring equipment setup and Figure 8.2 shows the location map of monitoring stations. The baseline vibration monitoring report is available as **Appendix G**.



Figure 8.1. Locations of ambient vibration monitoring stations within project area

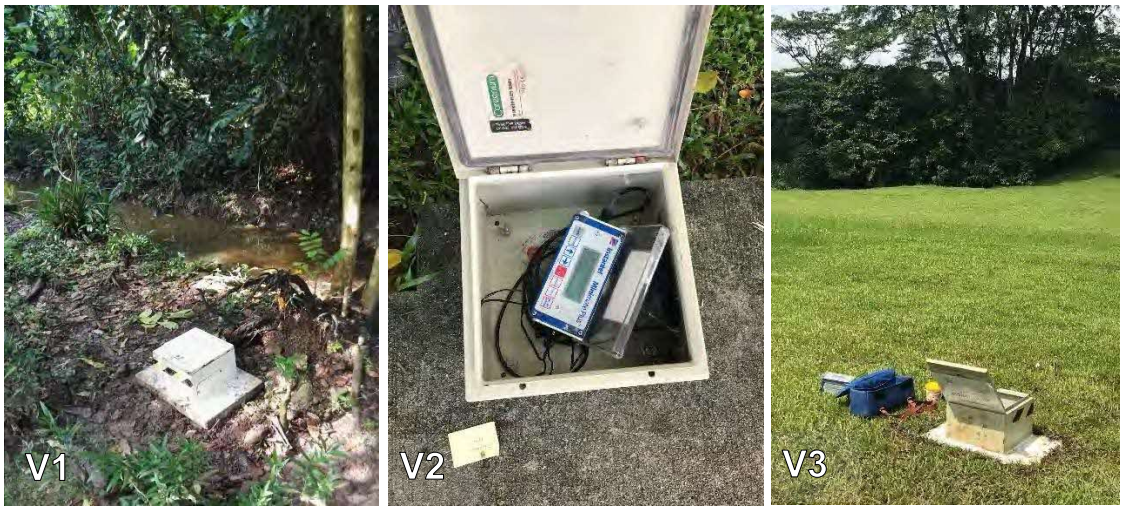


Figure 8.2. Pictures of the on-site baseline ground-borne vibration monitoring equipment

8.4 Baseline Results and Discussion

Table 8.4 summarises the baseline vibration levels recorded at the project site.

Table 8.4. Baseline ground-borne vibration level at the project site

Station	No. of Recorded Occurrences	90th Percentile (mm/s)	Maximum (mm/s)	Date & Time of Maximum Level Recorded
V1	18	0.349	1.458	24/4/2022, 21:47
V2	452	0.258	0.35	20/4/2022, 08:34
V3	2	0.131	0.132	21/4/2022, 09:32

In general, the baseline ground-borne vibration level did not go beyond 0.35 mm/s aside from two occurrences at Station V1 (i.e., 1.458 mm/s on 24 April 2022 at 21:47 and 0.408 mm/s on 25 April 2022 at 09:49). V1 is located near a well-maintained garden where there might be high levels of human activities, which could explain the relatively higher levels of vibration.

As can be observed from the table above, Station V2 recorded a substantially higher number of vibration occurrences compared to V1 and V3, indicating that there is more frequent vibration at V2. This difference in the number of recorded occurrences was expected, since Station V2 was located next to Commonwealth Avenue West and Dover MRT station that are constantly utilised by vehicular traffic while Stations V1 and V3 were not near any major roads.

8.5 Impact Assessment

8.5.1 Identification of Potential Impacts

Pre-construction / Construction Phase

Construction activities can result in ground-borne vibration, depending on the various type of construction methods and equipment employed. Use of construction equipment could cause ground-borne vibration which spread through the ground and diminish in

strength with distance. The ground vibrations generated during construction may create annoyance to people and detrimentally effect structures and sensitive devices. The focus on this vibration impact assessment during construction phase is on the nearest VSRs (i.e., workers and flora and fauna within Ulu Pandan).

The preliminary construction approach that would be used for this project is given in Chapter 2. The detailed information on the construction methodologies, specific equipment that will be used at each construction stage and their approximate quantity are not available at the time of this report preparation.

Main sources of ground vibration emissions during construction works at the project site of Ulu Pandan are:

- Vibro hammer for installing and removing sheet piles (temporary retaining walls)
- Bored piling rigs to be used to pre-bore the ground for casting of the piles
- Excavators for earth handling and tree-clearance
- Shaft construction and Micro Tunnel Boring Machine (MTBM) during pipe jacking method

There are currently no Singapore standards that provide methodology to predict levels of ground vibration from construction activities. As such, to control the impact of vibration during site activities, limits relating to the perceptibility of vibration are typically used (see Section 8.2). BS 5228-2 provides the distances (based on historical field measurements) as which certain activities could give rise to a just perceptible level of ground vibration. These distances are provided in Table 8.5.

Table 8.5. Perceptible vibration levels as per BS 5228-2

Construction Activities	Distance from Activity when Ground Vibration May Just be Perceptible (m)
Heavy vehicles	5 - 10
Rotary bored pilling	20 - 30
Vibro hammer	25 – 35
Driven sheet piling	30 – 35

The closest distance between project worksite and nearest human related VSRs (i.e., onsite workers) is within the project site. As the work activities would employ pipe jacking method, only the equipment used at ground level (e.g., mobile crane, excavator) were considered as potential vibration sources. Considering the limited extent of ground activities to be carried out for shaft construction, the potential impacts from these sources are considered short term and reversible as the impact should cease upon termination of the sources or completion of the construction. Other construction activities such as vehicle movement, soil compaction, lifting using mobile cranes are unlikely to generate significant ground-vibration.

Therefore, it is anticipated that human VSRs would not encounter vibration effect above the perceptible level for construction works and unlikely to be affected. However, it is recognised that the work activities are in close proximity to VSR3 – VSR5 (i.e.,

residential buildings) and VSR6 (i.e., institution of higher learning) hence Contractor shall implement recommended vibration mitigation measures/best practices for these worksites to minimise the vibration impacts.

There is no extensive research done on how vibration levels affect fauna. However, it is understood that vibration from anthropogenic sources affects the ability of some fauna, including frogs, to communicate (Caorsi, et al., 2019). Hence, fauna located within the retained forest area may be affected when construction vibration sources are located near the boundary of the retained area.

It is to be noted that vibration within the project site is likely a result of vehicular traffic along Commonwealth Avenue West. As recommended in Chapter 4, heavy construction activities are to be restricted to daytime. It is anticipated that lower vibration generating construction methods (use of bored piling & silent piler and pipe jacking method) will be used, which will reduce much of the major impacts from vibration to sensitive receptors.

Overall, potential vibration impacts on VSR are expected to be of slight negative nature, direct, and local. Duration is anticipated to be short term and reversible as the impact will cease upon completion of the vibration generating construction activities. Further, this impact is to be managed through the mitigation measures/best practices recommended in next section.

Post-construction Phase

No impacts on ground-borne vibration are expected to be generated during post-construction phase of the project. Nonetheless, it is important to note that this Environmental Study is meant to address impacts from the earthworks and infrastructure works phase of the development and are not meant to address the building construction phase of the development. Upon the completion of this project, building works for the upcoming residential developments are likely to commence. TAC recommends that the impacts from the building construction phase of this project are to be assessed separately.

8.5.2 Evaluation of Impacts

Table 8.6 summarises the impacts covering of all three areas with their corresponding Environmental Scores before and after the implementation of mitigation measures, which are elaborated in the following section.

8.6 Mitigation Measures

Pre-construction / Construction Phase

The following mitigation measures / best practices are recommended to manage the impact to fauna surrounding project work areas. The Contractor shall be responsible to implement these measures.

- Construction works involving the use of heavy equipment should be restricted to daytime only (i.e., 8 am – 6 pm).
- Contractors shall be responsible to comply all applicable regulatory and authority

requirements and recommendation in this Environmental Study report on ground-borne vibration.

- Vibrating equipment (e.g., pipe jacking unit) to be placed on isolators such as spring coils.
- Use of equipment or method which generate lower vibration levels, where possible. Examples: use of silent piler instead of vibro hammer, use only low-vibration mode for vibratory compactors.
- To monitor and assess the actual vibration levels near Stream 1 while carrying out sheet piling work within that work area during construction phase.
- Equipment, in particular the drilling rig engine, are to be switched off when not in use to reduce vibration.
- Route heavily loaded trucks away from the VSRs as far away as possible.
- To plan and phase excavation, earthworks, and pilling activities in a staggered manner where possible to minimise cumulative impact.
- Control speed of vehicle movement at the worksite to 10 km/hour.
- Notify nearby VSRs (e.g., residential buildings) in advance of the construction activities, particularly during pipe jacking works to allay potential concerns.
- To develop the vibration monitoring plan in consultation with Qualified Person (QP) and to monitor the vibration levels throughout construction period.
- Utilise a dynamic (vibratory) compactor that can adjust the impulse energy and frequency, or a static compactor that can compact the soil with the weight of the machine.
- Keep access roads within project work site in good condition to provide a smooth traveling surface.

Post-construction Phase

As no further impacts on ground-borne vibration are expected during post-construction phase of the project, no recommendations for vibration reduction are proposed.

8.7 Residual Impacts

The residual impacts were evaluated using the RIAM method (Table 8.6) with due consideration that the recommended mitigation measures are implemented by the Contractor. The residual impacts are likely to be in the band of minor to slight negative and considered acceptable.

Table 8.6. Environmental Scores of the identified vibration impacts with corresponding mitigation measures

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Ecology																
Pre-construction / Construction	Disturbance to the fauna due to vibration from construction activities	3	-3	2	2	3	-63	Minor negative	• Use of heavy equipment to be restricted to daytime only • Use of equipment or method which generate lower vibration levels • Route heavily loaded trucks away from the VSRs as far away as possible. • To plan and phase excavation, earth-moving, and ground pilling activities in staggered manner • Control speed of vehicle movement at the worksite • Keep access roads within project work site in good condition	3	-2	2	2	3	-42	Minor negative
Human Health and Safety																
Pre-construction / Construction	Disturbance/ annoyance to the VSR due vibration from construction activities	2	-3	2	2	3	-42	Minor negative	• Use of heavy equipment to be restricted to daytime only • Use of equipment or method which generate lower vibration levels • Route heavily loaded trucks away from the VSRs as far away as possible. • Control speed of vehicle movement at the worksite • To develop the vibration monitoring plan in consultation QP & to monitor throughout construction period • Notify nearby VSRs (residences) in advance of the construction activities	2	-2	2	2	3	-28	Slight negative

9 LIGHT

9.1 Introduction

Given its status as a highly urbanised city-state, high levels of light pollution are already being faced throughout Singapore. While unavoidable in cities, such lighting often has adverse impacts on the natural environment and wildlife.

Currently, within the study site, areas with artificial lighting which include streetlamps along the perimeter of the study area for traffic purposes and pedestrian walkways as well as household lightings from nearby residences. No artificial lights are present in the rest of the site, especially within the forested area.

It was observed that along the perimeters of the study area, the artificial lighting used along the portion of Commonwealth Avenue West and Ghim Moh Link used for traffic purposes illuminates the surrounding area including the adjacent vegetation (Figure 9.1). Vegetated areas along the portion of Ulu Pandan Park Connector and the pedestrian walkway connecting Commonwealth Avenue West to Dover MRT are also illuminated by artificial light (Figure 9.2).



Figure 9.1. Artificial light illuminating from Commonwealth Avenue West (left) and Ghim Moh Link (right)

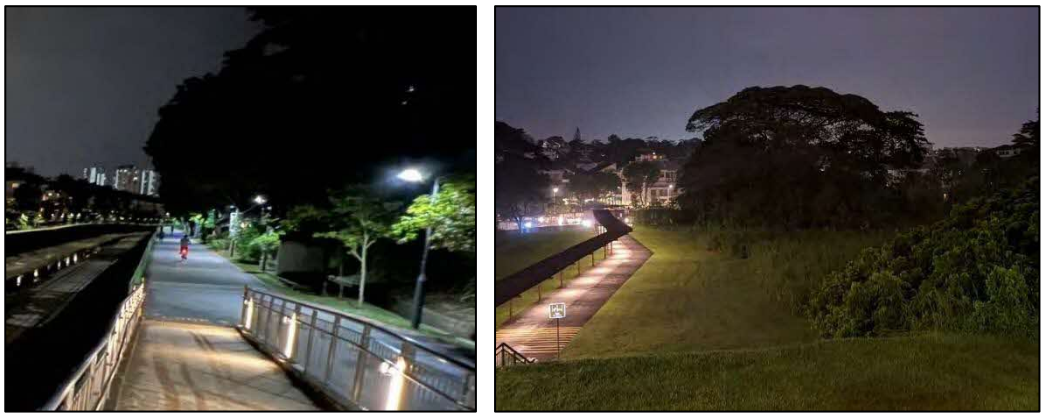


Figure 9.2. Artificial lighting observed along Ulu Pandan PCN (left) and connecting pedestrian walkway to Dover MRT (right)

9.2 Impact Assessment

9.2.1 Identification of Potential Impacts

Impacts to flora and fauna from light pollution should be avoided particularly for sensitive or threatened species highlighted in Chapter 4. Alteration of natural cycles of light and dark by artificial light sources can negatively impact the ecosystem. Increased artificial light during the night disrupts circadian cycles of animals and distorts the day-night cycle of plants. This may lead to increased predation pressure by diurnal carnivores on nocturnal animals, exhaustion from insects attracted to artificial light, disorientation and disruption of foraging by birds, and the alteration of breeding and sleeping cycles of various animals. As a whole, these effects derive from changes in orientation or disorientation, and attraction or repulsion from the altered light environment, which in turn may affect foraging, reproduction, migration, and communication behaviour.

Artificial night lights have also shown to have an impact on migratory birds, a large proportion of which migrate at night. In general, the risk of bird collisions increases with increased light emissions (Ogden, 2002).

Many groups of insects, such as moths, are attracted to lights resulting from their innate navigational behaviour. Visual communication within and between species can also be influenced by artificial lighting. Insects such as fireflies communicate through bioluminescent signals, which can only be achieved in the absence of background light (Longcore & Rich, 2004). Foraging behaviours of animals such as fruit bats are altered by light pollution, fruit bats are less active and forage less in artificially illuminated areas. As fruit bats play the ecological role of seed dispersers and pollinators, their reduced foraging activities may result in the loss of pollinating and seed-dispersal services they provide (Lewanzik & Voigt, 2014). The cumulative effects of such behavioural changes induced by artificial night lighting can have the potential to disrupt key ecosystem functions (Longcore & Rich, 2004).

Pre-construction / Construction Phase

During the pre-construction and construction stage, the source of impacts includes artificial lighting used to illuminate the project site, particularly if night works are conducted. The proposed works for the study area are along existing roads, which include part of Commonwealth Avenue West and Ghim Moh Link areas which already have existing artificial lighting. During the construction phase, particularly if night works are carried out, there will be additional light impacts from construction lighting. Impacts of light on the remaining forested area will be further exacerbated by edge effects, where vegetation clearance leads to open edges, thus allowing increased amount of light to enter these areas. The study area is a forested area used by nocturnal species, including the various species of bats and frogs. These species will be most impacted by nightworks. For this study area, it is assumed that all construction activities will be limited to daytime as far as possible except in case of work exigency, as described in section 2.7, with the implementation of the lighting management plan (LMP) approved by NParks. If left unmitigated, some slight impacts to biodiversity are expected.

Post-construction Phase

During the post-construction period, sources of light impacts will be derived from the streetlamps along Commonwealth Avenue West and Ghim Moh Link areas for traffic purposes and pedestrian walkways. These would include lights which illuminate the Ulu Pandan Park Connector and connecting walkway to Dover MRT as well as for safety or security reasons. With the clearance of forested areas, the edges of the retained forested area will be illuminated, causing disturbance to the flora and fauna species within.

Upon completion of infrastructure works in the study area, no additional lighting is required during the post-construction phase. Hence, some slight impacts from light pollution during this phase are anticipated. TAC recommends that the impacts from the building construction phase of this project are to be assessed separately.

9.2.2 Evaluation of Impacts

Table 9.1 summarises the impacts covering of all three areas with their corresponding Environmental Scores before and after the implementation of mitigation measures, which are elaborated in the following section.

9.3 Mitigation Measures

Where lighting is necessary for safety and security reasons for the proposed works within the study area, mitigation measures can be taken to ensure minimal impact on sensitive wildlife (i.e., fauna species in the surrounding areas).

9.3.1 Pre-construction and Construction Phase

During the construction phase, heavy construction activities within the study area are to be limited to daylight hours (8 am – 6 pm). If necessary, only light nightworks are to be conducted outside of daylight hours. Light nightworks refer to works without the use of heavy machinery (e.g., no piling, lights directed away from forested areas).

If light nightworks are necessary, construction lights should face downwards and away from forested areas. Such lights must be shielded, facing downwards and away from any forested areas. This will eliminate light spill, which is light that falls outside the area intended to be lit. Examples of ideal shielded lighting can be seen in Figure 9.3 below. All artificial lights should be turned off outside working hours except for safety & security reasons.



Figure 9.3. Example of light shielding

Additionally, a Lighting Management Plan (LMP) should be developed as part of the CEMMP in the case of work exigencies and for unavoidable nightwork, and the LMP is to be approved by NParks. The LMP should include minimally the following aspects:

- Objectives of Lighting Management Plan
- Purposes and categories of artificial lighting required
- Spatial layout of lighting utilised in project site
- Designs of lighting utilised – including height and shielding design
- Specifications of lighting utilised – lighting colour, spectrum, and brightness level
- Additional measures in place in the event that white or non-shielded lighting is required
- Implementation of monitoring plan

9.3.2 Post-construction Phase

Mitigation measures that should be implemented to mitigate the impacts on sensitive receptors for the project site are as follows:

- All unnecessary lights in project area should be turned off
- Use the minimum number and intensity of lights if required for safety and security
- Retain the hoarding along the edges of Ulu Pandan West and the linear park to prevent excess light from illuminating the forest.

9.4 Residual Impacts

The residual impacts were evaluated using the RIAM method (Table 9.1) with due consideration that the recommended mitigation measures are implemented by the Contractor. The residual impacts are likely to be negligible.

Table 9.1. Environmental Scores of the identified light impacts with corresponding mitigation measures

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Ecology																
Pre-construction / Construction	Disturbance to the flora and fauna in retained forested area and Stream 1 due to light from construction activities	1	-2	2	2	2	-12	Slight negative	• Construction lights shall be directed downwards and inwards, toward project site (i.e., directly away from forested areas) • Construction to be kept to daytime working hours (8 am – 6 pm) • All unnecessary lights should be turned off outside working hours • Develop and implement the LMP approved by NParks for the event of work exigencies	1	-1	2	2	2	-6	No Impact
Post-construction	Disturbance to the flora and fauna in retained forested area and Stream 1 vegetated buffer area due to post-construction phase lighting	1	-1	3	3	3	-9	Slight negative	• All unnecessary light to be turned off • Use the minimum number and intensity of lights if required for safety and security	1	-1	2	2	2	-6	No Impact

10 WASTE MANAGEMENT

10.1 Introduction

The main impacts related to waste storage, handling, transport, and disposal include:

- Deterioration of the environment (e.g., visual, water quality, biodiversity impacts, increase vectors, contamination etc.); and
- Health and safety risks with regards to hazardous wastes if they are not managed properly.

The main sources of potential impacts during the construction activities are identified as the following:

- Waste management requirement for cut vegetation (e.g., from site clearance)
- Waste management requirement for excavated material
- Waste management requirement for general waste
- Waste management requirement for hazardous waste
- Waste management requirement for other construction waste

There are legislations implemented and enforced by the Singapore government for management of general and hazardous wastes which are discussed in next section. Table 10.1 provides anticipated types of waste likely to be generated during construction.

Table 10.1. Types of waste likely to be generated during construction phase

Solid Waste Type	Source Activity	Classification
Cut vegetation	Site clearance	Non-hazardous
Excavated material	Excavation	Non-hazardous
Plastic/wooden planks	Packaging material	Mixed
Hazardous waste	Maintenance activity	Hazardous
Scrap metal	Form/temporary work	Non-hazardous
General waste	Construction workers	Non-hazardous

10.2 Relevant Environmental Legislation, Guidelines and Standards

The Environmental Public Health (EPHA) Act, 2002 set up the regulatory framework for waste management through following regulations:

- Environmental Public Health (General Waste Collection) Regulations, 2000
- Environmental Public Health (Toxic Industrial Wastes) Regulations, 2000

The Environmental Public Health (General Waste Collection) Regulations set out the requirements for the management of non-hazardous general waste and the duties of generators and companies collecting such wastes. General waste must be managed in an environmentally sound manner and collected by an NEA-licensed general waste collector.

The Environmental Public Health (Toxic Industrial Wastes) Regulations set requirements for the generation, management, and disposal of wastes characterised as hazardous,

such as oily sludge, solvents and asbestos containing materials. NEA has set out a list of specific wastes which are classified as Toxic Industrial Wastes (TIW) under the Schedule of this regulation. Special requirements apply to these TIWs with the key provisions includes appointment of a licensed TIW collection company to collect and treat the waste.

The Code of Practice for ECO stipulates the role of occupiers of construction sites and of the ECO, and their responsibilities pertaining to waste management at construction sites.

10.3 Impact Assessment

10.3.1 Identification of Potential Impacts

Pre-Construction and Construction Phase

Cut Vegetation

As discussed in Chapter 4 on Biodiversity, potentially large number of trees will be affected during the implementation of this project. Similarly, other vegetation, such as bushes and grassland will need to be cleared within footprint of the project boundary.

Where cutting is required, the waste vegetation needs to be properly managed to prevent fire risks. The preferred disposal route for this type of material is for the extraction of timber for use in the wood industry. Large stumps will require off-site transport for disposal at local disposal sites. The contractor shall not be permitted to dispose of cut vegetation by burning, as specified in the EPM (Prohibition on Use of Open Fires) Order.

Excavated Material

Due to the nature of construction work involved (i.e., cut and fill), no significant volumes of spoil are expected to be generated from this project. Based on preliminary information, the quantity of excavated material will be approximately 30,000 cubic meters. Most of excavated material is expected to be utilised for backfill within the project area. Any unutilised excavated material should by disposed through an NEA-licensed general waste collector for further treatment/ disposal.

Other Construction Waste

Other construction wastes will likely include:

- Broken rock or concrete
- Ferrous and non-ferrous scrap metal items
- Wooden planks, boards, pallets, formwork
- Packaging or wrapping materials such as plastic sheeting, corrugated
- Cardboard, paper
- Sacks and bags
- Metal or plastic containers and cans.

If not managed properly, the storage, handling, transport and disposal of construction wastes has the potential to result in visual, water, dust, noise and general environmental deterioration. In the event of inappropriate management methods, the disposal of construction waste is unlikely to raise any long-term concerns due to the inert nature of these types of materials. However, it is good practice to segregate different categories

of construction waste at source to facilitate recycling/disposal. It is expected that general waste will be handled, stored, managed and collected for appropriate disposal/treatment in accordance with the EPHA and the EPH (General Waste Collection) Regulations and there shall be no significant adverse impact to the environment.

General Waste

General waste will include debris, litter and wastes generated by the construction workers. The storage and handling of general waste has the potential to give rise to a variety of adverse impacts. These include odour problems if the waste is not collected regularly (i.e., daily), windblown litter, water quality impacts if waste enters watercourses, visual impacts as well as the attraction of pests, disease vectors and scavenging animals (insects, rodents etc.) to the site if waste materials are incorrectly stored onsite. Quantities of general waste produced by workers are typically in the range of 0.5 – 1 kg per person per day. It is expected that general waste will be handled, stored, managed and collected for appropriate disposal/ treatment in accordance with the EPHA and EPH (General Waste Collection) Regulations and there shall be no adverse impact to the environment.

Hazardous Waste

Hazardous wastes include those listed in the EPHA and EPH (Toxic Industrial Wastes) Regulations. Hazardous wastes are likely to arise principally as a result of maintenance activities for construction machinery and heavy vehicles at the construction site. Estimates of the quantities of hazardous waste are not available during preparation of this report. Types of hazardous construction waste generated include:

- Waste oils and used oil filters
- Paints and solvent residues
- Off-specification chemicals
- Oily water
- Drums, containers, packaging or wrapping materials, or soil contaminated with the TIW.

Hazardous construction wastes can pose serious environmental problems such as air, water, and land pollution unless they are handled, stored, transported and disposed of in an appropriate manner. Potential hazards may include:

- Toxic / adverse health effects on the workforce
- Adverse effects on water quality/ surface water resources, soil and groundwater in the event of spills and leaks
- Fire hazards

The generation of the hazardous construction wastes mentioned above is unavoidable. However, their environmental impact is not expected to raise long-term or irreversible negative effects as hazardous wastes are not routinely generated in big quantities by construction activities. In addition, hazardous wastes will not be generated after the construction phase of the Project has been completed.

Overall, potential waste management impacts are expected to be of slight negative nature, indirect, and local. Duration is anticipated to be short term and reversible as the

impact will cease upon completion of the construction activities. As such, mitigation measures are recommended to further reduce the potential impacts.

Post-construction Phase

No waste or hazardous materials management impacts have been identified during the post-construction phase. Nonetheless, it is important to note that this Environmental Study is meant to address impacts from the earthworks and infrastructure works phase of the development and are not meant to address the building construction phase of the development. Upon the completion of this project, building works for the upcoming residential developments are likely to commence. TAC recommends that the impacts from the building construction phase of this project are to be assessed separately.

10.3.2 Evaluation of Potential Impacts

Table 10.2 summarises the impacts covering of all three areas with their corresponding Environmental Scores before and after the implementation of mitigation measures, which are elaborated in the following section.

10.4 Mitigation Measures

10.4.1 Pre-Construction and Construction Phase

The various options within waste management can be categorised in terms of preference from an environmental perspective. The options considered to be more preferable have the least impacts and are more sustainable in a long-term context. Hence, the hierarchy is as follows:

- Avoidance and minimisation, i.e., not generating waste through changing or improving processes.
- Reuse or recycling of materials, thus minimising disposal.
- Disposed in a safe and appropriate manner through NEA-licensed general waste collectors.

It is recommended that the following guidelines and procedures are adopted:

- The contractor should develop a waste management plan to manage the collection, recycling and ultimate disposal of all generated wastes in an environmentally responsible manner.
- Timber/wood from cut vegetation can be recovered for use in the wood industry as far as possible.
- Surplus excavated material and inert wastes (soil, broken rock etc.) shall be reused within project site as backfill, landscaping, erosion control and restoration features wherever practicable.
- Scrap metals (e.g., welding rods, end caps, off-cuts etc.) can be recovered and sent for recycling as scrap.
- Other inert general waste will be collected and disposed through licensed waste collector.
- General waste generated on-site must be stored in enclosed bins separate from construction and hazardous wastes. A licensed general waste collector shall be

employed by the Contractor to remove general waste on a daily basis to minimise odour, pest and litter impacts.

- Portable toilet facilities/ septic tank system with collection of accumulated waste for off-site disposal by a licensed general waste collector.
- All non-hazardous wastes that are generated must be handled and disposed of in accordance with the requirements of the EPHA and the EPH (General Waste Collection) Regulations.
- Any hazardous wastes that are generated must be handled and disposed of in accordance with the requirements of the EPHA and the EPH (Toxic Industrial Wastes) Regulations.
- Disposal of hazardous waste must be through a licensed waste collector for hazardous waste.

The recommended measures above, when implemented effectively, shall mitigate the potential impacts of waste management to acceptable levels.

10.4.2 Post-construction Phase

The post-construction phase impact is assessed to be insignificant, therefore no mitigation measures are proposed.

10.5 Residual Impacts

The residual impacts were evaluated using the RIAM method (Table 10.2) with due consideration that the recommended mitigation measures are implemented by the Contractor. The residual impacts are likely to be in the band of slight negative to no impact and considered acceptable.

Table 10.2. Environmental Scores of the identified waste management impacts with corresponding mitigation measures

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Ecology																
Pre-construction / Construction	Disposal of cut vegetation	2	-2	2	2	2	-24	Slight Negative	• To develop solid waste management plan • Timber/wood to be recovered for use in the wood industry as far as possible	2	-1	2	2	2	-12	Slight Negative
	Disposal of excavated material	2	-3	2	2	2	-36	Slight Negative	• To develop solid waste management plan • Surplus excavated material to be reused within project site as fill, landscaping, erosion control and restoration wherever practicable	2	-2	2	2	2	-24	Slight Negative
	Disposal of general waste material	1	-2	2	2	2	-12	Slight Negative	• Scrap metals to be recovered and sent for recycling as scrap • Inert general waste to be collected and disposed through licensed waste collector • All non-hazardous wastes to be handled and disposed of in accordance with EPH (General Waste Collection) Regulations	1	-1	2	2	2	-6	No Impact
Human Health and Safety																
Pre-construction / Construction	Disposal of hazardous waste	1	-3	2	2	2	-18	Slight Negative	• All hazardous wastes to be handled and disposed of in accordance with EPH (Toxic Industrial Wastes) Regulations • Disposal of hazardous waste to be conducted by a licensed waste collector for hazardous waste	1	-1	2	2	2	-6	No impact

11 VECTOR CONTROL

11.1 Introduction

As Singapore has warm tropical climate, the possibility of vector borne diseases is always present. Vectors are organisms that transmit disease. According to NEA, the five main vectors in Singapore and the diseases that they could transmit are summarised in Table 11.1. As the majority of vector-borne diseases in Singapore are transmitted by mosquitoes, vector control management shall mainly focus on mosquito control during construction activities.

Table 11.1. Common vectors in Singapore

Vector	Disease
Mosquitoes	- Dengue and Dengue Hemorrhagic Fever - Chikungunya - Zika - Malaria - Japanese Encephalitis - Filariasis
Rat Flea	- Plague
Rodent	- Rat Bite Fever - Leptospirosis - Murine Typhus
Cockroach	- Cholera - Food-Borne Diseases
Fly	- Cholera - Typhoid and Para Typhoid - Salmonellosis - Dysentery

Source: https://www.nea.gov.sg/our-services/pest-control/overview

11.2 Relevant Environmental Legislation, Guidelines and Standards

The Control of Vectors and Pesticides Act, 2002 is the main legislation for control of vectors with the prime objective to prevent related diseases such as dengue fever in Singapore. It aims to prevent the propagation of vectors and stipulates the prohibition of creation of any condition favourable to the propagation and harbouring of vectors. Under Part V of the Act, only companies that are registered with NEA as Vector Control Operators (VCO) are allowed to be engaged to conduct any vector control treatment or activity. Employees of vector control operators are required to be licensed as vector control technicians or vector control workers to conduct any vector control activity. All public health pesticide/repellent products intended for use against the five vectors (namely rodents, mosquitoes, flies, cockroaches, and rat fleas) must be registered prior to local sales in Singapore as per this Act.

The Environmental Public Health Act, 2002 stipulates requirements pertaining to vector control such as public cleansing, public nuisances, and insanitary premises.
Environmental Public Health Act (Specified Construction Sites) Order 2021, and Code of Practice for Environmental Control Officers which require construction site occupiers

to employ either a part-time or full-time ECO, depending on the contract sum of the construction works. The Code of Practice for Environmental Control Officers sets out requirements on environmental health management of construction sites in the areas of vector control.

11.3 Impact Assessment

11.3.1 Identification of Potential Impacts

Pre-construction and Construction Phase

The main impact is the potential to cause an increase in the vector population within and in surrounding project site areas including Singapore Polytechnic as well as the residential areas at Holland Grove View and Ghim Moh Link during construction stage. There is a likelihood of vector-borne diseases affecting humans.

An increase in vectors may be caused by:

- Pooled water on the construction site (e.g., potholes, access roads with puddles)
- Storage of water on the construction site (e.g., water for washing)
- Storage and improper management of garbage and food waste
- Creation of stagnant conditions during drainage diversion
- Entrainment of debris, waste and silts in stormwater run-off resulting choked drains and stagnant drainage
- Poor cleanliness and unsanitary conditions

The assessment of the potential impacts is described below.

Increase in Number of Mosquitos

Project construction activities have the potential to create suitable breeding conditions for mosquito populations. Specifically, without control measures construction work can create pools of water due to site conditions (e.g., vehicle potholes), construction work (e.g., trenches) and storage of equipment and wastes favouring the breeding of mosquito populations. The likelihood of mosquitoes breeding without control measures in place is high.

Increase in Number of Other Vectors

During the construction, construction personnel will generate domestic waste and food waste that if not managed, can attract other vectors (e.g., rats, flies and cockroaches). A lack of correct and secure disposal of these wastes would create suitable breeding conditions for these vectors. The likelihood of rats, flies and cockroaches breeding without control measures in place is high.

Fleas require a host (e.g., rodents or other mammal) in order to breed and therefore fleas are considered to be directly relevant to the construction of the Project. With control of other vectors, fleas and related diseases are not likely to occur.

Increase in the Incidence of Dengue-Fever and Other Vector-related Diseases

If the number of mosquitoes increase in the construction works areas, the likelihood of a dengue outbreak occurring in the vicinity of the project can increase. Therefore, it is

important to prevent mosquitoes breeding at the construction works areas. The residential areas at Holland Grove View and Ghim Moh Link are in immediate surrounding of the project area. Hence occupiers of these premises can be exposed to vectors if proper control measures are not implemented.

If the number of rats, flies and cockroaches increases in the construction works areas, the likelihood of nuisance issues and vector-related diseases could increase. These impacts associated with these vectors can quickly change from nuisance to vector-disease levels. Rats can cause diseases and also damage equipment.

Overall, potential impacts are expected to be of slight negative nature, indirect, and local. Duration is anticipated to be short term and reversible as the impact will cease upon completion of the construction activities. As such, mitigation measures are recommended to further reduce the potential impacts.

Post-construction Phase

During the post-construction phase of the project, pools of water may still be formed in areas where earth levels are not even. This could create potential breeding conditions for mosquito populations, leading to a high likelihood of mosquitoes breeding if there are no control measures in place.

11.3.2 Evaluation of Potential Impacts

Table 11.2 summarises the impacts covering of all three areas with their corresponding Environmental Scores before and after the implementation of mitigation measures, which are elaborated in the following section.

11.4 Mitigation Measures

11.4.1 Pre-construction / Construction Phase

Increase in Number of Mosquitoes

It is essential that the construction contractor proactively implements vector control plan with appropriate requirements. Source reduction and effective drainage are proposed to be the main forms of mosquito control, with the following mitigation measures to be implemented:

- Before construction commences, the construction contractor shall engage a Vector Control Operator registered with NEA to prepare and implement a Vector Management Plan.
- Before construction starts, a Vector Management Plan shall be submitted to NEA.
- The construction contractor shall form a vector control team to check construction sites for breeding of mosquitoes.
- During the daily checks, particular attention shall be made to discarded receptacles and building wastes; building materials, canvas sheets, equipment and machinery; puddles on the ground levels; water storage drums, tanks and containers; bulk storage containers; trenches; drains and channels temporarily constructed to drain off water; air handling units and air conditioners; and, flat roofs of temporary buildings.

- Empty pails, basins and other containers shall be kept indoors.
- Construction worksite shall be kept free of litter; construction wastes shall be disposed promptly into bulk waste containers and the containers shall be emptied daily.
- Building materials shall be stored under shelter as far as practicable; materials shall be stored at least 60 cm above the ground to allow water collected below to be treated by the Vector Control Operator.
- Air-handling units shall be stored under shelter or, the overflow pipe shall be uncapped to allow rainwater to drain out.
- Stagnant water shall be pumped from the works areas and ground depressions shall be covered with earth.
- Anti-mosquito oil and insecticides including BTI (*Bacillus thuringiensis israelensis*) shall be applied into stagnant water at least once a week. The application should be repeated after rain as the oil and insecticides would be washed away by the rain.
- Any significant increase in numbers of vectors shall be reported to the NEA and investigated.

Thermal fogging shall not be carried out due to location of project site adjacent to a forested area.

Increase in Number of Other Vectors

Rats, flies, and cockroaches shall also be targeted for active preventative measures to reduce their breeding habitats (waste disposal areas and wet areas). General cleanliness and waste disposal protocols will control these vector populations and worker hygiene can help reduce insect attraction. The following mitigation shall be implemented:

- Worksite shall be kept litter-free and waste bins shall always be covered tightly.
- Construction workers' food provisions shall be stored in rodent-proof rooms or cabinets.
- All food items shall be adequately covered and stored at least 60 cm above the ground.
- The vector control team and the Vector Control Operator should check for rodent burrows every week. Active burrows should be treated with rodenticides for three consecutive days or until the rats are all dead (i.e., no more dead rats found), and then sealed with compacted earth.
- Sanitary waste/domestic waste should be removed from the site in accordance with Singapore's legislation promptly.
- Any significant increase in numbers of vectors shall be reported to the NEA and investigated.

Increase in the Incidence of Dengue-Fever and Other Vector-related diseases

The mitigation to control mosquito numbers and other vectors will mitigate this secondary impact on increase of dengue. Additionally, the following mitigation is proposed:

- During construction, vector control shall be undertaken as per the NEA Guidebook for "Scope of Works for Mosquito Control".

- If required, assistance shall be provided to the authorities to investigate outbreaks of vector-borne diseases at the construction site.
- Weekly monitoring of the NEA's dengue cluster map shall be undertaken to determine if the workers at construction areas are at risk.

With the implementation of the mitigation measures proposed, it is expected that the impacts can be reduced along with the potential for vector borne diseases.

11.4.2 Post-construction Phase

To prevent the increase of mosquitoes, the following mitigation measures should be implemented:

- Empty pails, basins and other containers shall be kept indoors.
- Area shall be kept free of litter; construction wastes shall be disposed promptly into bulk waste containers and the containers shall be emptied daily.
- Building materials shall be stored under shelter as far as practicable; materials shall be stored at least 60 cm above the ground to allow water collected below to be treated by the Vector Control Operator.
- Stagnant water shall be pumped from the works areas and ground depressions shall be covered with earth.
- Anti-mosquito oil and insecticides including BTI shall be applied into stagnant water at least once a week. The application should be repeated after rain as the oil and insecticides would be washed away by the rain.
- Any significant increase in numbers of vectors shall be reported to the NEA and investigated.

Thermal fogging shall not be carried out due to location of project site adjacent to a forested area.

11.5 Residual Impacts

The residual impacts were evaluated using the RIAM method (Table 11.2) with due consideration that the recommended mitigation measures are implemented by the Contractor. The residual impacts are likely to be in the band of slight negative to no impact and considered acceptable.

Table 11.2. Environmental Scores of the identified vector control impacts with corresponding mitigation measures

Phase	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
		I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Human Health and Safety																
Pre-construction / Construction	Increase in the number of mosquitoes	2	-2	2	2	2	-24	Slight Negative	• Contractor to engage an NEA-registered Vector Control Operator to prepare and implement vector management plan • A vector control team to check construction sites for breeding of mosquitoes • Construction worksite to be kept free of litter; construction wastes shall be disposed promptly into bulk waste containers and the containers shall be emptied daily	2	-1	2	2	2	-12	Slight Negative
	Increase in the number of other vectors (e.g., flies and rodents)	1	-2	2	2	2	-12	Slight Negative	• Worksite shall be kept litter-free and waste bins shall always be covered tightly. • Construction workers' food provisions shall be stored in rodent-proof rooms or cabinets • Vector control team and Vector Control Operator to check for rodent burrows every week	1	-1	2	2	2	-6	No Impact
	Increase in incidence of dengue fever and vector-related diseases (*secondary impact)*	2	-3	2	2	2	-36	Slight Negative	• To implement mitigation measures to control mosquito numbers and other vectors • To aid the authorities to investigate outbreaks of vector-borne diseases if required	2	-2	2	2	2	-24	Slight Negative

12 SUMMARY OF IMPACT ASSESSMENT & MITIGATION MEASURES

Table 12.1. Summary of Environmental Scores of the identified impacts with corresponding mitigation measures

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Ecology																	
Pre-construction / Construction	Biodiversity	Flora and fauna species damage and mortality due to vegetation clearance for temporary working space	1	-2	2	2	2	-12	Slight negative	• Erect temporary hoarding • Identify plants to be transplanted • Avoid tree roots • Establish Tree Protection Zones (TPZ) for trees to be retained • Visually inspect trees and holes for nesting birds and animals prior to felling	1	-1	2	2	2	-6	No impact
		Loss of habitats due to vegetation clearance for temporary working space	1	-2	2	2	2	-12	Slight negative	• Erect temporary hoarding to limit vegetation clearance • Avoid placement of working areas in waterbodies • Reinstate habitats where possible upon completion of works	1	-2	2	2	2	-12	Slight negative
		Impacts to flora and fauna due to illegal encroachment of vegetated areas by construction personnel	3	-2	2	2	2	-36	Minor negative	• Incorporate signs prohibiting entrance into vegetated areas • Erect fences to prevent illegal entry	3	-1	2	2	2	-18	Slight negative
		Impact on native species due to the introduction of invasive species	1	-2	3	3	2	-16	Slight negative	• Ensure equipment, vehicles, and footwear used are clean prior to commencing works • Use native plants for replanting of roadside verges • Periodic checks within hoarding boundary to ensure that no introduced plant species have spontaneously established	1	-1	3	3	2	-8	Slight negative

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
		Loss of habitats due to vegetation clearance for development of Ulu Pandan	3	-3	3	3	2	-72	Minor negative	• Ensure project layout avoids targeted sensitive habitats, including Stream 1 • Erect temporary hoarding to limit vegetation clearance • Reinstate habitats with native flora species where possible upon completion of works	3	-3	3	3	2	-72	Minor negative
		Flora and fauna species mortality due to vegetation clearance for development of Ulu Pandan	3	-3	3	3	3	-81	Moderate negative	• Erect temporary hoarding • Ensure project layout avoids targeted sensitive receptors where possible • Identify trees to be transplanted • Conduct phased, directional vegetation clearance along with fauna translocation where required • Conduct daily checks of ECM blankets and pits to rescue any entrapped fauna • Utilise only non-plastic, biodegradable ECM mats throughout the site. • Reinstate working areas with selected native species • As far as practicable, avoid commencement of tree felling during the peak bird nesting period (February to July) • Establish Tree Protection Zones (TPZ) for trees to be retained • Visually inspect trees for nesting birds and animals prior to felling	3	-2	3	3	3	-54	Minor negative
		Roadkill or road injury to fauna escaping from forested site	3	-3	3	3	2	-72	Minor negative	• Erect physical barriers to direct fauna movement into unaffected forested areas and prevent fauna from crossing the road	3	-2	3	3	2	-48	Minor negative

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
										• Erect speed bumps or signages to alert drivers about potential animal crossings • Enforce speed limit on the roads							
		Impact on habitats including waterbodies due to soil erosion, runoff, and discharge of silty water	3	-3	3	2	3	-72	Minor negative	• Implement Earth Control Measures (ECMs) that are approved by PUB	3	-2	2	2	2	-36	Slight negative
		Indirect impact on habitats due to edge effect	3	-2	2	2	2	-36	Slight negative	• Avoid night works (i.e., limit construction activities to 8 am – 6 pm) • Construction lights (if any) should face inwards and away from the forest	3	-1	2	2	2	-18	Slight negative
	Hydrology & Water Quality	Degradation and loss of stream habitats	2	-3	3	3	2	-48	Minor negative	• The minimum dry weather flow to be maintained in the natural stream for sustainability. • Design and incorporate open sump (Figure 5.22) • Ensure that none of the site investigation boreholes are located within 10 m of the natural streams • Regular water quality monitoring is to be conducted according to the proposed Environmental Monitoring Plan during construction and post-construction stage • Design appropriately to ensure that stormwater flow can be controlled during heavy rain period	2	-2	3	3	2	-32	Slight negative
		Impact to water quality due to sediment runoff and trade effluent	2	-3	2	2	2	-42	Minor negative	• Contractor to provide sufficient storage tanks of adequate size to temporarily store trade effluent before treatment and disposal. • Area where trade effluent is being transported out to be kerbed to minimise spills	2	-2	2	2	2	-24	Slight negative

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
										• Contractor to provide sampling point and inspection for collection of trade effluent to be tested for parameters stipulated in the Regulations, depending on the discharge point (i.e., sewer, watercourse). • Regular water quality monitoring is to be conducted according to the proposed Environmental Monitoring Plan during construction and post-construction stage. • Contractor should install and maintain trade effluent treatment facilities (e.g., slurry treatment plant, grease trap and suspended solid settling tank) as per NEA's requirements.							
		Impact to water quality due to accidental spillage of construction materials, fuel, and solvents	2	-2	2	2	3	-28	Slight negative	• To ensure that slurry is contained within the working area and does not enter any watercourses or surface water drains. • Micropile storage tanks for slurry should have secondary containment. • Foreign material should not be illegally disposed at the water bodies but removed from site by a licensed waste collector. • Waste bins to be provided within the construction work area for proper disposal of construction debris and rubbish. • Vehicle fuelling and major maintenance to be minimised within the project area/ No vehicle fuelling and maintenance to be allowed within the project area.	2	-1	2	2	2	-12	Slight negative

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
										• Excess loose soil and rock to be contained prior to the commencement of the works. • Appropriate concrete wash bays should be provided and should not be performed in or near any water body. • Emergency spill kits should be provided by contractor on site in the event of any chemical spillages. Emergency response team should also be trained in the use of these spill kits.							
	Noise	Disturbance to fauna species in and around the project site	2	-3	2	2	2	-36	Slight negative	• No heavy nightworks (i.e., limit heavy construction activities to 8 am – 6 pm), • Develop and implement LMP • Noise barrier with 6 m height as hoarding • Quieter equipment and vehicles with low noise levels to be used • For piling work, to consider the use of quieter piling methods • Acoustic enclosures to be considered for compressors, generators, drilling tools etc. • Noise level monitoring throughout all phases to ensure that the construction noises remain within acceptable limits	2	-2	2	2	2	-24	Slight negative
	Ambient Air Quality	Impact to biodiversity due to generation of fugitive dust	1	-2	2	2	2	-12	Slight negative	• To implement dust suppression plan • Use of hoarding at project boundary to minimise dust generation by attenuating wind forces. • To avoid stockpiles of soil and dusty materials at project site within forested area as far as possible.	1	-1	2	2	2	-6	No Impact

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
										• Stockpiles of dusty material should be properly stored, covered entirely with impervious sheeting • Use of regular watering to reduce dust emissions from exposed site surface							
	Vibration	Disturbance to the fauna due to vibration from construction activities	3	-3	2	2	3	-63	Minor negative	• Use of heavy equipment to be restricted to daytime only • Use of equipment or method which generate lower vibration levels • Route heavily loaded trucks away from the VSRs as far away as possible. • To plan and phase excavation, earth-moving, and ground pilling activities in staggered manner • Control speed of vehicle movement at the worksite • Keep access roads within project work site in good condition	3	-2	2	2	3	-42	Minor negative
	Light	Disturbance to the flora and fauna in retained forested area and Stream 1 due to light from construction activities	1	-2	2	2	2	-12	Slight negative	• Construction lights shall be directed downwards and inwards, toward project site (i.e., directly away from forested areas) • Construction to be kept to daytime working hours (8 am – 6 pm) • All unnecessary lights should be turned off outside working hours • Develop and implement LMP approved by NParks for the event of work exigencies	1	-1	2	2	2	-6	No Impact
	Waste Management	Disposal of cut vegetation	2	-2	2	2	2	-24	Slight Negative	• To develop solid waste management plan • Timber/wood to be recovered for use in the wood industry as far as possible	2	-1	2	2	2	-12	Slight Negative

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
		Disposal of excavated material	2	-3	2	2	2	-36	Slight Negative	• To develop solid waste management plan • Surplus excavated material to be reused within project site as fill, landscaping, erosion control and restoration wherever practicable	2	-2	2	2	2	-24	Slight Negative
		Disposal of general waste material	1	-2	2	2	2	-12	Slight Negative	• Scrap metals to be recovered and sent for recycling as scrap • Inert general waste to be collected and disposed through licensed waste collector • All non-hazardous wastes to be handled and disposed of in accordance with EPH (General Waste Collection) Regulations	1	-1	2	2	2	-6	No Impact
Post-construction	Hydrology & Water Quality	Impact to drainage pattern and water quality in Stream 1	2	-3	3	3	2	-48	Minor negative	• Ensure that the source of the flow is maintained in Stream 1 in order to minimise the impact of the development on the Stream 1. • Design and incorporate open sump • No discharge of process effluent or release of pollutants through this outlet to the stream. • Flow rate of discharge is to be regulated to prevent erosion within receiving stream. • Water quality checks if there is suspicion of discharge of pollutant to the stream.	2	-2	2	2	2	-24	Slight negative
	Light	Disturbance to the flora and fauna in retained forested area and Stream 1 vegetated buffer area due to post-construction phase lighting	1	-1	3	3	3	-9	Slight negative	• All unnecessary light to be turned off • Use the minimum number and intensity of lights if required for safety and security	1	-1	2	2	2	-6	No Impact

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
Human Health and Safety																	
Pre-construction / Construction	Biodiversity	Attacks of construction personnel by animals including bees and snakes	3	-3	2	3	2	-63	Minor negative	• Establish designated areas for food and waste disposal • Install monkey-proof bins • Conduct information sessions on what to do upon encountering wildlife	3	-2	2	3	1	-36	Slight negative
		Injury caused by tree falls due to damaged roots	3	-4	2	3	2	-84	Moderate negative	• Establish Tree Protection Zones (TPZ) for trees to be retained • Regularly monitor health of trees on project site	3	-3	2	3	1	-36	Slight negative
	Hydrology & Water Quality	Impact to water quality due to accidental spillage of construction materials, fuel, and solvents	2	-2	2	2	3	-28	Slight negative	• Contractor to provide storage tanks of adequate size and sufficient numbers to temporarily store trade effluent before treatment and disposal. • Contractor to provide sampling point and inspection for collection of trade effluent to be tested for parameters stipulated in the Regulations, depending on the discharge point (i.e., sewer, watercourse, controlled watercourse). • Contractor should install and maintain trade effluent treatment facilities (e.g., slurry treatment plant, grease trap and suspended solid settling tank) as per NEA's requirements	2	-1	2	2	2	-12	Slight negative
	Noise	Impact to construction workers due to exposure to high noise levels of construction activities	2	-2	2	2	2	-24	Slight negative	• Personnel are to wear appropriate Personal Protective Equipment (PPE) at all times while on the construction site • Quieter equipment and vehicles with low noise levels to be used.	2	-1	2	2	2	-12	Slight negative

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
										• All noise and acoustic barriers to be able to achieve at least 10 dB(A) noise reduction from source noise levels.							
		Impact to NSR due to noise pollution from construction activities	2	-2	2	2	2	-24	Slight negative	• No heavy nightworks (i.e., limit heavy construction activities to 8 am – 6 pm) • Develop and implement the LMP approved by NParks • Noise barrier with 6 m height as hoarding • To consider erection of temporary acoustic barriers around piling equipment • Acoustic enclosures to be considered for compressors, generators, drilling tools etc. • Noise level monitoring throughout all phases to ensure that the construction noises remain within acceptable limits	2	-1	2	2	2	-12	Slight negative
	Ambient Air Quality	Impact on construction workers due to generation of fugitive dust and exhaust emissions from construction machineries	1	-2	2	2	2	-12	Slight Negative	• To implement dust suppression plan • Personal protective equipment i.e., face mask to be worn during dust exposure • Stockpiles of dusty material to be properly stored, covered entirely with impervious sheeting, or dampened with water • Use of regular watering to reduce dust emissions from exposed site surfaces • Proper maintenance of construction vehicles and fuel burning equipment • Intermittently-used vehicles and machinery are to be shut down between work periods	1	-1	2	2	2	-6	No Impact

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
		Impact on ASR (i.e., nearby residents) due to generation of fugitive dust	1	-2	2	2	2	-12	Slight Impact	• To implement dust suppression plan • Provide dust screen at project boundary near residential community • Stockpiles of dusty material to be properly stored, covered entirely with impervious sheeting, or dampened with water • Use of regular watering to reduce dust emissions from exposed site surface	1	-1	2	2	2	-12	Slight Impact
		Impact due to generation of odour	1	-1	2	2	2	-6	No Impact	• Refer to Section 10.4	1	-1	2	2	2	-6	No Impact
	Vibration	Disturbance/ annoyance to the VSR due vibration from construction activities	2	-3	2	2	3	-42	Minor negative	• Use of heavy equipment to be restricted to daytime only • Use of equipment or method which generate lower vibration levels • Route heavily loaded trucks away from the VSRs as far away as possible. • Control speed of vehicle movement at the worksite • To develop the vibration monitoring plan in consultation QP & to monitor throughout construction period • Notify nearby VSRs (residences) in advance of the construction activities	2	-2	2	2	3	-28	Slight negative
	Waste Management	Disposal of hazardous waste	1	-3	2	2	2	-18	Slight Negative	• All hazardous wastes to be handled and disposed of in accordance with EPH (Toxic Industrial Wastes) Regulations • Disposal of hazardous waste to be conducted by a licensed waste collector for hazardous waste	1	-1	2	2	2	-6	No impact
	Vector control	Increase in the number of mosquitoes	2	-2	2	2	2	-24	Slight Negative	• Contractor to engage an NEA-registered vector control operator to	2	-1	2	2	2	-12	Slight Negative

Phase	Aspects	Impact component	Predicted impact before mitigation							Mitigation measures	Predicted impact after mitigation						
			I	M	P	R	C	ES	Impact		I	M	P	R	C	ES	Impact
										prepare and implement vector management plan • A vector control team to check construction sites for breeding of mosquitoes • Construction worksite to be kept free of litter; construction wastes shall be disposed promptly into bulk waste containers and the containers shall be emptied daily							
		Increase in the number of other vectors (e.g., flies and rodents)	1	-2	2	2	2	-12	Slight Negative	• Worksite shall be kept litter-free and waste bins shall always be covered tightly. • Construction workers' food provisions shall be stored in rodent-proof rooms or cabinets • Vector control team and Vector Control Operator to check for rodent burrows every week	1	-1	2	2	2	-6	No Impact
		Increase in incidence of dengue fever and vector-related diseases (*secondary impact)*	2	-3	2	2	2	-36	Slight Negative	• To implement mitigation measures to control mosquito numbers and other vectors • To aid the authorities to investigate outbreaks of vector-borne diseases if required	2	-2	2	2	2	-24	Slight Negative

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APPENDIX A

List of Plant Species Recorded at Study Area

List of Plant Species Recorded at Project Study Area

No.	Species Name	Common Name	Family	Origin	Local Status (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	Present Surveys	Previous Surveys (AECOM; East only)	Previous Surveys (AECOM; East & West)
1	*Acacia auriculiformis*	Acacia Tree	Fabaceae	Non-native	Naturalised	✓	✓	✓
2	*Acalypha siamensis*	Tumput	Euphorbiaceae	Non-native	Naturalised	✓		✓
3	*Acalypha wilkesiana*	Copperleaf	Euphorbiaceae	Non-native	Cultivated Only	✓		
4	*Acrostichum aureum*	Mangrove Fern	Pteridaceae	Native	Least Concern	✓		
5	*Adenanthera pavonina*	Saga	Fabaceae	Non-native	Naturalised	✓		
6	*Adiantum latifolium*	Broadleaf Maiden's Hair Fern	Pteridaceae	Non-native	Naturalised	✓		
7	*Aglaonema commutatum*	Chinese Evergreen	Araceae	Non-native	Casual	✓		✓
8	*Alocasia macrorrhizos*	Giant taro	Araceae	Non-native	Naturalised	✓		✓
9	*Alstonia angustifolia*	Red-leaved pulai, Pulai penipu paya	Apocynaceae	Native	Least Concern		✓	✓
10	*Alstonia angustiloba*	Common pulai	Apocynaceae	Native	Least Concern	✓		✓
11	*Amblovenatum opulentum*	Jeweled Maiden Fern	Thelypteridaceae	Native	Least Concern	✓		
12	*Andira inermis*	Brown Heart	Fabaceae	Non-native	Casual	✓	✓	✓
13	*Antidesma bunius*	Bignay	Phyllanthaceae	Non-native	Casual	✓		
14	*Aphanamixis polystachya*	Pithraj tree	Meliaceae	Native	Least Concern	✓	✓	✓
15	*Archontophoenix alexandrae*	Alexandra Palm	Arecaceae	Non-native	Cultivated Only	✓		

No.	Species Name	Common Name	Family	Origin	**Local Status** (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	Present Surveys	Previous Surveys (AECOM; East only)	Previous Surveys (AECOM; East & West)
16	*Ardisia elliptica*	Sea-shore Ardisia	Primulaceae	Native	Endangered	✓		✓
17	*Arthrophyllum jackianum*	Common Ivy Palm	Araliaceae	Native	Least Concern	✓		✓
18	*Artocarpus heterophyllus*	Jackfruit, Nangka	Moraceae	Non-native	Casual	✓	✓	✓
19	*Artocarpus integer*	Cempedak	Moraceae	Uncertain	Cryptogenic	✓		✓
20	*Asplenium longissimum*	Spleenwort	Aspleniaceae	Native	Least Concern	✓		✓
21	*Asplenium nidus*	Bird Nest Fern	Aspleniaceae	Native	Least Concern	✓		✓
22	*Asystasia gangetica* subsp. *micrantha*	Chinese Violet, Creeping Foxglove	Acanthaceae	Non-native	Naturalised	✓		
23	*Averrhoa carambola*	Star Fruit, Belimbing Besi	Oxalidaceae	Non-native	Casual	✓		✓
24	*Axonopus compressus*	Cow Grass, Tropical Carpet Grass	Poaceae	Non-native	Naturalised	✓		
25	*Baccaurea motleyana*	Rambai	Phyllanthaceae	Native	Critically Endangered	✓	✓	✓
26	*Bambusa vulgaris*	Common Bamboo	Poaceae	Non-native	Cultivated Only	✓		✓
27	*Breynia androgyna*	Cekur Manis	Phyllanthaceae	Native	Vulnerable	✓		
28	*Bridelia stipularis*	Kenidai	Phyllanthaceae	Native	Vulnerable	✓		
29	*Bridelia tomentosa*	Kenidai	Phyllanthaceae	Native	Least Concern	✓	✓	✓
30	*Calophyllum soulattri*	Bintangor Bunut, Malang-Malang, Mintak	Calophyllaceae	Non-native	Not Evaluated	✓		✓

No.	Species Name	Common Name	Family	Origin	**Local Status** (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	**Present Surveys**	**Previous Surveys (AECOM; East only)**	**Previous Surveys (AECOM; East & West)**
31	*Capsicum frutescens*	Chilli Padi	Solanaceae	Non-native	Cultivated Only	✓		
32	*Carallia suffruticosa*	Tulang Daing, Sisik Puyuh	Rhizophoraceae	Non-native	Cultivated Only	✓		
33	*Caryota mitis*	Common Fishtail Palm	Arecaceae	Native	Least Concern	✓	✓	✓
34	*Centrosema molle*	Soft Butterfly Pea	Fabaceae	Non-native	Naturalised	✓		
35	cf. *Belosynapsis ciliata*	-	Commelinaceae	Non-native	Not Evaluated	✓		
36	*Christella subpubescens*	-	Thelypteridaceae	Native	Least Concern	✓		
37	*Cinnamomum iners*	Wild Cinnamon	Lauraceae	Native	Least Concern	✓	✓	✓
38	*Cissus hastata*	Spear-shaped Cissus	Vitaceae	Native	Least Concern	✓		✓
39	*Claoxylon indicum*	Jarak Kayu	Euphorbiaceae	Native	Least Concern	✓	✓	✓
40	*Clausena excavata*	False Curry Tree, Pink Lime Berry	Rutaceae	Native	Least Concern	✓	✓	✓
41	*Clerodendrum disparifolium*	Swaddling Flower	Lamiaceae	Native	Least Concern	✓		
42	*Clerodendrum paniculatum*	Pagoda Flower, Quezonia	Lamiaceae	Non-native	Naturalised	✓		✓
43	*Clinacanthus nutans*	Sabah Snake Grass	Acanthaceae	Non-native	Not Evaluated	✓		
44	*Cocos nucifera*	Coconut	Arecaceae	Non-native	Naturalised	✓		

No.	Species Name	Common Name	Family	Origin	Local Status (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	Present Surveys	Previous Surveys (AECOM; East only)	Previous Surveys (AECOM; East & West)
45	*Colocasia esculenta*	Cocoyam, Taro, Elephant's ear	Araceae	Non-native	Casual	✓		✓
46	*Commelina diffusa*	Spreading Dayflower	Commelinaceae	Uncertain	Cryptogenic	✓		
47	*Cyanthillium cinereum*	Common Vernonia	Asteraceae	Native	Least Concern	✓		
48	*Cyathula prostrata*	Hookweed, Pastureweed	Amaranthaceae	Native	Least Concern	✓		
49	*Cyclosorus interruptus*	Hottentot fern, Swamp Shield-fern	Thelypteridaceae	Native	Least Concern	✓		
50	*Cyperus brevifolius*	Shortleaf Spikesedge, Green Kyllinga	Cyperaceae	Native	Vulnerable	✓		
51	*Cyperus* cf. *compressus*	Poorland Flatsedge	Cyperaceae	Native	Vulnerable	✓		
52	*Cyperus* cf. *rotundus*	Nutgrass	Cyperaceae	Native	Least Concern	✓		
53	*Cyperus mindorensis*	White Kyllinga	Cyperaceae	Native	Least Concern	✓		
54	*Cyrtococcum accrescens*	-	Poaceae	Native	Vulnerable	✓		
55	*Cyrtococcum patens*	Bowgrass	Poaceae	Native	Vulnerable	✓		
56	*Derris elliptica*	-	Fabaceae	Non-native	Naturalised	✓		
57	*Dieffenbachia seguine*	Dumbcane	Araceae	Non-native	Casual	✓		✓
58	*Digitaria* cf. *didactyla*	Blue Couch, Blue Serangoon Grass	Poaceae	Non-native	Naturalised	✓		
59	*Dillenia suffruticosa*	Simpoh Air	Dilleniaceae	Native	Least Concern	✓	✓	✓

No.	Species Name	Common Name	Family	Origin	Local Status (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	Present Surveys	Previous Surveys (AECOM; East only)	Previous Surveys (AECOM; East & West)
60	*Dimocarpus lichi*	Mata Kucing, Isau, Sau, Kakus	Sapindaceae	Native	Data Deficient	✓		
61	*Dioscorea bulbifera*	Air Potato	Dioscoreaceae	Uncertain	Cryptogenic	✓		✓
62	*Dracaena fragrans*	Corn Palm, Palmillo, Fortune Plant	Asparagaceae	Non-native	Casual	✓		✓
63	*Dracaena sanderiana*	Lucky Bamboo Plant	Asparagaceae	Non-native	Naturalised	✓		✓
64	*Dracaena surculosa*	Gold Dust Dracaena, Spotted Dracaena, Japanese Bamboo	Asparagaceae	Non-native	Naturalised	✓		✓
65	*Durio zibethinus*	Durian	Malvaceae	Non-native	Casual	✓	✓	✓
66	*Elaeis guineensis*	Oil Palm, Kelapa Sawit	Arecaceae	Non-native	Casual	✓	✓	✓
67	*Elaeocarpus* cf. *ngii*	-	Elaeocarpaceae	Non-native	Not Evaluated	✓		
68	*Elaeocarpus ferrugineus*	Rusty Oil Fruit	Elaeocarpaceae	Native	Vulnerable	✓		
69	*Eleocharis* cf. *geniculata*	Bent Spikerush	Cyperaceae	Native	Least Concern	✓		
70	*Embelia ribes*	False Black Pepper	Primulaceae	Native	Least Concern	✓		
71	*Emblica urinaria*	Shatterstone	Phyllanthaceae	Non-native	Naturalised	✓		
72	*Emilia sonchifolia*	Cupid's Shaving Brush	Asteraceae	Native	Least Concern	✓		
73	*Epipremnum aureum*	Ivy Arum, Money Plant	Araceae	Non-native	Casual	✓		✓
74	*Epipremnum pinnatum*	Dragon-tail Vine, Taro Vine	Araceae	Non-native	Naturalised	✓		
75	*Erigeron bellioides*	Bellorita	Asteraceae	Non-native	Naturalised	✓		

No.	Species Name	Common Name	Family	Origin	**Local Status** (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	**Present Surveys**	**Previous Surveys (AECOM; East only)**	**Previous Surveys (AECOM; East & West)**
76	*Erycibe tomentosa*	Akar Pelandok	Convolvulaceae	Native	Least Concern	✓		
77	*Erythrophleum suaveolens*	Red Water Tree, Sasswood	Fabaceae	Non-native	Cultivated Only	✓	✓	✓
78	*Falcataria falcata*	Albizia Tree	Fabaceae	Non-native	Naturalised	✓	✓	✓
79	*Fibraurea tinctoria*	Akar Badi	Menispermaceae	Native	Least Concern	✓		
80	*Ficus aurata*	Yellow Hairy Fig	Moraceae	Native	Least Concern	✓		
81	*Ficus benjamina*	Weeping Fig	Moraceae	Uncertain	Cryptogenic	✓		✓
82	*Ficus fistulosa*	Yellow Stem Fig	Moraceae	Native	Least Concern	✓	✓	✓
83	*Ficus grossularioides*	White-leafed Fig	Moraceae	Native	Least Concern	✓		
84	*Ficus heteropleura*	Sandy-leaved Fig	Moraceae	Native	Least Concern	✓		✓
85	*Ficus hispida*	Hairy Fig	Moraceae	Non-native	Casual	✓		
86	*Ficus microcarpa*	Malayan Banyan, Small-fruited Fig, Indian Laurel Fig	Moraceae	Native	Least Concern	✓		✓
87	*Ficus punctata*	Climbing Fig	Moraceae	Native	Least Concern	✓		✓
88	*Ficus variegata*	Common red-stem Fig	Moraceae	Native	Least Concern	✓		✓
89	*Ficus virens*	Grey Fig, Spotted Fig	Moraceae	Native	Endangered	✓		✓

No.	Species Name	Common Name	Family	Origin	**Local Status** (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	**Present Surveys**	**Previous Surveys (AECOM; East only)**	**Previous Surveys (AECOM; East & West)**
90	*Fimbristylis acuminata*	Pointed Fimbristylis	Cyperaceae	Native	Least Concern	✓		
91	*Fimbristylis dichotoma*	Forked Fimbry, Common Fimbristylis	Cyperaceae	Native	Least Concern	✓		
92	*Flagellaria indica*	False Rattan	Flagellariaceae	Native	Least Concern	✓		✓
93	*Geophila herbacea*	Snake Pennywort	Rubiaceae	Native	Endangered	✓		
94	*Gigantochloa ligulata*	-	Poaceae	Native	Critically Endangered	✓		
95	*Glochidion zeylanicum* var. *zeylanicum*	-	Phyllanthaceae	Native	Vulnerable	✓		✓
96	*Gmelina arborea*	Gamar, Grey Teak	Lamiaceae	Non-native	Cultivated Only	✓		
97	*Gnetum gnemon*	Belinjau	Gnetaceae	Native	Critically Endangered	✓		
98	*Grona heterophylla*	Spanish Clover, Greater Clover-leaved Desmodium	Fabaceae	Native	Least Concern	✓		
99	*Grona triflora*	Creeping Tick Trefoil, Three-flower Beggarweed	Fabaceae	Native	Least Concern	✓		
100	*Grypothrix triphylla*	Three-leaved Crescent Fern	Thelypteridaceae	Native	Least Concern	✓		✓
101	*Gymnanthemum amygdalinum*	Bitter Leaf	Asteraceae	Non-native	Cultivated Only	✓		
102	*Hedyotis biflora*	Twoflower Mille Graines	Rubiaceae	Native	Least Concern	✓		

No.	Species Name	Common Name	Family	Origin	**Local Status** (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	**Present Surveys**	**Previous Surveys (AECOM; East only)**	**Previous Surveys (AECOM; East & West)**
103	*Hedyotis diffusa*	Snake-needle Grass	Rubiaceae	Native	Least Concern	✓		
104	*Heptapleurum sp.*	-	Araliaceae	Non-native	Not Evaluated	✓		
105	*Hevea brasiliensis*	Rubber Tree	Euphorbiaceae	Non-native	Naturalised		✓	✓
106	*Horsfieldia* cf. *polyspherula*	-	Myristicaceae	Native	Vulnerable	✓		
107	*Hyptis capitata*	Knobweed	Lamiaceae	Non-native	Naturalised	✓		
108	*Ipomoea cairica*	Messina Creeper	Convolvulaceae	Non-native	Naturalised	✓		✓
109	*Ipomoea indica*	Blue Morning Glory	Convolvulaceae	Non-native	Naturalised	✓		
110	*Ischaemum ciliare*	Smutgrass	Poaceae	Native	Least Concern	✓		
111	*Ixora congesta*	Malayan Ixora	Rubiaceae	Native	Least Concern	✓		
112	*Jasminum elongatum*	Common Malayan Jasmine	Oleaceae	Native	Endangered	✓		
113	*Justicia* cf. *gendarussa*	Willow-leaves Justicia, Ganda Rusa	Acanthaceae	Non-native	Cultivated Only	✓		
114	*Justicia procumbens*	Water Willow	Acanthaceae	Uncertain	Cryptogenic	✓		
115	*Khaya senegalensis*	Senegal Mahogany	Meliaceae	Non-native	Cultivated Only	✓	✓	✓
116	*Leea indica*	Bandicoot Berry, Common Tree-Vine	Vitaceae	Native	Least Concern	✓		
117	*Legazpia polygonoides*	Kerak Nasi, Malayan Eyebright	Linderniaceae	Uncertain	Cryptogenic	✓		

No.	Species Name	Common Name	Family	Origin	**Local Status** (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	**Present Surveys**	**Previous Surveys (AECOM; East only)**	**Previous Surveys (AECOM; East & West)**
118	*Lepisanthes rubiginosa*	Rusty Sapindus	Sapindaceae	Native	Least Concern	✓		
119	*Lindernia antipoda*	Sparrow False Pimpernel	Linderniaceae	Uncertain	Cryptogenic	✓		
120	*Lindernia crustacea*	Malaysian False Pimpernel	Linderniaceae	Uncertain	Cryptogenic	✓		
121	*Litsea elliptica*	Common Medang	Lauraceae	Native	Least Concern	✓		✓
122	*Macaranga conifera*	-	Euphorbiaceae	Native	Least Concern	✓		
123	*Macaranga griffithiana*	Mahang Bulan, Mahang Tutup	Euphorbiaceae	Native	Vulnerable	✓		
124	*Macaranga hypoleuca*	-	Euphorbiaceae	Native	Least Concern	✓		
125	*Mallotus paniculatus*	Turn-in-the Wind, Balek Angin	Euphorbiaceae	Native	Least Concern	✓		
126	*Mangifera indica*	Mango, Mangga	Anacardiaceae	Non-native	Casual	✓		✓
127	*Manihot esculenta*	Cassava, Manioc, Yuca	Euphorbiaceae	Non-native	Naturalised	✓		✓
128	*Melicope lunu-ankenda*	Tenggek Burong	Rutaceae	Native	Critically Endangered	✓		
129	*Melothria pendula*	Guadeloupe Cucumber, Creeping Cucumber	Cucurbitaceae	Non-native	Naturalised	✓		
130	*Merremia cf. hederacea*	Ivy Woodrose	Convolvulaceae	Native	Least Concern	✓		
131	*Miconia crenata*	Koster's Curse	Melastomataceae	Non-native	Naturalised	✓		

No.	Species Name	Common Name	Family	Origin	**Local Status** (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	**Present Surveys**	**Previous Surveys (AECOM; East only)**	**Previous Surveys (AECOM; East & West)**
132	*Microlepia speluncae*	Limpleaf Fern	Dennstaedtiaceae	Native	Least Concern	✓		
133	*Mikania micrantha*	Mile-A-Minute Weed	Asteraceae	Non-native	Naturalised	✓		✓
134	*Millettia pinnata*	Seashore Mempari, Indian Beech	Fabaceae	Native	Endangered		✓	✓
135	*Mimosa pudica*	Sensitive Plant	Fabaceae	Non-native	Naturalised	✓		✓
136	*Morus alba*	White Mulberry	Moraceae	Non-native	Cultivated Only	✓		
137	*Mukia maderaspatana*	Madras Pea Pumpkin	Cucurbitaceae	Uncertain	Cryptogenic	✓		
138	*Murdannia nudiflora*	Nakedstem Dewflower	Commelinaceae	Uncertain	Cryptogenic	✓		
139	*Musa acuminata*	Banana	Musaceae	Non-native	Cultivated Only	✓		
140	*Nelsonia* cf. *canescens*	Blue Pussyleaf	Acanthaceae	Uncertain	Cryptogenic	✓		
141	*Nephelium lappaceum*	Rambutan	Sapindaceae	Uncertain	Cryptogenic	✓	✓	✓
142	*Nephrolepis biserrata*	Broad Sword Fern	Nephrolepidaceae	Native	Least Concern	✓		
143	*Neustanthus phaseoloides*	Tropical Kudzu	Fabaceae	Non-native	Naturalised	✓		✓
144	*Orthosiphon aristatus*	Cat's Whiskers, Java Tea	Lamiaceae	Non-native	Casual	✓		
145	*Ottochloa nodosa*	Slender Panic Grass	Poaceae	Native	Least Concern	✓		✓
146	*Oxyceros longiflorus*	Akar Berdara Laut	Rubiaceae	Native	Vulnerable	✓	✓	✓
147	*Paederia foetida*	Skunkvine, Lesser Malayan Stinkwort	Rubiaceae	Native	Least Concern	✓		

No.	Species Name	Common Name	Family	Origin	Local Status (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	Present Surveys	Previous Surveys (AECOM; East only)	Previous Surveys (AECOM; East & West)
148	*Pandanus amaryllifolius*	Pandan Wagi, Fragrant Pandan	Pandanaceae	Non-native	Casual	✓		
149	*Panicum* cf. *repens*	Creeping Panic Grass	Poaceae	Non-native	Naturalised	✓		
150	*Paspalum* cf. *conjugatum*	Buffalo Grass, Hilo Grass	Poaceae	Non-native	Naturalised	✓		
151	*Passiflora laurifolia*	Water Lemon, Yellow Granadilla	Passifloraceae	Non-native	Naturalised	✓		✓
152	*Peperomia pellucida*	Shiny Bush	Piperaceae	Non-native	Naturalised	✓		
153	*Peristrophe bivalvis*	Peristrophe, Magenta Plant	Acanthaceae	Uncertain	Cryptogenic	✓		
154	*Persicaria chinensis*	Chinese Knotweed	Polygonaceae	Non-native	Naturalised	✓		
155	*Piper aduncum*	Spiked Pepper	Piperaceae	Non-native	Naturalised	✓		✓
156	*Piper betle*	Betel	Piperaceae	Non-native	Casual	✓		
157	*Piper* cf. *crassipes*	Sireh Murai	Piperaceae	Native	Least Concern	✓		
158	*Piper sarmentosum*	Wild Pepper	Piperaceae	Native	Least Concern	✓		✓
159	*Pouzolzia zeylanica*	Graceful Pouzolzsbush	Urticaceae	Uncertain	Cryptogenic	✓		
160	*Premna serratifolia*	Buas-buas, Arani	Lamiaceae	Native	Least Concern	✓		✓
161	*Pterocarpus indicus*	Angsana Tree	Fabaceae	Non-native	Casual	✓		✓
162	*Ptychosperma macarthurii*	MacArthur Palm	Arecaceae	Non-native	Naturalised	✓		
163	*Ruellia* cf. *blechum*	Green Shrimp Plant	Acanthaceae	Non-native	Casual	✓		
164	*Ruellia repens*	Creeping Ruellia	Acanthaceae	Uncertain	Cryptogenic	✓		

No.	Species Name	Common Name	Family	Origin	**Local Status** (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	**Present Surveys**	**Previous Surveys (AECOM; East only)**	**Previous Surveys (AECOM; East & West)**
165	*Sacciolepis indica*	Glenwood Grass	Poaceae	Native	Least Concern	✓		
166	*Samanea saman*	Rain Tree	Fabaceae	Non-native	Casual	✓		✓
167	*Senna siamea*	Kassod Tree, Siamese Cassia	Fabaceae	Non-native	Cultivated Only	✓		
168	*Sorghum propinquum*	Sorghum	Poaceae	Non-native	Naturalised	✓		✓
169	*Spathodea campanulata*	African Tulip Tree	Bignoniaceae	Non-native	Naturalised	✓	✓	✓
170	*Spermacoce exilis*	Pacific False Buttonweed	Rubiaceae	Non-native	Naturalised	✓		
171	*Spermacoce latifolia*	Broad-leaved Buttonweed	Rubiaceae	Non-native	Naturalised	✓		
172	*Stenochlaena palustris*	Climbing Fern	Blechnaceae	Native	Least Concern	✓		✓
173	*Sterculia parviflora*	Common Sterculia	Malvaceae	Native	Critically Endangered	✓		
174	*Strobilanthes reptans*	Red Flame	Acanthaceae	Non-native	Naturalised	✓		
175	*Strobilanthes scabra*	Black Face General	Acanthaceae	Non-native	Not Evaluated	✓		
176	*Struchium sparganophorum*	Yerba de Faja	Asteraceae	Non-native	Naturalised	✓		
177	*Synedrella nodiflora*	Nodeweed	Asteraceae	Non-native	Naturalised	✓		
178	*Syngonium angustatum*	Arrowhead Vine	Araceae	Non-native	Naturalised	✓		✓
179	*Syzygium cerasiforme*	Common Kelat	Myrtaceae	Native	Least Concern	✓		✓

No.	Species Name	Common Name	Family	Origin	**Local Status** (Davison et al., 2008; Chong et al., 2009; Lindsay, et al., 2022)	**Present Surveys**	**Previous Surveys (AECOM; East only)**	**Previous Surveys (AECOM; East & West)**
180	*Syzygium grande*	Sea Apple, Jambu Air Laut	Myrtaceae	Native	Least Concern	✓		✓
181	*Syzygium jambos*	Rose Apple	Myrtaceae	Non-native	Casual	✓		
182	*Syzygium polyanthum*	Indonesian Bayleaf	Myrtaceae	Native	Least Concern	✓		✓
183	*Tabebuia rosea*	Pink Poui	Bignoniaceae	Non-native	Casual	✓		✓
184	*Tabernaemontana divaricata*	Great Rosebay	Apocynaceae	Non-native	Cultivated Only	✓		
185	*Taenitis blechnoides*	Ribbon Fern	Pteridaceae	Native	Least Concern	✓		
186	*Tectaria incisa*	Incised Halberd Fern	Tectariaceae	Non-native	Naturalised	✓		
187	*Terminalia catappa*	Sea Almond, Ketapang	Combretaceae	Native	Least Concern	✓		✓
188	*Tetracera indica*	Sandpaper Vine	Dilleniaceae	Native	Least Concern	✓		✓
189	*Uncaria* cf. *gambir*	Gambir	Rubiaceae	Non-native	Naturalised	✓		
190	*Urochloa maxima*	Guinea Grass, Rumput Benggala	Poaceae	Non-native	Naturalised	✓		
191	*Vandellia diffusa*	Spreading False Pimpernel	Linderniaceae	Non-native	Not Evaluated	✓		
192	*Vitex pinnata*	Leban	Lamiaceae	Native	Least Concern	✓		✓
193	*Zingiber* cf. *officinale*	Common Ginger	Zingiberaceae	Non-native	Cultivated Only	✓		

APPENDIX B

Photographs of Plants Observed at Study Area

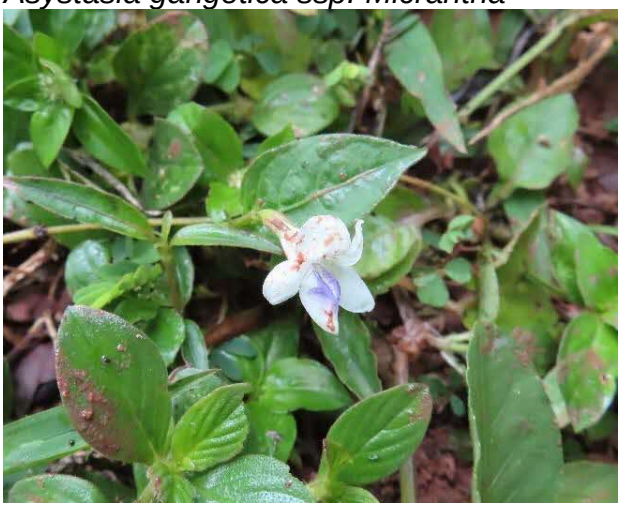
Photographs of Plants Observed at Ulu Pandan East

Ardisia elliptica 	*Acacia auriculiformis* 
Adiantum latifolium 	*Aglaonema commutatum* 
Andira inermis 	*Aphanamixis polystachya* 

Artocarpus heterophyllus



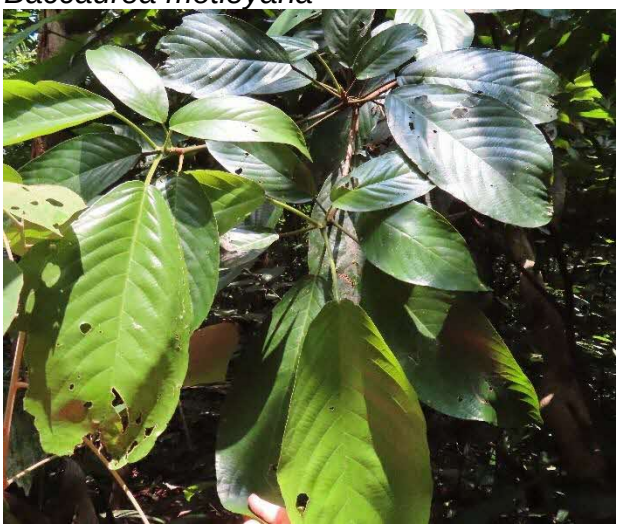
Asystasia gangetica ssp. Micrantha



Axonopus compressus



Baccaurea motleyana



Breynia androgyna



Bridelia stipularis



Caryota mitis



Centrosema molle



Cinnamomum iners



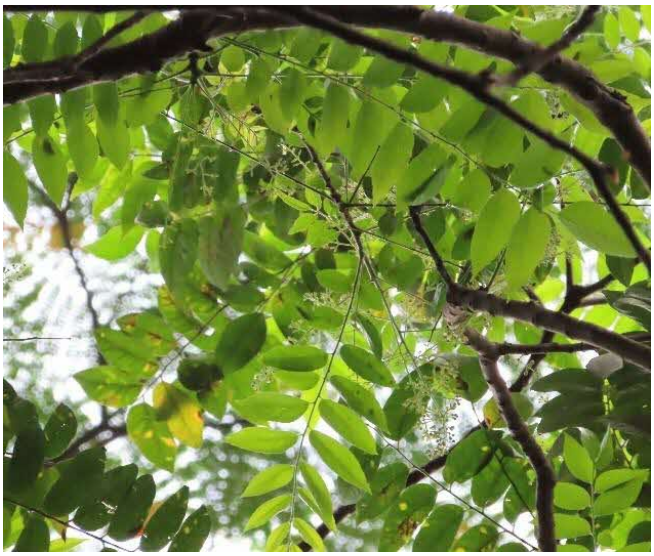
Cissus hastata



Claoxylon indicum



Clausena excavata



Clinacanthus nutans 	*Commelina diffusa* 
Cyperus brevifolius 	*Cyrtococcum patens* 
Derris elliptica 	*Dieffenbachia seguine* 

Dillenia suffruticosa



Dimocarpus lichi



Dracaena sanderiana



Elaeis guineensis



Elaeocarpus ferrugineus



Emblica urinaria



Epipremnum aureum



Erycibe tomentosa



Falcataria moluccana



Ficus aurata



Ficus fistulosa



Ficus virens



Fimbristylis dichotoma



Flagellaria indica



Geophila herbacea



Gigantochloa ligulata



Glochidion zeylanicum var. zeylanicum



Gnetum gnemon



Grona heterophylla



Grona triflora



Horsfieldia cf. polyspherula



Ipomoea cairica



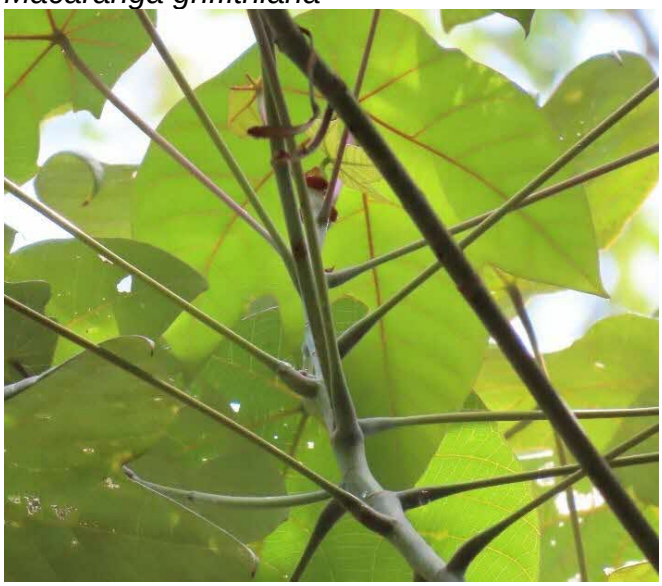
Jasminum elongatum



Lindernia crustacea



Macaranga griffithiana



Macaranga hypoleuca



Manihot esculenta



Melicope lunu-ankenda



Miconia crenata



Microlepia speluncae



Mikania micrantha



Murdannia nudiflora



Nephelium lappaceum



Nephrolepis biserrata



Neustanthus phaseoloides



Ottochloa nodosa



Oxyceros longiflorus 	*Paederia foetida* 
Peristrophe bivalvis 	*Persicaria chinensis* 
Piper betle 	*Piper sarmentosum* 

Arthrophyllum jackianum (previously known as *Polyscias diversifolia)*



Premna serratifolia



Sacciolepis indica



Sorghum propinquum



Spathodea campanulata



Stenochlaena palustris



Sterculia parviflora



Struchium sparganophorum



Syngonium angustatum



Syzygium grande



Syzygium polyanthum



Terminalia catappa



Tetracera indica



Thelypteris interrupta



Thelypteris subpubescens



Vitex pinnata



APPENDIX C

List of Fauna Species Recorded at Study Area

List of Fauna Species Recorded at Project Study Area

Table 1. List of birds found in the project study area

No.	Family	Species name	Common Name	Local Status	Local Conservation Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
1	Ardeidae	*Ardea cinerea*	Grey Heron	RB	VU	LC		✓
2	Ardeidae	*Butorides striata*	Striated Heron	RB WV	-	LC	✓	✓
3	Ardeidae	*Egretta garzetta*	Little Egret	WV	-	LC		✓
4	Ardeidae	*Gorsachius melanolophus*	Malayan Night Heron	WV PM	-	LC		✓
5	Ardeidae	*Ixobrychus sinensis*	Yellow Bittern	RB WV	-	LC		✓
6	Accipitridae	*Pernis ptilorhynchus*	Crested Honey Buzzard	PM WV NBV	-	LC	✓	✓
7	Accipitridae	*Haliastur indus*	Brahminy Kite	RB	-	LC	✓	✓
8	Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea Eagle	RB	-	LC		✓
9	Accipitridae	*Nisaetus cirrhatus*	Changeable Hawk-Eagle	RB (F/W)	EN	LC	✓	✓
10	Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	RB WV	-	LC	✓	✓
11	Columbidae	*Treron vernans*	Pink-necked Green Pigeon	RB	-	LC	✓	✓
12	Columbidae	*Ducula bicolor*	Pied Imperial Pigeon	IR(B) NBV	-	LC	✓	✓
13	Columbidae	*Spilopelia chinensis*	Spotted Dove	RB	-	LC	✓	✓
14	Columbidae	*Geopelia striata*	Zebra Dove	RB	-	LC	✓	✓
15	Psittacidae	*Trichoglossus haematodus*	Coconut Lorikeet	IRB	-	LC	✓	✓
16	Psittacidae	*Psittacula krameri*	Rose-ringed Parakeet	IRB	-	LC	✓	✓
17	Psittacidae	*Psittacula alexandri*	Red-breasted Parakeet	IRB	-	NT	✓	✓
18	Psittacidae	*Psittacula longicauda*	Long-tailed Parakeet	RB (F/W)	-	VU	✓	✓
19	Psittacidae	*Loriculus galgulus*	Blue-crowned Hanging Parrot	RB	EN	LC	✓	✓

No.	Family	Species name	Common Name	Local Status	Local Conservation Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
20	Cuculidae	*Cacomantis merulinus*	Plaintive Cuckoo	RB (F/W)	-	LC		✓
21	Cuculidae	*Chrysococcyx xanthorhynchus*	Violet Cuckoo	RB WV	EN	LC		✓
22	Cuculidae	*Chrysococcyx minutillus*	Little Bronze Cuckoo	RB	-	LC	✓	✓
23	Cuculidae	*Eudynamys scolopacea*	Asian Koel	RB WV	-	LC	✓	✓
24	Cuculidae	*Centropus bengalensis*	Lesser Coucal	RB	-	LC		✓
25	Strigidae	*Otus bakkamoena*	Indian Scops Owl	-	-	LC		✓
26	Caprimulgidae	*Caprimulgus macrurus*	Large-tailed Nightjar	RB	-	LC		✓
27	Apodidae	*Aerodramus germani*	Germain's Swiftlet	RB	-	LC		✓
28	Apodidae	*Collocalia affinis*	Plume-toed swiftlet	R(B)	CR	LC		✓
29	Hemiprocnidae	*Hemiprocne longipennis*	Grey-rumped Treeswift	RB	-	LC		✓
30	Alcedinidae	*Ceyx erithaca*	Oriental Dwarf Kingfisher	WV PM	-	LC		✓
31	Alcedinidae	*Pelargopsis capensis*	Stork-billed Kingfisher	RB	-	LC		✓
32	Alcedinidae	*Halcyon smyrnensis*	White-throated Kingfisher	RB	-	LC	✓	✓
33	Alcedinidae	*Todiramphus chloris*	Collared Kingfisher	RB	-	LC	✓	✓
34	Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	WV	-	LC	✓	✓
35	Meropidae	*Merops viridis*	Blue-throated Bee-eater	MB (F/W)	-	LC	✓	✓
36	Coraciidae	*Eurystomus orientalis*	Oriental Dollarbird	RB WV (F/W)	-	LC	✓	✓
37	Megalaimidae	*Psilopogon lineatus*	Lineated Barbet	IRB	-	LC	✓	✓
38	Megalaimidae	*Psilopogon haemacephalus*	Coppersmith Barbet	RB	-	LC	✓	✓
39	Picidae	*Micropternus brachyurus*	Rufous Woodpecker	RB (F/W)	-	LC		✓
40	Picidae	*Picus vittatus*	Laced Woodpecker	RB (F/W)	-	LC	✓	✓

No.	Family	Species name	Common Name	Local Status	Local Conservation Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
41	Picidae	*Chrysophlegma miniaceum*	Banded Woodpecker	RB	-	LC	✓	✓
42	Picidae	*Dinopium javanense*	Common Flameback	RB (F/W)	-	LC	✓	✓
43	Picidae	*Dendrocopos moluccensis*	Sunda Pygmy Woodpecker	RB	-	LC		✓
44	Pittidae	*Pitta moluccensis*	Blue-winged Pitta	WV PM	-	LC	✓	✓
45	Hirundinidae	*Hirundo rustica*	Barn Swallow	WV PM	-	LC		✓
46	Hirundinidae	*Hirundo tahitica*	Pacific/Tahiti Swallow	RB	-	LC	✓	✓
47	Campephagidae	*Lalage nigra*	Pied Triller	RB	-	LC		✓
48	Campephagidae	*Pericrocotus divaricatus*	Ashy Minivet	WV PM (F/W)	-	LC	✓	✓
49	Aegithinidae	*Aegithina tiphia*	Common Iora	RB	-	LC	✓	✓
50	Pycnonotidae	*Pycnonotus jocosus*	Red-whiskered Bulbul	IRB	-	LC	✓	✓
51	Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul	RB	-	LC	✓	✓
52	Pycnonotidae	*Pycnonotus plumosus*	Olive-winged Bulbul	RB	-	LC	✓	✓
53	Dicruridae	*Dicrurus annectans*	Crow-billed Drongo	WV PM (F/W)	-	LC		✓
54	Dicruridae	*Dicrurus paradiseus*	Greater Racket-tailed Drongo	RB	-	LC	✓	✓
55	Oriolidae	*Oriolus chinensis*	Black-naped Oriole	RB	-	LC	✓	✓
56	Corvidae	*Corvus splendens*	House Crow	IRB	-	LC	✓	✓
57	Corvidae	*Corvus macrorhynchos*	Large-billed Crow	RB (F/W)	-	LC	✓	✓
58	Timaliidae	*Macronus gularis*	Pin-striped Tit-Babbler	RB	-	LC	✓	✓
59	Leiothrichidae	*Garrulax leucolophus*	White-crested Laughingthrush	IRB	-	LC	✓	✓
60	Leiothrichidae	*Pterorhinus chinensis*	Black-throated Laughingthrush	-	-	LC	✓	✓
61	Muscicapidae	*Copsychus saularis*	Oriental Magpie-Robin	RB	EN	LC	✓	✓
62	Acanthizidae	*Gerygone sulphurea*	Golden-bellied Gerygone	RB (F/W)	-	LC	✓	✓

No.	Family	Species name	Common Name	Local Status	Local Conservation Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
63	Phylloscopidae	*Phylloscopus borealis*	Arctic Warbler	WV PM (F/W)	-	LC	✓	✓
64	Cisticolidae	*Orthotomus sutorius*	Common Tailorbird	RB	-	LC	✓	✓
65	Cisticolidae	*Orthotomus atrogularis*	Dark-necked Tailorbird	RB (F/W)	-	LC	✓	✓
66	Cisticolidae	*Orthotomus sericeus*	Rufous-tailed Tailorbird	RB	-	LC	✓	✓
67	Cisticolidae	*Cisticola juncidis*	Zitting Cisticola	RB	-	LC	✓	✓
68	Muscicapidae	*Muscicapa dauurica*	Asian Brown Flycatcher	WV PM (F/W)	-	LC		✓
69	Rhipiduridae	*Rhipidura javanica*	Malaysian Pied Fantail	RB	-	LC	✓	✓
70	Motacillidae	*Motacilla cinerea*	Grey Wagtail	WV PM	-	LC	✓	✓
71	Laniidae	*Lanius cristatus*	Brown Shrike	WV PM	-	LC		✓
72	Laniidae	*Lanius tigrinus*	Tiger Shrike	WV PM (F/W)	-	LC	✓	✓
73	Sturnidae	*Aplonis panayensis*	Asian Glossy Starling	RB	-	LC	✓	✓
74	Sturnidae	*Agropsar sturninus*	Daurian Starling	WV PM	-	LC		✓
75	Sturnidae	*Acridotheres tristis*	Common Myna	RB	-	LC	✓	✓
76	Sturnidae	*Acridotheres javanicus*	Javan Myna	IRB	-	VU	✓	✓
77	Sturnidae	*Gracula religiosa*	Common Hill Myna	RB	-	LC	✓	✓
78	Nectariniidae	*Anthreptes malacensis*	Brown-throated Sunbird	RB	-	LC	✓	✓
79	Nectariniidae	*Cinnyris jugularis*	Olive-backed Sunbird	RB	-	LC	✓	✓
80	Nectariniidae	*Aethopyga siparaja*	Crimson Sunbird	RB (F/W)	-	LC	✓	✓
81	Dicaeidae	*Dicaeum cruentatum*	Scarlet-backed Flowerpecker	RB	-	LC	✓	✓
82	Zosteropidae	*Zosterops palpebrosus*	Oriental White-eye	-	-	LC		✓
83	Phasianidae	*Gallus gallus*	Red Junglefowl	RB	EN	LC	✓	
84	Rallidae	*Lewinia striata*	Slaty-breasted Rail	RB	-	LC	✓	
85	Zosteropidae	*Zosterops simplex*	Swinhoe's White-eye	I? RB	-	LC	✓	

No.	Family	Species name	Common Name	Local Status	Local Conservation Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
86	Bucerotidae	*Anthracoceros albirostris*	Oriental Pied Hornbill	RB	CR	LC	✓	
87	Strigidae	*Ketupa ketupu*	Buffy Fish Owl	RB	CR	LC	✓	
88	Strigidae	*Otus lempiji*	Sunda Scops Owl	RB	-	LC	✓	
89	Cuculidae	*Centropus sinensis*	Greater Coucal	RB	-	LC	✓	
90	Pycnonotidae	*Pycnonotus zeylanicus*	Straw-headed Bulbul	RB (F/W)	EN	CR	✓	
91	Cacatuidae	*Cacatua sulphurea*	Yellow-crested Cockatoo	IRB	-	CR	✓	
92	Columbidae	*Chalcophaps indica*	Common emerald dove	RB	-	LC	✓	
93	Rallidae	*Rallina fasciata*	Red-legged crake	RB WV	VU	LC	✓	
94	Ardeidae	*Ixobrychus eurhythmus*	Von Schrenck's bittern	WV	-	LC	✓	
95	Accipitridae	*Accipiter gularis*	Japanese sparrowhawk	PM WV	-	LC	✓	
96	Ardeidae		Intermediate/Great Egret				✓	

Local Status

RB	Resident Breeder
R(B)	Resident, breeding not proven
WV	Winter Visitor
PM	Passage Migrant
MB	Migrant Breeder
NBV	Non-breeding Visitor
I	Introduced
?	Status Uncertain

Conservation Status

DD	Data Deficient
LC	Least Concern
NT	Near Threatened
VU	Vulnerable
EN	Endangered
CR	Critically Endangered

Table 2. List of mammals found in the project study area

No.	Family	Species name	Common Name	Local Status	Local Conservation Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
1	Tupaiidae	*Tupaia glis*	Common Malayan Treeshrew	Native	LC	LC	✓	✓
2	Pteropodidae	*Cynopterus brachyotis*	Lesser Dog-faced Fruit Bat	Native	LC	LC	✓	✓
3	Emballonuridae	*Saccolaimus saccolaimus*	Pouched Tomb Bat	Native	LC	LC		✓
4	Vespertilionidae	*Myotis muricola*	Whiskered Myotis	Native	LC	LC		✓
5	Vespertilionidae	*Scotophilus kuhlii*	Lesser Asian House Bat	Native	LC	LC		✓
6	Sciuridae	*Callosciurus notatus*	Plantain Squirrel	Native	LC	LC	✓	✓
7	Muridae	*Rattus tiomanicus*	Malaysian Wood Rat	Native	LC	LC		✓
8	Viverridae	*Paradoxurus musangus*	Common Palm Civet	Native	LC	LC	✓	✓
9	Emballonuridae	*Taphozous melanopogon*	Black-bearded Tomb Bat	Native	LC	LC	✓	
10	Vespertilionidae	*Pipistrellus stenopterus*	Narrow-winged Pipistrelle	Native	LC	LC	✓	
11	Emballonuridae	*Taphozous longimanus*	Long-winged Tomb Bat	Native	CR	LC	✓	

Table 3. List of herpetofauna found in the project study area

No.	Family	Species name	Common Name	Local Status	Local Conservation Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
Reptiles								
1	Colubridae	*Dendrelaphis pictus*	Painted Bronzeback	Native	LC	LC	✓	✓
2	Varanidae	*Varanus salvator*	Malayan Water Monitor	Native	LC	LC	✓	✓
3	Varanidae	*Varanus nebulosus*	Clouded Monitor	Native	LC	LC		✓
4	Scincidae	*Eutropis multifasciatus*	Many-lined Sun Skink	Native	LC	LC	✓	✓
5	Scincidae	*Lygosoma bowringii*	Garden Supple Skink	Native	LC	LC		✓
6	Agamidae	*Bronchocela cristatella*	Green Crested Lizard	Native	LC	LC	✓	✓
7	Agamidae	*Calotes versicolor*	Changeable Lizard	Introduced	-	LC	✓	✓
8	Gekkonidae	*Gekko monarchus*	Spotted House Gecko	Native	LC	LC	✓	✓
9	Gekkonidae	*Gehyra mutilata*	Four-clawed Gecko	Native	LC	LC	✓	✓
10	Gekkonidae	*Hemidactylus frenatus*	Spiny-tailed House Gecko	Native	LC	LC	✓	✓
11	Colubridae	*Ahaetulla prasina*	Oriental Whip Snake	Native	LC	LC	✓	
12	Gekkonidae	*Hemidactylus brookii*	Brooke's House Gecko	Introduced	-	LC	✓	
13	Dactyloidae	*Anolis sagrei*	Brown Anole	Introduced	-	LC	✓	
14	Agamidae	*Draco sumatranus*	Common Flying Dragon	Native	LC	LC	✓	
15	Typhlopidae	*Indotyphlops braminus*	Brahminy Blind Snake	Native	LC	LC	✓	
Amphibians								
1	Bufonidae	*Duttaphrynus melanostictus*	Asian Toad	Native	LC	LC	✓	✓
2	Dicroglossidae	*Limnonectes blythii*	Malayan Giant Frog	Native	LC	NT	✓	✓
3	Dicroglossidae	*Fejervarya limnocharis*	Field Frog	Native	LC	LC	✓	✓
4	Ranidae	*Sylvirana guentheri*	Gunther's Frog	Introduced	-	LC		✓

No.	Family	Species name	Common Name	Local Status	Local Conservation Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
5	Rhacophoridae	*Polypedates leucomystax*	Four-lined Tree Frog	Native	LC	LC	✓	✓
6	Microhylidae	*Microhyla butleri*	Painted Chorus Frog	Native	LC	LC	✓	✓
7	Microhylidae	*Microhyla heymonsi*	Dark-sided Chorus Frog	Native	LC	LC	✓	✓
8	Microhylidae	*Microhyla fissipes*	East Asian Ornate Chorus Frog	Exotic / Introduced	-	LC		✓
9	Eleutherodactylidae	*Eleutherodactylus planirostris*	Greenhouse Frog	Introduced	-	LC	✓	
10	Microhylidae	*Kaloula pulchra*	Banded Bullfrog	Introduced	-	LC	✓	
11	Microhylidae	*Microhyla mukhlesuri*	Mukhlesur's Narrow-mouthed Frog	Introduced	-	LC	✓	
12	Ranidae	*Hylarana erythraea*	Common Greenback	Native	LC	LC	✓	

Table 4. List of butterflies found in the project study area

No.	Family	Subfamily	Species name	Common Name	Local Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
1	Papilionidae	Papilioninae	*Papilio polytes romulus*	Common Mormon	Common	-	✓	✓
2	Pieridae	Pierinae	*Delias hyparete metarete*	Painted Jezebel	Common	-	✓	✓
3	Pieridae	Pierinae	*Appias libythea olferna*	Striped Albatross	Common	-		✓
4	Pieridae	Coliadinae	*Catopsilia pomona pomona*	Lemon Emigrant	Common	-	✓	✓
5	Pieridae	Coliadinae	*Eurema simulatrix tecmessa*	Forest Grass Yellow	Moderately Common	-		✓
6	Pieridae	Coliadinae	*Eurema hecabe contubernalis*	Common Grass Yellow	Common	-	✓	✓
7	Nymphalidae	Danainae	*Ideopsis vulgaris macrina*	Blue Glassy Tiger	Common	LC	✓	✓
8	Nymphalidae	Satyrinae	*Elymnias hypermnestra agina*	Common Palmfly	Common	-	✓	✓
9	Nymphalidae	Satyrinae	*Mycalesis perseus cepheus*	Dingy Bush Brown	Moderately Common	-		✓
10	Nymphalidae	Satyrinae	*Mycalesis mineus macromalayana*	Dark-brand Bush Brown	Common	-		✓
11	Nymphalidae	Satyrinae	*Ypthima baldus newboldi*	Common Five Ring	Common	-		✓
12	Nymphalidae	Satyrinae	*Faunis canens arcesilas*	Common Faun	Common	-		✓
13	Nymphalidae	Satyrinae	*Zeuxidia amethystus amethystus*	Saturn	Moderately Rare	-		✓
14	Nymphalidae	Nymphalinae	*Hypolimnas bolina bolina*	Great Eggfly	Moderately Common	-		✓
15	Nymphalidae	Nymphalinae	*Junonia almana javana*	Peacock Pansy	Common	LC	✓	✓
16	Nymphalidae	Nymphalinae	*Junonia hedonia ida*	Chocolate Pansy	Common	-	✓	✓
17	Nymphalidae	Heliconiinae	*Acraea terpsicore*	Tawny Coster	Common	-	✓	✓
18	Nymphalidae	Limenitidinae	*Lebadea martha parkeri*	Knight	Moderately Common	-		✓
19	Nymphalidae	Limenitidinae	*Neptis hylas papaja*	Common Sailor	Moderately Common	-	✓	✓

No.	Family	Subfamily	Species name	Common Name	Local Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
20	Lycaenidae	Polyommatinae	*Zizula hylax pygmaea*	Pygmy Grass Blue	Common	-	✓	✓
21	Lycaenidae	Polyommatinae	*Zizina otis lampa*	Lesser Grass Blue	Common	-	✓	✓
22	Hesperiidae	Hesperiinae	*Iambrix salsala salsala*	Chestnut Bob	Common	-	✓	✓
23	Hesperiidae	Hesperiinae	*Potanthus omaha omaha*	Lesser Dart	Common	-		✓
24	Papilionidae	Papilioninae	*Papilio demoleus malayanus*	Lime Butterfly	Common	-	✓	
25	Lycaenidae	Polyommatinae	*Chilades pandava pandava*	Cycad Blue	Common	-	✓	
26	Papilionidae	Papilioninae	*Graphium sarpedon luctatius*	Common Bluebottle	Common	-	✓	
27	Lycaenidae	Polyommatinae	*Zizeeria maha serica*	Pale Grass Blue	Common	-	✓	
28	Nymphalidae	Danainae	*Danaus chrysippus chrysippus*	Plain Tiger	Common	-	✓	
29	Lycaenidae	Theclinae	*Flos apidanus saturatus*	Plain Plushblue	Moderately Common	-	✓	
30	Lycaenidae	Polyommatinae	*Prosotas dubiosa lumpura*	Tailless Line Blue	Common	-	✓	
31	Lycaenidae	Polyommatinae	*Euchrysops cnejus cnejus*	Gram Blue	Moderately Common	-	✓	
32	Pieridae	Coliadinae	*Eurema sari sodalis*	Chocolate Grass Yellow	Moderately Common	-	✓	
33	Nymphalidae	Limenitidinae	*Neptis leucoporos cresina*	Burmese Sailor (or Grey Sailor)	Common	-	✓	
34	Hesperiidae	Hesperiinae	*Taractrocera archias quinta*	Yellow Grass Dart	Moderately Common	-	✓	

Table 5. List of odonates found in the project study area

No.	Family	Species name	Common Name	Distribution and Rarity	Local Conservation Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
1	Coenagrionidae	*Agriocnemis femina*	Variable wisp	Widespread & Common	LC	LC		✓
2	Coenagrionidae	*Ceriagrion cerinorubellum*	Ornate Coraltail	Widespread & Common	LC	LC	✓	✓
3	Coenagrionidae	*Pseudagrion microcephalum*	Blue Sprite	Widespread & Common	LC	LC	✓	✓
4	Aeshnidae	*Gynacantha subinterrupta*	Dingy Duskhawker	Widespread but Uncommon	LC	LC		✓
5	Libellulidae	*Agrionoptera insignis*	Grenadier	Widespread & Common	LC	LC	✓	✓
6	Libellulidae	*Crocothemis servilia*	Common Scarlet	Widespread & Common	LC	LC		✓
7	Libellulidae	*Lathrecista asiatica*	Scarlet Grenadier	Widespread & Common	LC	LC		✓
8	Libellulidae	*Neurothemis fluctuans*	Common Parasol	Widespread & Common	LC	LC	✓	✓
9	Libellulidae	*Orthetrum chrysis*	Spine-tufted Skimmer	Widespread & Common	LC	LC	✓	✓
10	Libellulidae	*Orthetrum glaucum*	Blue Skimmer	Widespread & Common	LC	LC	✓	✓
11	Libellulidae	*Orthetrum sabina*	Variegated Green Skimmer	Widespread & Common	LC	LC	✓	✓
12	Libellulidae	*Orthetrum testaceum*	Scarlet Skimmer	Widespread & Common	LC	LC	✓	✓
13	Libellulidae	*Pantala flavescens*	Wandering Glider	Widespread & Common	LC	LC	✓	✓
14	Libellulidae	*Rhyothemis phyllis*	Yellow-barred Flutterer	Widespread & Common	LC	LC		✓
15	Libellulidae	*Tholymis tillarga*	White-barred Duskhawk	Widespread & Common	LC	LC		✓
16	Libellulidae	*Tramea transmarina*	Saddlebag Glider	Widespread & Common	LC	LC		✓
17	Libellulidae	*Trithemis aurora*	Crimson Dropwing	Widespread & Common	LC	LC	✓	✓
18	Coenagrionidae	*Ischnura senegalensis*	Common Bluetail	Widespread & Common	LC	LC	✓	

No.	Family	Species name	Common Name	Distribution and Rarity	Local Conservation Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
19	Libellulidae	*Nesoxenia lineata*	Striped Grenadier	Widespread but Uncommon	LC	LC	✓	
20	Libellulidae	*Orthetrum luzonicum*	Slender Blue Skimmer	Widespread & Common	LC	LC	✓	
21	Libellulidae	*Brachydiplax chalybea*	Blue Dasher	Widespread & Common	LC	LC	✓	

Table 6. List of aquatic fauna found in the project study area

No.	Family	Species name	Common Name	Local Status	IUCN status	Present Surveys	Previous Surveys (AECOM)
Freshwater Fish							
1	Poeciliidae (live-bearing toothcarps)	*Poecilia sphenops*	Green Molly	Introduced	LC	✓	✓
2	Poeciliidae (live-bearing toothcarps)	*Poecilia reticulata*	Guppy	Introduced	LC	✓	✓
3	Synbranchidae	*Monopterus albus*	Asian Swamp Eel	-	LC		✓
4	Cichlidae (Cichlids)	*Oreochromis mossambicus*	Mozambique Tilapia	Introduced	VU		✓
5	Poeciliidae (live-bearing toothcarps)	*Xiphophorus maculatus*	Southern Platy	Introduced	DD	✓	
6	Poeciliidae (live-bearing toothcarps)	*Gambusia affinis*	Mosquitofish	Introduced	LC	✓	
7	Cichlidae (Cichlids)	*Cichlasoma urophthalmum*	Mayan Cichlid	Introduced	LC	✓	
8	Synbranchidae (swamp-eels)	*Monopterus javanensis*	Sunda Swamp-eel	Native	LC	✓	
Molluscs							
1	Physidae	*Physa acuta*	Acute bladder snail	Introduced	-	✓	✓
2	Melanoides	*Melanoides tuberculata*	Malayan Trumpet Snail	Native, Common	LC	✓	✓
3	Thiaridae	*Mieniplotia scabra*	Pagoda Tiara	Native, Common	LC		✓
4	Physidae	*Physa sp.*	Tadpole Snail	Introduced	-		✓
5	Ampullariidae	*Pila scutata*	Apple Snail	Rare	LC	✓	✓
6	Lymnaeidae	*Radix rubiginosa*	Pond Snail	Introduced	-	✓	✓

APPENDIX D

Photographs of Animals Observed at Study Area

Photographs of Animals Observed at Project Study Area

Banded Woodpecker 	**Blue-crowned Hanging Parrot** 
Blue-winged Pitta 	**Changeable Hawk Eagle** 
Crested Honey Buzzard 	**Malaysian Pied Fantail** 

Striated Heron 	**Pacific Swallow** 
Brahminy Blind Snake 	**Changeable Lizard** 
Green-crested Lizard 	**Malayan Water Monitor** 
Many-lined Sun Skink 	**Oriental Whip Snake** 

Spiny-tailed House Gecko 	**Spotted House Gecko** 
Blue Sprite 	**Common Blue Skimmer** 
Common Bluetail 	**Common Parasol** 
Crimson Dropwing 	**Grenadier** 

Spine-tufted Skimmer 	**Common Bluebottle** 
Common Mormon 	**Common Sailor** 
Dark-brand Bushbrown 	**Lemon Emigrant** 
Lesser Grass Blue 	**Tawny Coster** 

Asian Toad



Malayan Giant Frog



Malayan Trumpet Snail



Apple Snail



Green Molly



Guppy



Southern Platy



Sunda Swamp-Eel



APPENDIX E

Baseline Surface Water Quality Laboratory Test Report

ASTAR LABORATORY PTE LTD
ENVIRONMENTAL CONSULTANTS & TESTING

27 Gul Avenue, Singapore 629667
Tel: 63396136 Fax: 62557608 Email: admin@astarlab.com
Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY SAC-SINGLAS Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0798-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 13 April 2022
Date Tested : 13 April 2022 – 27 April 2022
Date Reported : 28 April 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 13 April 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS1-1 (DRY)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	28.4	45
pH @ 25°C (On-Site)	APHA 4500-H-B	7.7	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	1.5	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	85	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	5.97	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	43	1000
Total Suspended Solids, mg/L	APHA 2540 D	1.0	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	1.44	-
Total Nitrogen, mg/L	SOP-WAT-048	2.1	-
Total Phosphorus, mg/L	HI93713/HI801	1.01	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	1.01	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	1.93	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	0.19	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	<1	-

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The results reported herein have been performed in accordance with the terms of accreditation under the Singapore Accreditation Council."

Remarks: 1) The above results were tested as per sample received and evaluated based on "Allowable limits for trade effluent discharge to Controlled Watercourse, as stipulated by National Environment Agency (NEA).

2) < = Less than

Roselle Monteloyola
Laboratory Manager

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ENVIRONMENTAL CONSULTANTS & TESTING

27 Gul Avenue, Singapore 629667
Tel: 63396136 Fax: 62557608 Email: admin@astarlab.com
Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY
SAC-SINGLAS
Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0891-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 04 May 2022
Date Tested : 04 May 2022 – 13 May 2022
Date Reported : 17 May 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 04 May 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS1-1 (WET)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	27.6	45
pH @ 25°C (On-Site)	APHA 4500-H-B	7.6	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	37	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	222	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	5.86	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	111	1000
Total Suspended Solids, mg/L	APHA 2540 D	4.0	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	4.87	-
Total Nitrogen, mg/L	SOP-WAT-048	2.5	-
Total Phosphorus, mg/L	HI93713/HI801	0.31	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	0.31	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	2.32	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	<0.10	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	8	-

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Remarks: 1) The above results were tested as per sample received and evaluated based on "Allowable limits for trade effluent discharge to Controlled Watercourse, as stipulated by National Environment Agency (NEA).

2) < = Less than

Roselle Monteloyola
Laboratory Manager

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Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY
SAC-SINGLAS
Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0797-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 13 April 2022
Date Tested : 13 April 2022 – 27 April 2022
Date Reported : 28 April 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 13 April 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS1-2 (DRY)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	27.1	45
pH @ 25°C (On-Site)	APHA 4500-H-B	6.6	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	7.2	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	149	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	3.06	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	75	1000
Total Suspended Solids, mg/L	APHA 2540 D	5.0	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	1.89	-
Total Nitrogen, mg/L	SOP-WAT-048	0.7	-
Total Phosphorus, mg/L	HI93713/HI801	1.24	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	1.24	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	0.65	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	0.71	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	169	-

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Remarks: 1) The above results were tested as per sample received and evaluated based on "Allowable limits for trade effluent discharge to Controlled Watercourse, as stipulated by National Environment Agency (NEA).

2) < = Less than

Roselle Monteloyola
Laboratory Manager

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Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY
SAC-SINGLAS
Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0892-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 04 May 2022
Date Tested : 04 May 2022 – 13 May 2022
Date Reported : 17 May 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 04 May 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS1-2 (WET)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	26.3	45
pH @ 25°C (On-Site)	APHA 4500-H-B	7.0	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	85	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	140	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	5.07	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	70.0	1000
Total Suspended Solids, mg/L	APHA 2540 D	9.0	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	9.28	-
Total Nitrogen, mg/L	SOP-WAT-048	3.2	-
Total Phosphorus, mg/L	HI93713/HI801	<0.10	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	<0.10	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	3.00	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	**1.46**	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	5	-

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Remarks: 1) The above results were tested as per sample received and evaluated based on "Allowable limits for trade effluent discharge to Controlled Watercourse, as stipulated by National Environment Agency (NEA).

2) < = Less than

Roselle Monteloyola
Laboratory Manager

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Tel: 63396136 Fax: 62557608 Email: admin@astarlab.com
Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY SAC-SINGLAS Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0796-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 13 April 2022
Date Tested : 13 April 2022 –27 April 2022
Date Reported : 28 April 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 13 April 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS1-3 (DRY)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	27.0	45
pH @ 25°C (On-Site)	APHA 4500-H-B	6.4	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	13	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	128	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	1.73	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	64	1000
Total Suspended Solids, mg/L	APHA 2540 D	10.5	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	2.17	-
Total Nitrogen, mg/L	SOP-WAT-048	0.5	-
Total Phosphorus, mg/L	HI93713/HI801	0.55	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	0.55	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	0.49	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	0.60	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	156	-

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Remarks: 1) The above results were tested as per sample received and evaluated based on "Allowable limits for trade effluent discharge to Controlled Watercourse, as stipulated by National Environment Agency (NEA).

2) < = Less than



Roselle Monteloyola
Laboratory Manager

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ENVIRONMENTAL CONSULTANTS & TESTING

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Tel: 63396136 Fax: 62557608 Email: admin@astarlab.com
Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY
SAC-SINGLAS
Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0893-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 04 May 2022
Date Tested : 04 May 2022 – 13 May 2022
Date Reported : 17 May 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 04 May 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS1-3 (WET)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	26.3	45
pH @ 25°C (On-Site)	APHA 4500-H-B	6.7	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	100	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	81	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	4.12	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	40.0	1000
Total Suspended Solids, mg/L	APHA 2540 D	54.0	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	9.04	-
Total Nitrogen, mg/L	SOP-WAT-048	1.6	-
Total Phosphorus, mg/L	HI93713/HI801	1.00	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	1.00	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	1.45	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	**1.68**	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	7	-

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The results reported herein have been performed in accordance with the terms of accreditation under the Singapore Accreditation Council."

Remarks: 1) The above results were tested as per sample received and evaluated based on "Allowable limits for trade effluent discharge to Controlled Watercourse, as stipulated by National Environment Agency (NEA).

2) < = Less than

Roselle Monteloyola
Laboratory Manager

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ASTAR LABORATORY PTE LTD
ENVIRONMENTAL CONSULTANTS & TESTING

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Tel: 63396136 Fax: 62557608 Email: admin@astarlab.com
Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY
SAC-SINGLAS
Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0793-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 13 April 2022
Date Tested : 13 April 2022 – 27 April 2022
Date Reported : 28 April 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 13 April 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS2-1 (DRY)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	26.3	45
pH @ 25°C (On-Site)	APHA 4500-H-B	6.3	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	55	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	207	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	0.99	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	103	1000
Total Suspended Solids, mg/L	APHA 2540 D	**146**	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	3.68	-
Total Nitrogen, mg/L	SOP-WAT-048	0.4	-
Total Phosphorus, mg/L	HI93713/HI801	1.08	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	1.08	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	0.40	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	**25.6**	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	19	-

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Remarks: 1) The above results were tested as per sample received and evaluated based on "Allowable limits for trade effluent discharge to Controlled Watercourse, as stipulated by National Environment Agency (NEA).

2) < = Less than



Roselle Monteloyola
Laboratory Manager

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ASTAR LABORATORY PTE LTD
ENVIRONMENTAL CONSULTANTS & TESTING

27 Gul Avenue, Singapore 629667
Tel: 63396136 Fax: 62557608 Email: admin@astarlab.com
Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY
SAC-SINGLAS
Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0894-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 04 May 2022
Date Tested : 04 May 2022 – 13 May 2022
Date Reported : 17 May 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 04 May 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS2-1 (WET)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	26.4	45
pH @ 25°C (On-Site)	APHA 4500-H-B	6.5	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	360	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	110	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	3.22	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	54.0	1000
Total Suspended Solids, mg/L	APHA 2540 D	**357**	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	19.0	-
Total Nitrogen, mg/L	SOP-WAT-048	3.3	-
Total Phosphorus, mg/L	HI93713/HI801	0.20	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	0.20	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	3.02	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	**8.32**	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	100	-

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2) < = Less than

Roselle Monteloyola
Laboratory Manager

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ENVIRONMENTAL CONSULTANTS & TESTING

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Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY
SAC-SINGLAS
Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0794-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 13 April 2022
Date Tested : 13 April 2022 –27 April 2022
Date Reported : 28 April 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 13 April 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS3-1 (DRY)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	27.3	45
pH @ 25°C (On-Site)	APHA 4500-H-B	7.6	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	5.7	-
Conductivity, uS/cm (On-Site)	APHA 2510 B	428	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	6.10	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	214	1000
Total Suspended Solids, mg/L	APHA 2540 D	2.7	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	3.41	-
Total Nitrogen, mg/L	SOP-WAT-048	6.7	-
Total Phosphorus, mg/L	HI93713/HI801	0.26	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	0.26	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	6.49	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	0.41	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	600	-

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Remarks: 1) The above results were tested as per sample received and evaluated based on "Allowable limits for trade effluent discharge to Controlled Watercourse, as stipulated by National Environment Agency (NEA).

2) < = Less than



Roselle Monteloyola
Laboratory Manager

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Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY
SAC-SINGLAS
Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0895-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 04 May 2022
Date Tested : 04 May 2022 – 13 May 2022
Date Reported : 17 May 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 04 May 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS3-1 (WET)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	27.4	45
pH @ 25°C (On-Site)	APHA 4500-H-B	8.2	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	33	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	256	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	5.32	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	128	1000
Total Suspended Solids, mg/L	APHA 2540 D	17.0	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	6.55	-
Total Nitrogen, mg/L	SOP-WAT-048	2.4	-
Total Phosphorus, mg/L	HI93713/HI801	<0.10	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	<0.10	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	2.10	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	0.55	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	7	-

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Remarks: 1) The above results were tested as per sample received and evaluated based on "Allowable limits for trade effluent discharge to Controlled Watercourse, as stipulated by National Environment Agency (NEA).

2) < = Less than

Roselle Monteloyola
Laboratory Manager

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Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY SAC-SINGLAS Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0795-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 13 April 2022
Date Tested : 13 April 2022 –27 April 2022
Date Reported : 28 April 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 13 April 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS3-2 (DRY)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	29.0	45
pH @ 25°C (On-Site)	APHA 4500-H-B	7.4	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	6.1	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	278	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	7.32	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	139	1000
Total Suspended Solids, mg/L	APHA 2540 D	4.7	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	3.94	-
Total Nitrogen, mg/L	SOP-WAT-048	1.6	-
Total Phosphorus, mg/L	HI93713/HI801	0.36	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	0.36	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	1.58	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	0.20	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	480	-

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2) < = Less than

Roselle Monteloyola
Laboratory Manager

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Company Registration No. & GST: 201323826G

ACCREDITED LABORATORY
SAC-SINGLAS
Certificate No. : LA-2014-0578-F

TEST REPORT NO: ASL-W0896-22

Company Name : Tembusu Asia Consulting Pte. Ltd.
Address : 1 Commonwealth Ln, #06-06 One Commonwealth, Singapore 149544
Date Received : 04 May 2022
Date Tested : 04 May 2022 – 13 May 2022
Date Reported : 17 May 2022
Sample Description : One (1) sample of water.

The sampling was done by our technical personnel (with reference to SOP-WAT-101) on 04 May 2022 which consisted of 1 x 1L plastic and 1 x 500mL sterilized plastic bottle and marked as shown below:

WS3-2 (WET)

On analysis, the following results were obtained:

Test	Method	Result	Maximum Allowable Limits for Trade Effluent Discharge into Controlled Watercourse
Temperature, °C (On-Site)	APHA 2550 B	27.6	45
pH @ 25°C (On-Site)	APHA 4500-H-B	7.6	Not less than 6 Not more than 9
Turbidity, NTU (On-Site)	APHA 2130 B	37	-
Conductivity, µS/cm (On-Site)	APHA 2510 B	236	-
Dissolved Oxygen, mg/L (On-Site)	APHA 4500-O-G	6.35	-
Total Dissolved Solids, mg/L (On-Site)	APHA 2540 C	118	1000
Total Suspended Solids, mg/L	APHA 2540 D	14.0	30
Total Organic Carbon (TOC), mg/L	APHA 5310 B	5.91	-
Total Nitrogen, mg/L	SOP-WAT-048	3.6	-
Total Phosphorus, mg/L	HI93713/HI801	0.60	-
Nitrate as N, mg/L	HI93713/HI801	<0.10	20
Phosphate as P, mg/L	HI93713/HI801	0.60	2
Ammoniacal Nitrogen, mg/L	APHA 4500-NH_3-E	3.33	-
Arsenic (As), mg/L	APHA 3120 B	<0.01	0.01
Cadmium (Cd), mg/L	APHA 3120 B	<0.003	0.003
Copper (Cu), mg/L	APHA 3120 B	<0.10	0.1
Lead (Pb), mg/L	APHA 3120 B	<0.10	0.1
Zinc (Zn), mg/L	APHA 3120 B	<0.10	0.5
Nickel (Ni), mg/L	APHA 3120 B	<0.10	0.1
Iron (Fe), mg/L	APHA 3120 B	0.47	1
Chromium (Cr), mg/L	APHA 3120 B	<0.05	0.05
Mercury (Hg), mg/L	VGA/ICPOES	<0.001	0.001
Enterococcus, cfu/100mL	APHA 9230 C	26	-

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2) < = Less than

Roselle Monteloyola
Laboratory Manager

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APPENDIX F

Baseline Noise Level Monitoring Data

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
15/06/2022 10:56:37	45.5
15/06/2022 11:01:37	52.8
15/06/2022 11:06:37	56.7
15/06/2022 11:11:37	47.8
15/06/2022 11:16:37	41.9
15/06/2022 11:21:37	46.5
15/06/2022 11:26:37	49.1
15/06/2022 11:31:37	47.1
15/06/2022 11:36:37	44.4
15/06/2022 11:41:37	45.5
15/06/2022 11:46:37	46.9
15/06/2022 11:51:37	47.4
15/06/2022 11:56:37	44.1
15/06/2022 12:01:37	47.6
15/06/2022 12:06:37	51
15/06/2022 12:11:37	48.5
15/06/2022 12:16:37	43.1
15/06/2022 12:21:37	42.8
15/06/2022 12:26:37	43.3
15/06/2022 12:31:37	51.3
15/06/2022 12:36:37	52.1
15/06/2022 12:41:37	47
15/06/2022 12:46:37	50.3
15/06/2022 12:51:37	47.3
15/06/2022 12:56:37	49.6
15/06/2022 13:01:37	50.2
15/06/2022 13:06:37	47
15/06/2022 13:11:37	49
15/06/2022 13:16:37	55
15/06/2022 13:21:37	48.9
15/06/2022 13:26:37	47.4
15/06/2022 13:31:37	45.9
15/06/2022 13:36:37	48.6
15/06/2022 13:41:37	50.8
15/06/2022 13:46:37	50.2
15/06/2022 13:51:37	50.3
15/06/2022 13:56:37	47.5
15/06/2022 14:01:37	71.3
15/06/2022 14:06:37	59
15/06/2022 14:11:37	48.6
15/06/2022 14:16:37	52.5
15/06/2022 14:21:37	52.4
15/06/2022 14:26:37	47.7
15/06/2022 14:31:37	51.3
15/06/2022 14:36:37	52.2
15/06/2022 14:41:37	49.4
15/06/2022 14:46:37	47.6
15/06/2022 14:51:37	47.8
15/06/2022 14:56:37	48.1

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
14/4/2022 15:00:00	70.2
14/4/2022 15:05:00	69.4
14/4/2022 15:10:00	68.9
14/4/2022 15:15:00	70.9
14/4/2022 15:20:00	71.7
14/4/2022 15:25:00	70
14/4/2022 15:30:00	70.3
14/4/2022 15:35:00	69.4
14/4/2022 15:40:00	68.8
14/4/2022 15:45:00	69.1
14/4/2022 15:50:00	71
14/4/2022 15:55:00	69.3
14/4/2022 16:00:00	70
14/4/2022 16:05:00	70.2
14/4/2022 16:10:00	68
14/4/2022 16:15:00	69.4
14/4/2022 16:20:00	68.9
14/4/2022 16:25:00	68.6
14/4/2022 16:30:00	68.6
14/4/2022 16:35:00	70.4
14/4/2022 16:40:00	68.9
14/4/2022 16:45:00	69.1
14/4/2022 16:50:00	67.8
14/4/2022 16:55:00	71
14/4/2022 17:00:00	68.5
14/4/2022 17:05:00	70.1
14/4/2022 17:10:00	69.2
14/4/2022 17:15:00	69
14/4/2022 17:20:00	70.1
14/4/2022 17:25:00	70.1
14/4/2022 17:30:00	69.5
14/4/2022 17:35:00	69.5
14/4/2022 17:40:00	70.5
14/4/2022 17:45:00	71.3
14/4/2022 17:50:00	70.1
14/4/2022 17:55:00	70
14/4/2022 18:00:00	70.6
14/4/2022 18:05:00	70.1
14/4/2022 18:10:00	70.1
14/4/2022 18:15:00	70.4
14/4/2022 18:20:00	70.4
14/4/2022 18:25:00	71.2
14/4/2022 18:30:00	70.6
14/4/2022 18:35:00	70.8
14/4/2022 18:40:00	69.9
14/4/2022 18:45:00	70.7
14/4/2022 18:50:00	70.6
14/4/2022 18:55:00	70.6
Thu, 14/4/2022, 19:00	69.6

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
15/06/2022 15:01:37	53
15/06/2022 15:06:37	51.7
15/06/2022 15:11:37	49.5
15/06/2022 15:16:37	45.7
15/06/2022 15:21:37	48.3
15/06/2022 15:26:37	51.1
15/06/2022 15:31:37	50.9
15/06/2022 15:36:37	49.7
15/06/2022 15:41:37	46.7
15/06/2022 15:46:37	48.1
15/06/2022 15:51:37	54.5
15/06/2022 15:56:37	57.5
15/06/2022 16:01:37	55.1
15/06/2022 16:06:37	57.7
15/06/2022 16:11:37	55.2
15/06/2022 16:16:37	50.6
15/06/2022 16:21:37	50.4
15/06/2022 16:26:37	46.6
15/06/2022 16:31:37	50.6
15/06/2022 16:36:37	51.4
15/06/2022 16:41:37	51.1
15/06/2022 16:46:37	47
15/06/2022 16:51:37	46.7
15/06/2022 16:56:37	48.6
15/06/2022 17:01:37	50.8
15/06/2022 17:06:37	49.7
15/06/2022 17:11:37	51.5
15/06/2022 17:16:37	46.7
15/06/2022 17:21:37	53.2
15/06/2022 17:26:37	46.8
15/06/2022 17:31:37	45.3
15/06/2022 17:36:37	49.5
15/06/2022 17:41:37	47.8
15/06/2022 17:46:37	49.5
15/06/2022 17:51:37	49.4
15/06/2022 17:56:37	50.9
15/06/2022 18:01:37	49.4
15/06/2022 18:06:37	55.9
15/06/2022 18:11:37	51.5
15/06/2022 18:16:37	49.5
15/06/2022 18:21:37	53
15/06/2022 18:26:37	50.6
15/06/2022 18:31:37	46.7
15/06/2022 18:36:37	48.3
15/06/2022 18:41:37	50.1
15/06/2022 18:46:37	50.5
15/06/2022 18:51:37	50
15/06/2022 18:56:37	48.7
15/06/2022 19:01:37	46.1

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
14/4/2022 19:05:00	71
14/4/2022 19:10:00	70.3
14/4/2022 19:15:00	69.7
14/4/2022 19:20:00	70.7
14/4/2022 19:25:00	70
14/4/2022 19:30:00	69.2
14/4/2022 19:35:00	68.9
14/4/2022 19:40:00	68.3
14/4/2022 19:45:00	69.7
14/4/2022 19:50:00	67.4
14/4/2022 19:55:00	69.1
14/4/2022 20:00:00	68.4
14/4/2022 20:05:00	68.5
14/4/2022 20:10:00	71.4
14/4/2022 20:15:00	71.9
14/4/2022 20:20:00	71.3
14/4/2022 20:25:00	70.8
14/4/2022 20:30:00	67
14/4/2022 20:35:00	67.9
14/4/2022 20:40:00	67.2
14/4/2022 20:45:00	67.5
14/4/2022 20:50:00	66.5
14/4/2022 20:55:00	68.6
14/4/2022 21:00:00	67.8
14/4/2022 21:05:00	68.4
14/4/2022 21:10:00	67.7
14/4/2022 21:15:00	68.2
14/4/2022 21:20:00	67.8
14/4/2022 21:25:00	67.9
14/4/2022 21:30:00	68.9
14/4/2022 21:35:00	68
14/4/2022 21:40:00	68.4
14/4/2022 21:45:00	66.9
14/4/2022 21:50:00	69.5
14/4/2022 21:55:00	66.7
14/4/2022 22:00:00	66.4
14/4/2022 22:05:00	69.2
14/4/2022 22:10:00	66.5
14/4/2022 22:15:00	65.5
14/4/2022 22:20:00	67.7
14/4/2022 22:25:00	67.6
14/4/2022 22:30:00	67.1
14/4/2022 22:35:00	64.5
14/4/2022 22:40:00	67.5
14/4/2022 22:45:00	66
14/4/2022 22:50:00	67.4
14/4/2022 22:55:00	68.1
14/4/2022 23:00:00	64.6
14/4/2022 23:05:00	66.9

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
15/06/2022 19:06:37	50.6
15/06/2022 19:11:37	47.1
15/06/2022 19:16:37	49.8
15/06/2022 19:21:37	46.5
15/06/2022 19:26:37	50.5
15/06/2022 19:31:37	50.9
15/06/2022 19:36:37	48.3
15/06/2022 19:41:37	49
15/06/2022 19:46:37	50.6
15/06/2022 19:51:37	54.7
15/06/2022 19:56:37	48.4
15/06/2022 20:01:37	48.7
15/06/2022 20:06:37	48.2
15/06/2022 20:11:37	48.9
15/06/2022 20:16:37	52.6
15/06/2022 20:21:37	49.8
15/06/2022 20:26:37	49.1
15/06/2022 20:31:37	50.8
15/06/2022 20:36:37	54.2
15/06/2022 20:41:37	48
15/06/2022 20:46:37	49.5
15/06/2022 20:51:37	50.3
15/06/2022 20:56:37	48.5
15/06/2022 21:01:37	55
15/06/2022 21:06:37	47.4
15/06/2022 21:11:37	52.6
15/06/2022 21:16:37	48.4
15/06/2022 21:21:37	48.8
15/06/2022 21:26:37	48
15/06/2022 21:31:37	48.1
15/06/2022 21:36:37	45.8
15/06/2022 21:41:37	47.7
15/06/2022 21:46:37	46.2
15/06/2022 21:51:37	51.4
15/06/2022 21:56:37	53
15/06/2022 22:01:37	46.6
15/06/2022 22:06:37	45.7
15/06/2022 22:11:37	60.3
15/06/2022 22:16:37	58.9
15/06/2022 22:21:37	45.5
15/06/2022 22:26:37	50.2
15/06/2022 22:31:37	49
15/06/2022 22:36:37	44.9
15/06/2022 22:41:37	47.6
15/06/2022 22:46:37	46.1
15/06/2022 22:51:37	45.3
15/06/2022 22:56:37	47.9
15/06/2022 23:01:37	44.9
15/06/2022 23:06:37	43.4

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
14/4/2022 23:10:00	65.7
14/4/2022 23:15:00	66.5
14/4/2022 23:20:00	66.8
14/4/2022 23:25:00	65.2
14/4/2022 23:30:00	67.2
14/4/2022 23:35:00	65.3
14/4/2022 23:40:00	65.7
14/4/2022 23:45:00	65.3
14/4/2022 23:50:00	64.5
14/4/2022 23:55:00	64.5
14/4/2022 00:00:00	64.1
15/4/2022 00:05:00	65.3
15/4/2022 00:10:00	65.8
15/4/2022 00:15:00	64.1
15/4/2022 00:20:00	63.4
15/4/2022 00:25:00	64.6
15/4/2022 00:30:00	65.1
15/4/2022 00:35:00	61.9
15/4/2022 00:40:00	61.2
15/4/2022 00:45:00	65.4
15/4/2022 00:50:00	62.5
15/4/2022 00:55:00	61.5
15/4/2022 01:00:00	63.1
15/4/2022 01:05:00	57.1
15/4/2022 01:10:00	63.5
15/4/2022 01:15:00	61.3
15/4/2022 01:20:00	67.9
15/4/2022 01:25:00	62
15/4/2022 01:30:00	63.3
15/4/2022 01:35:00	60.6
15/4/2022 01:40:00	62
15/4/2022 01:45:00	62.1
15/4/2022 01:50:00	59.9
15/4/2022 01:55:00	61.4
15/4/2022 02:00:00	60
15/4/2022 02:05:00	62.2
15/4/2022 02:10:00	63
15/4/2022 02:15:00	61.6
15/4/2022 02:20:00	62.6
15/4/2022 02:25:00	60.7
15/4/2022 02:30:00	64.2
15/4/2022 02:35:00	64.4
15/4/2022 02:40:00	61.1
15/4/2022 02:45:00	64.4
15/4/2022 02:50:00	60.1
15/4/2022 02:55:00	60.6
Fri, 15/4/2022, 03:00:00	60.7
15/4/2022 03:05:00	60.6
15/4/2022 03:10:00	62.8

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
15/06/2022 23:11:37	43.3
15/06/2022 23:16:37	45.3
15/06/2022 23:21:37	48.4
15/06/2022 23:26:37	45.2
15/06/2022 23:31:37	44.3
15/06/2022 23:36:37	44.2
15/06/2022 23:41:37	46.9
15/06/2022 23:46:37	45.7
15/06/2022 23:51:37	44.6
15/06/2022 23:56:37	46.8
16/06/2022 00:01:37	46.6
16/06/2022 00:06:37	45.5
16/06/2022 00:11:37	44.7
16/06/2022 00:16:37	42.2
16/06/2022 00:21:37	43.4
16/06/2022 00:26:37	44.8
16/06/2022 00:31:37	42
16/06/2022 00:36:37	46.1
16/06/2022 00:41:37	43.9
16/06/2022 00:46:37	46.2
16/06/2022 00:51:37	41.2
16/06/2022 00:56:37	42.8
16/06/2022 01:01:37	41.9
16/06/2022 01:06:37	45
16/06/2022 01:11:37	42.5
16/06/2022 01:16:37	42.6
16/06/2022 01:21:37	43.6
16/06/2022 01:26:37	41.4
16/06/2022 01:31:37	42.5
16/06/2022 01:36:37	44.9
16/06/2022 01:41:37	41.3
16/06/2022 01:46:37	42.8
16/06/2022 01:51:37	43.6
16/06/2022 01:56:37	43.4
16/06/2022 02:01:37	43.5
16/06/2022 02:06:37	45.9
16/06/2022 02:11:37	45.6
16/06/2022 02:16:37	46.1
16/06/2022 02:21:37	45.4
16/06/2022 02:26:37	45.3
16/06/2022 02:31:37	46.1
16/06/2022 02:36:37	45.6
16/06/2022 02:41:37	45.5
16/06/2022 02:46:37	46
16/06/2022 02:51:37	45.4
16/06/2022 02:56:37	45.1
16/06/2022 03:01:37	45
16/06/2022 03:06:37	45.6
16/06/2022 03:11:37	45.3

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
15/4/2022 03:15:00	63
15/4/2022 03:20:00	63.5
15/4/2022 03:25:00	60.9
15/4/2022 03:30:00	63.7
15/4/2022 03:35:00	57.7
15/4/2022 03:40:00	63.5
15/4/2022 03:45:00	60.2
15/4/2022 03:50:00	58.8
15/4/2022 03:55:00	60.5
15/4/2022 04:00:00	59.4
15/4/2022 04:05:00	61.4
15/4/2022 04:10:00	59.2
15/4/2022 04:15:00	58.1
15/4/2022 04:20:00	57.4
15/4/2022 04:25:00	62.7
15/4/2022 04:30:00	63.7
15/4/2022 04:35:00	61.6
15/4/2022 04:40:00	60.3
15/4/2022 04:45:00	58.9
15/4/2022 04:50:00	60.8
15/4/2022 04:55:00	60.1
15/4/2022 05:00:00	62.7
15/4/2022 05:05:00	60.9
15/4/2022 05:10:00	59.6
15/4/2022 05:15:00	61
15/4/2022 05:20:00	56
15/4/2022 05:25:00	60.1
15/4/2022 05:30:00	60.9
15/4/2022 05:35:00	61.9
15/4/2022 05:40:00	61.7
15/4/2022 05:45:00	63.7
15/4/2022 05:50:00	64.8
15/4/2022 05:55:00	64.3
15/4/2022 06:00:00	65.3
15/4/2022 06:05:00	64.9
15/4/2022 06:10:00	66.1
15/4/2022 06:15:00	63.4
15/4/2022 06:20:00	68.6
15/4/2022 06:25:00	66.9
15/4/2022 06:30:00	67.7
15/4/2022 06:35:00	72.9
15/4/2022 06:40:00	74.8
15/4/2022 06:45:00	70.3
15/4/2022 06:50:00	72.7
15/4/2022 06:55:00	72
Fri, 15/4/2022, 07:00	74.5
15/4/2022 07:05:00	74.7
15/4/2022 07:10:00	73.2
15/4/2022 07:15:00	71.2

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
16/06/2022 03:16:37	45.6
16/06/2022 03:21:37	46
16/06/2022 03:26:37	45.7
16/06/2022 03:31:37	45.5
16/06/2022 03:36:37	42.8
16/06/2022 03:41:37	42
16/06/2022 03:46:37	42.9
16/06/2022 03:51:37	43
16/06/2022 03:56:37	42.8
16/06/2022 04:01:37	43.6
16/06/2022 04:06:37	44.4
16/06/2022 04:11:37	42.7
16/06/2022 04:16:37	42.2
16/06/2022 04:21:37	43.8
16/06/2022 04:26:37	47.3
16/06/2022 04:31:37	43.9
16/06/2022 04:36:37	44.1
16/06/2022 04:41:37	42.5
16/06/2022 04:46:37	42.5
16/06/2022 04:51:37	42.9
16/06/2022 04:56:37	43.5
16/06/2022 05:01:37	44.6
16/06/2022 05:06:37	44.9
16/06/2022 05:11:37	43
16/06/2022 05:16:37	41.9
16/06/2022 05:21:37	44.2
16/06/2022 05:26:37	45.3
16/06/2022 05:31:37	42.7
16/06/2022 05:36:37	44.7
16/06/2022 05:41:37	45.5
16/06/2022 05:46:37	43.7
16/06/2022 05:51:37	47.4
16/06/2022 05:56:37	47
16/06/2022 06:01:37	44.6
16/06/2022 06:06:37	46.9
16/06/2022 06:11:37	46.5
16/06/2022 06:16:37	47.5
16/06/2022 06:21:37	47.5
16/06/2022 06:26:37	50.2
16/06/2022 06:31:37	48.3
16/06/2022 06:36:37	48.7
16/06/2022 06:41:37	48.8
16/06/2022 06:46:37	51.5
16/06/2022 06:51:37	53.9
16/06/2022 06:56:37	52.9
16/06/2022 07:01:37	49.7
16/06/2022 07:06:37	50.3
16/06/2022 07:11:37	49.7
16/06/2022 07:16:37	59.4

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
15/4/2022 07:20:00	73.3
15/4/2022 07:25:00	72.8
15/4/2022 07:30:00	74.6
15/4/2022 07:35:00	73.5
15/4/2022 07:40:00	74.2
15/4/2022 07:45:00	72.6
15/4/2022 07:50:00	75.6
15/4/2022 07:55:00	74.9
15/4/2022 08:00:00	74.4
15/4/2022 08:05:00	74.6
15/4/2022 08:10:00	72.8
15/4/2022 08:15:00	72.4
15/4/2022 08:20:00	70
15/4/2022 08:25:00	70.4
15/4/2022 08:30:00	72.5
15/4/2022 08:35:00	69
15/4/2022 08:40:00	70.3
15/4/2022 08:45:00	70.5
15/4/2022 08:50:00	72
15/4/2022 08:55:00	71.1
15/4/2022 09:00:00	71.7
15/4/2022 09:05:00	71.4
15/4/2022 09:10:00	70.1
15/4/2022 09:15:00	70.2
15/4/2022 09:20:00	69.2
15/4/2022 09:25:00	71.9
15/4/2022 09:30:00	74.2
15/4/2022 09:35:00	76.5
15/4/2022 09:40:00	75.5
15/4/2022 09:45:00	75
15/4/2022 09:50:00	73.6
15/4/2022 09:55:00	73.5
15/4/2022 10:00:00	74
15/4/2022 10:05:00	71.9
15/4/2022 10:10:00	71.6
15/4/2022 10:15:00	73.3
15/4/2022 10:20:00	74.9
15/4/2022 10:25:00	71.8
15/4/2022 10:30:00	72.8
15/4/2022 10:35:00	72.4
15/4/2022 10:40:00	72.7
15/4/2022 10:45:00	72.3
15/4/2022 10:50:00	72.9
15/4/2022 10:55:00	73.3
15/4/2022 11:00:00	72
15/4/2022 11:05:00	71.1
15/4/2022 11:10:00	71.8
15/4/2022 11:15:00	71.5
15/4/2022 11:20:00	70.8

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
16/06/2022 07:21:37	50.5
16/06/2022 07:26:37	54.5
16/06/2022 07:31:37	52.8
16/06/2022 07:36:37	48.2
16/06/2022 07:41:37	50.6
16/06/2022 07:46:37	52.9
16/06/2022 07:51:37	54.1
16/06/2022 07:56:37	52.9
16/06/2022 08:01:37	53.2
16/06/2022 08:06:37	49.5
16/06/2022 08:11:37	53
16/06/2022 08:16:37	53.5
16/06/2022 08:21:37	52
16/06/2022 08:26:37	52.4
16/06/2022 08:31:37	49.2
16/06/2022 08:36:37	49.6
16/06/2022 08:41:37	49.6
16/06/2022 08:46:37	51.3
16/06/2022 08:51:37	48.2
16/06/2022 08:56:37	50.6
16/06/2022 09:01:37	48.6
16/06/2022 09:06:37	50.6
16/06/2022 09:11:37	48.5
16/06/2022 09:16:37	48.7
16/06/2022 09:21:37	47.1
16/06/2022 09:26:37	48.5
16/06/2022 09:31:37	48.3
16/06/2022 09:36:37	47.8
16/06/2022 09:41:37	48
16/06/2022 09:46:37	71.5
16/06/2022 09:51:37	52.6
16/06/2022 09:56:37	49.5
16/06/2022 10:01:37	49.4
16/06/2022 10:06:37	49
16/06/2022 10:11:37	50.9
16/06/2022 10:16:37	51
16/06/2022 10:21:37	47.3
16/06/2022 10:26:37	47
16/06/2022 10:31:37	50
16/06/2022 10:36:37	61.7
16/06/2022 10:41:37	48.8
16/06/2022 10:46:37	52
16/06/2022 10:51:37	51.5
16/06/2022 10:56:37	53
16/06/2022 11:01:37	48.8
16/06/2022 11:06:37	50.1
16/06/2022 11:11:37	50.3
16/06/2022 11:16:37	45.1
16/06/2022 11:21:37	55.7

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
15/4/2022 11:25:00	71.2
15/4/2022 11:30:00	71.3
15/4/2022 11:35:00	71.3
15/4/2022 11:40:00	70.6
15/4/2022 11:45:00	70.6
15/4/2022 11:50:00	69.7
15/4/2022 11:55:00	70.2
15/4/2022 12:00:00	70.2
15/4/2022 12:05:00	69.3
15/4/2022 12:10:00	69.9
15/4/2022 12:15:00	70.6
15/4/2022 12:20:00	69.2
15/4/2022 12:25:00	71.3
15/4/2022 12:30:00	68.7
15/4/2022 12:35:00	68.6
15/4/2022 12:40:00	70
15/4/2022 12:45:00	68.2
15/4/2022 12:50:00	69.8
15/4/2022 12:55:00	69.4
15/4/2022 13:00:00	68.1
15/4/2022 13:05:00	69.3
15/4/2022 13:10:00	69.4
15/4/2022 13:15:00	69.3
15/4/2022 13:20:00	68.7
15/4/2022 13:25:00	69.6
15/4/2022 13:30:00	68.5
15/4/2022 13:35:00	70.2
15/4/2022 13:40:00	67.9
15/4/2022 13:45:00	68.1
15/4/2022 13:50:00	69.6
15/4/2022 13:55:00	71.6
15/4/2022 14:00:00	68.3
15/4/2022 14:05:00	69.8
15/4/2022 14:10:00	68.2
15/4/2022 14:15:00	69
15/4/2022 14:20:00	70
15/4/2022 14:25:00	69.8
15/4/2022 14:30:00	69.2
15/4/2022 14:35:00	68.5
15/4/2022 14:40:00	69.5
15/4/2022 14:45:00	67.4
15/4/2022 14:50:00	68.1
15/4/2022 14:55:00	68.9
Fri, 15/4/2022, 15:00	68.3
15/4/2022 15:05:00	69.4
15/4/2022 15:10:00	67.7
15/4/2022 15:15:00	68
15/4/2022 15:20:00	69.1
15/4/2022 15:25:00	68.8

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
16/06/2022 11:26:37	50.5
16/06/2022 11:31:37	51.2
16/06/2022 11:36:37	53.3
16/06/2022 11:41:37	49
16/06/2022 11:46:37	51.2
16/06/2022 11:51:37	45.3
16/06/2022 11:56:37	60.2
16/06/2022 12:01:37	52.9
16/06/2022 12:06:37	48.4
16/06/2022 12:11:37	51.8
16/06/2022 12:16:37	46.7
16/06/2022 12:21:37	53.6
16/06/2022 12:26:37	52.4
16/06/2022 12:31:37	52.4
16/06/2022 12:36:37	52.2
16/06/2022 12:41:37	50.3
16/06/2022 12:46:37	55.1
16/06/2022 12:51:37	55.2
16/06/2022 12:56:37	54.9
16/06/2022 13:01:37	47.6
16/06/2022 13:06:37	50
16/06/2022 13:11:37	53.2
16/06/2022 13:16:37	48.1
16/06/2022 13:21:37	48.8
16/06/2022 13:26:37	57.5
16/06/2022 13:31:37	50.7
16/06/2022 13:36:37	50.2
16/06/2022 13:41:37	48.9
16/06/2022 13:46:37	57
16/06/2022 13:51:37	61
16/06/2022 13:56:37	57.9
16/06/2022 14:01:37	58.4
16/06/2022 14:06:37	51.6
16/06/2022 14:11:37	53.4
16/06/2022 14:16:37	52.4
16/06/2022 14:21:37	49.9
16/06/2022 14:26:37	49.7
16/06/2022 14:31:37	59.6
16/06/2022 14:36:37	49.8
16/06/2022 14:41:37	53.9
16/06/2022 14:46:37	52.6
16/06/2022 14:51:37	52.4
16/06/2022 14:56:37	50.2
16/06/2022 15:01:37	49.6
16/06/2022 15:06:37	47.7
16/06/2022 15:11:37	50.8
16/06/2022 15:16:37	49.7
16/06/2022 15:21:37	49.6
16/06/2022 15:26:37	47.3

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
15/4/2022 15:30:00	69
15/4/2022 15:35:00	67.9
15/4/2022 15:40:00	68.4
15/4/2022 15:45:00	68.8
15/4/2022 15:50:00	67.7
15/4/2022 15:55:00	70.2
15/4/2022 16:00:00	68.2
15/4/2022 16:05:00	70.7
15/4/2022 16:10:00	68
15/4/2022 16:15:00	73.2
15/4/2022 16:20:00	68.5
15/4/2022 16:25:00	67.8
15/4/2022 16:30:00	68.3
15/4/2022 16:35:00	68.5
15/4/2022 16:40:00	67.7
15/4/2022 16:45:00	68.1
15/4/2022 16:50:00	69.7
15/4/2022 16:55:00	69.7
15/4/2022 17:00:00	68.7
15/4/2022 17:05:00	68.5
15/4/2022 17:10:00	66.1
15/4/2022 17:15:00	68.4
15/4/2022 17:20:00	69.9
15/4/2022 17:25:00	70.3
15/4/2022 17:30:00	67.9
15/4/2022 17:35:00	67.4
15/4/2022 17:40:00	70.2
15/4/2022 17:45:00	68.2
15/4/2022 17:50:00	69.9
15/4/2022 17:55:00	69.3
15/4/2022 18:00:00	69.3
15/4/2022 18:05:00	72.9
15/4/2022 18:10:00	68.3
15/4/2022 18:15:00	69
15/4/2022 18:20:00	69.1
15/4/2022 18:25:00	69.1
15/4/2022 18:30:00	68.4
15/4/2022 18:35:00	68.1
15/4/2022 18:40:00	69.3
15/4/2022 18:45:00	69.5
15/4/2022 18:50:00	69
15/4/2022 18:55:00	67.8
Fri, 15/4/2022, 19:00	69.5
15/4/2022 19:05:00	67.8
15/4/2022 19:10:00	67.3
15/4/2022 19:15:00	67.6
15/4/2022 19:20:00	69
15/4/2022 19:25:00	67.9
15/4/2022 19:30:00	67.5

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
16/06/2022 15:31:37	50
16/06/2022 15:36:37	48.3
16/06/2022 15:41:37	47.3
16/06/2022 15:46:37	48.1
16/06/2022 15:51:37	52.7
16/06/2022 15:56:37	60.6
16/06/2022 16:01:37	47.7
16/06/2022 16:06:37	48.8
16/06/2022 16:11:37	50.3
16/06/2022 16:16:37	48.9
16/06/2022 16:21:37	48.4
16/06/2022 16:26:37	50
16/06/2022 16:31:37	50.2
16/06/2022 16:36:37	46.7
16/06/2022 16:41:37	47.1
16/06/2022 16:46:37	47.6
16/06/2022 16:51:37	45.7
16/06/2022 16:56:37	47.6
16/06/2022 17:01:37	47
16/06/2022 17:06:37	45.4
16/06/2022 17:11:37	48.4
16/06/2022 17:16:37	48.9
16/06/2022 17:21:37	50.3
16/06/2022 17:26:37	46.9
16/06/2022 17:31:37	47.7
16/06/2022 17:36:37	45.6
16/06/2022 17:41:37	49
16/06/2022 17:46:37	48
16/06/2022 17:51:37	54.5
16/06/2022 17:56:37	48.3
16/06/2022 18:01:37	49.2
16/06/2022 18:06:37	51.2
16/06/2022 18:11:37	50.6
16/06/2022 18:16:37	49.1
16/06/2022 18:21:37	49.9
16/06/2022 18:26:37	52.4
16/06/2022 18:31:37	58
16/06/2022 18:36:37	48.7
16/06/2022 18:41:37	46.3
16/06/2022 18:46:37	47
16/06/2022 18:51:37	49.7
16/06/2022 18:56:37	48.1
16/06/2022 19:01:37	48.2
16/06/2022 19:06:37	47.3
16/06/2022 19:11:37	45.2
16/06/2022 19:16:37	50.7
16/06/2022 19:21:37	46.9
16/06/2022 19:26:37	48.8
16/06/2022 19:31:37	47.4

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
15/4/2022 19:35:00	67.4
15/4/2022 19:40:00	66.7
15/4/2022 19:45:00	67.8
15/4/2022 19:50:00	68.6
15/4/2022 19:55:00	67.6
15/4/2022 20:00:00	67.9
15/4/2022 20:05:00	67.8
15/4/2022 20:10:00	67.7
15/4/2022 20:15:00	67.7
15/4/2022 20:20:00	67.1
15/4/2022 20:25:00	68.3
15/4/2022 20:30:00	67.3
15/4/2022 20:35:00	69.1
15/4/2022 20:40:00	65.9
15/4/2022 20:45:00	68.9
15/4/2022 20:50:00	66.5
15/4/2022 20:55:00	66.6
15/4/2022 21:00:00	66.7
15/4/2022 21:05:00	66.4
15/4/2022 21:10:00	68
15/4/2022 21:15:00	66.4
15/4/2022 21:20:00	67.8
15/4/2022 21:25:00	68
15/4/2022 21:30:00	68.1
15/4/2022 21:35:00	68.1
15/4/2022 21:40:00	65.3
15/4/2022 21:45:00	67.7
15/4/2022 21:50:00	67.8
15/4/2022 21:55:00	69.1
15/4/2022 22:00:00	66.4
15/4/2022 22:05:00	66.6
15/4/2022 22:10:00	67
15/4/2022 22:15:00	67.7
15/4/2022 22:20:00	66.5
15/4/2022 22:25:00	68.1
15/4/2022 22:30:00	66.7
15/4/2022 22:35:00	70.2
15/4/2022 22:40:00	67.2
15/4/2022 22:45:00	66.8
15/4/2022 22:50:00	66.2
15/4/2022 22:55:00	66.3
15/4/2022 23:00:00	65.7
15/4/2022 23:05:00	66.1
15/4/2022 23:10:00	65.4
15/4/2022 23:15:00	66.1
15/4/2022 23:20:00	66.1
15/4/2022 23:25:00	65.8
15/4/2022 23:30:00	66.1
15/4/2022 23:35:00	64.8

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
16/06/2022 19:36:37	48.1
16/06/2022 19:41:37	46.6
16/06/2022 19:46:37	48.4
16/06/2022 19:51:37	46.8
16/06/2022 19:56:37	46.7
16/06/2022 20:01:37	52.1
16/06/2022 20:06:37	47.9
16/06/2022 20:11:37	50.3
16/06/2022 20:16:37	48.2
16/06/2022 20:21:37	46.1
16/06/2022 20:26:37	50.5
16/06/2022 20:31:37	50.1
16/06/2022 20:36:37	48.2
16/06/2022 20:41:37	47.5
16/06/2022 20:46:37	46.6
16/06/2022 20:51:37	48.9
16/06/2022 20:56:37	51.6
16/06/2022 21:01:37	49.8
16/06/2022 21:06:37	46.2
16/06/2022 21:11:37	45.5
16/06/2022 21:16:37	49.1
16/06/2022 21:21:37	47.7
16/06/2022 21:26:37	45.3
16/06/2022 21:31:37	49.5
16/06/2022 21:36:37	45.7
16/06/2022 21:41:37	48.1
16/06/2022 21:46:37	47
16/06/2022 21:51:37	46.7
16/06/2022 21:56:37	52.4
16/06/2022 22:01:37	47.4
16/06/2022 22:06:37	46.5
16/06/2022 22:11:37	52.4
16/06/2022 22:16:37	47.9
16/06/2022 22:21:37	45.4
16/06/2022 22:26:37	46.1
16/06/2022 22:31:37	45.3
16/06/2022 22:36:37	46.3
16/06/2022 22:41:37	47.3
16/06/2022 22:46:37	46.8
16/06/2022 22:51:37	47.2
16/06/2022 22:56:37	47.4
16/06/2022 23:01:37	45.1
16/06/2022 23:06:37	47.4
16/06/2022 23:11:37	49.1
16/06/2022 23:16:37	48
16/06/2022 23:21:37	49.1
16/06/2022 23:26:37	48
16/06/2022 23:31:37	51
16/06/2022 23:36:37	50.9

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
15/4/2022 23:40:00	65.8
15/4/2022 23:45:00	67.5
15/4/2022 23:50:00	65.1
15/4/2022 23:55:00	65.8
15/4/2022 00:00:00	61.5
16/4/2022 00:05:00	65.8
16/4/2022 00:10:00	64.6
16/4/2022 00:15:00	61.2
16/4/2022 00:20:00	63.8
16/4/2022 00:25:00	64.1
16/4/2022 00:30:00	64.4
16/4/2022 00:35:00	63.8
16/4/2022 00:40:00	64.7
16/4/2022 00:45:00	65
16/4/2022 00:50:00	63.1
16/4/2022 00:55:00	62.5
16/4/2022 01:00:00	61.7
16/4/2022 01:05:00	65.5
16/4/2022 01:10:00	61.8
16/4/2022 01:15:00	64
16/4/2022 01:20:00	60.8
16/4/2022 01:25:00	62.6
16/4/2022 01:30:00	64
16/4/2022 01:35:00	62
16/4/2022 01:40:00	66.6
16/4/2022 01:45:00	62.7
16/4/2022 01:50:00	63.3
16/4/2022 01:55:00	58.8
16/4/2022 02:00:00	60.1
16/4/2022 02:05:00	60.3
16/4/2022 02:10:00	60.5
16/4/2022 02:15:00	61.5
16/4/2022 02:20:00	62.5
16/4/2022 02:25:00	61.7
16/4/2022 02:30:00	61
16/4/2022 02:35:00	61
16/4/2022 02:40:00	78
16/4/2022 02:45:00	60.2
16/4/2022 02:50:00	62.9
16/4/2022 02:55:00	61
Sat, 16/4/2022, 03:00	60.3
16/4/2022 03:05:00	63.7
16/4/2022 03:10:00	59.6
16/4/2022 03:15:00	58.6
16/4/2022 03:20:00	59.5
16/4/2022 03:25:00	58.6
16/4/2022 03:30:00	60.4
16/4/2022 03:35:00	61.4
16/4/2022 03:40:00	59.8

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
16/06/2022 23:41:37	49.1
16/06/2022 23:46:37	51.7
16/06/2022 23:51:37	50.6
16/06/2022 23:56:37	47.2
17/06/2022 00:01:37	47.1
17/06/2022 00:06:37	46.3
17/06/2022 00:11:37	44.8
17/06/2022 00:16:37	45.1
17/06/2022 00:21:37	44.9
17/06/2022 00:26:37	42.8
17/06/2022 00:31:37	43.1
17/06/2022 00:36:37	43.8
17/06/2022 00:41:37	43.3
17/06/2022 00:46:37	43.7
17/06/2022 00:51:37	46
17/06/2022 00:56:37	41.5
17/06/2022 01:01:37	41.3
17/06/2022 01:06:37	42.1
17/06/2022 01:11:37	40.8
17/06/2022 01:16:37	41.3
17/06/2022 01:21:37	41.5
17/06/2022 01:26:37	42.4
17/06/2022 01:31:37	42.5
17/06/2022 01:36:37	43.2
17/06/2022 01:41:37	41.8
17/06/2022 01:46:37	40.8
17/06/2022 01:51:37	44.8
17/06/2022 01:56:37	42.7
17/06/2022 02:01:37	41.8
17/06/2022 02:06:37	45.3
17/06/2022 02:11:37	47.2
17/06/2022 02:16:37	47.2
17/06/2022 02:21:37	45.6
17/06/2022 02:26:37	44.8
17/06/2022 02:31:37	44.7
17/06/2022 02:36:37	45
17/06/2022 02:41:37	46.3
17/06/2022 02:46:37	45.7
17/06/2022 02:51:37	45.2
17/06/2022 02:56:37	45.5
17/06/2022 03:01:37	45.2
17/06/2022 03:06:37	44.9
17/06/2022 03:11:37	44.9
17/06/2022 03:16:37	46.4
17/06/2022 03:21:37	45.8
17/06/2022 03:26:37	45.6
17/06/2022 03:31:37	45.6
17/06/2022 03:36:37	46.4
17/06/2022 03:41:37	45.3

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
16/4/2022 03:45:00	65
16/4/2022 03:50:00	62.4
16/4/2022 03:55:00	59.5
16/4/2022 04:00:00	60
16/4/2022 04:05:00	57
16/4/2022 04:10:00	60
16/4/2022 04:15:00	57.5
16/4/2022 04:20:00	60.8
16/4/2022 04:25:00	60.3
16/4/2022 04:30:00	60.7
16/4/2022 04:35:00	59.5
16/4/2022 04:40:00	60.8
16/4/2022 04:45:00	62
16/4/2022 04:50:00	59.6
16/4/2022 04:55:00	61.6
16/4/2022 05:00:00	62.3
16/4/2022 05:05:00	60.7
16/4/2022 05:10:00	62.2
16/4/2022 05:15:00	58.2
16/4/2022 05:20:00	60.1
16/4/2022 05:25:00	59.5
16/4/2022 05:30:00	61.8
16/4/2022 05:35:00	59.3
16/4/2022 05:40:00	63.6
16/4/2022 05:45:00	63.1
16/4/2022 05:50:00	66.6
16/4/2022 05:55:00	68.1
16/4/2022 06:00:00	69.6
16/4/2022 06:05:00	67.6
16/4/2022 06:10:00	70.1
16/4/2022 06:15:00	68.7
16/4/2022 06:20:00	68.4
16/4/2022 06:25:00	67.2
16/4/2022 06:30:00	69.5
16/4/2022 06:35:00	67.6
16/4/2022 06:40:00	66.5
16/4/2022 06:45:00	66.2
16/4/2022 06:50:00	68.5
16/4/2022 06:55:00	68.1
Sat, 16/4/2022, 07:00	67.4
16/4/2022 07:05:00	69.2
16/4/2022 07:10:00	67.6
16/4/2022 07:15:00	67.5
16/4/2022 07:20:00	64.2
16/4/2022 07:25:00	65.9
16/4/2022 07:30:00	68.7
16/4/2022 07:35:00	67.5
16/4/2022 07:40:00	66.4
16/4/2022 07:45:00	67.7

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
17/06/2022 03:46:37	45.2
17/06/2022 03:51:37	44
17/06/2022 03:56:37	46.5
17/06/2022 04:01:37	46.7
17/06/2022 04:06:37	47.3
17/06/2022 04:11:37	47.7
17/06/2022 04:16:37	47
17/06/2022 04:21:37	47.3
17/06/2022 04:26:37	49.1
17/06/2022 04:31:37	46.1
17/06/2022 04:36:37	46.4
17/06/2022 04:41:37	45.6
17/06/2022 04:46:37	46.2
17/06/2022 04:51:37	45.5
17/06/2022 04:56:37	44.2
17/06/2022 05:01:37	42.2
17/06/2022 05:06:37	43.1
17/06/2022 05:11:37	42.2
17/06/2022 05:16:37	43.4
17/06/2022 05:21:37	46.2
17/06/2022 05:26:37	45.3
17/06/2022 05:31:37	45.2
17/06/2022 05:36:37	44.7
17/06/2022 05:41:37	48.3
17/06/2022 05:46:37	45.1
17/06/2022 05:51:37	46.6
17/06/2022 05:56:37	48
17/06/2022 06:01:37	47.7
17/06/2022 06:06:37	48
17/06/2022 06:11:37	49.5
17/06/2022 06:16:37	52.1
17/06/2022 06:21:37	48.1
17/06/2022 06:26:37	47
17/06/2022 06:31:37	47.7
17/06/2022 06:36:37	48.2
17/06/2022 06:41:37	48.5
17/06/2022 06:46:37	50.7
17/06/2022 06:51:37	55.8
17/06/2022 06:56:37	50.4
17/06/2022 07:01:37	56.4
17/06/2022 07:06:37	48.6
17/06/2022 07:11:37	62.1
17/06/2022 07:16:37	48.5
17/06/2022 07:21:37	54.4
17/06/2022 07:26:37	51.3
17/06/2022 07:31:37	48.3
17/06/2022 07:36:37	48.9
17/06/2022 07:41:37	49.8
17/06/2022 07:46:37	54.9

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
16/4/2022 07:50:00	67.6
16/4/2022 07:55:00	68.2
16/4/2022 08:00:00	68.5
16/4/2022 08:05:00	67.9
16/4/2022 08:10:00	68.1
16/4/2022 08:15:00	69.4
16/4/2022 08:20:00	68.5
16/4/2022 08:25:00	70.4
16/4/2022 08:30:00	68.6
16/4/2022 08:35:00	68.6
16/4/2022 08:40:00	69.8
16/4/2022 08:45:00	69.4
16/4/2022 08:50:00	70.1
16/4/2022 08:55:00	69.8
16/4/2022 09:00:00	69.6
16/4/2022 09:05:00	69.6
16/4/2022 09:10:00	69.2
16/4/2022 09:15:00	68.9
16/4/2022 09:20:00	68
16/4/2022 09:25:00	69.8
16/4/2022 09:30:00	69.5
16/4/2022 09:35:00	68.6
16/4/2022 09:40:00	69.2
16/4/2022 09:45:00	69.4
16/4/2022 09:50:00	69.1
16/4/2022 09:55:00	68.6
16/4/2022 10:00:00	68.4
16/4/2022 10:05:00	68.6
16/4/2022 10:10:00	72.8
16/4/2022 10:15:00	70
16/4/2022 10:20:00	68.7
16/4/2022 10:25:00	69.1
16/4/2022 10:30:00	72
16/4/2022 10:35:00	67.9
16/4/2022 10:40:00	70.5
16/4/2022 10:45:00	69.5
16/4/2022 10:50:00	73.6
16/4/2022 10:55:00	69.9
16/4/2022 11:00:00	69.6
16/4/2022 11:05:00	69.7
16/4/2022 11:10:00	69.4
16/4/2022 11:15:00	69.1
16/4/2022 11:20:00	69.9
16/4/2022 11:25:00	70.7
16/4/2022 11:30:00	70.4
16/4/2022 11:35:00	70.1
16/4/2022 11:40:00	69.4
16/4/2022 11:45:00	69.5
16/4/2022 11:50:00	69.3

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
17/06/2022 07:51:37	52.9
17/06/2022 07:56:37	49.2
17/06/2022 08:01:37	52.2
17/06/2022 08:06:37	47.3
17/06/2022 08:11:37	51.1
17/06/2022 08:16:37	54.1
17/06/2022 08:21:37	50.3
17/06/2022 08:26:37	57.6
17/06/2022 08:31:37	50.1
17/06/2022 08:36:37	49.8
17/06/2022 08:41:37	51.1
17/06/2022 08:46:37	48.1
17/06/2022 08:51:37	49.2
17/06/2022 08:56:37	48.9
17/06/2022 09:01:37	51.2
17/06/2022 09:06:37	52.5
17/06/2022 09:11:37	49.4
17/06/2022 09:16:37	62.6
17/06/2022 09:21:37	47.7
17/06/2022 09:26:37	47.5
17/06/2022 09:31:37	50.9
17/06/2022 09:36:37	49.6
17/06/2022 09:41:37	50.1
17/06/2022 09:46:37	55.2
17/06/2022 09:51:37	56.2
17/06/2022 09:56:37	50.3
17/06/2022 10:01:37	50.7
17/06/2022 10:06:37	53.2
17/06/2022 10:11:37	49.2
17/06/2022 10:16:37	47.9
17/06/2022 10:21:37	49.8
17/06/2022 10:26:37	50.4
17/06/2022 10:31:37	47.6
17/06/2022 10:36:37	56.4
17/06/2022 10:41:37	49.6
17/06/2022 10:46:37	51.7
17/06/2022 10:51:37	48.2
17/06/2022 10:56:37	54.4
17/06/2022 11:01:37	55.5
17/06/2022 11:06:37	57.1
17/06/2022 11:11:37	51.8
17/06/2022 11:16:37	51
17/06/2022 11:21:37	57.4
17/06/2022 11:26:37	50.8
17/06/2022 11:31:37	50
17/06/2022 11:36:37	50
17/06/2022 11:41:37	50.1
17/06/2022 11:46:37	49.2
17/06/2022 11:51:37	48.1

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
16/4/2022 11:55:00	68.4
16/4/2022 12:00:00	68.8
16/4/2022 12:05:00	69.3
16/4/2022 12:10:00	68.6
16/4/2022 12:15:00	68.4
16/4/2022 12:20:00	69.4
16/4/2022 12:25:00	70.4
16/4/2022 12:30:00	71
16/4/2022 12:35:00	69.6
16/4/2022 12:40:00	69.5
16/4/2022 12:45:00	68.9
16/4/2022 12:50:00	68.8
16/4/2022 12:55:00	69.1
16/4/2022 13:00:00	69.4
16/4/2022 13:05:00	69.3
16/4/2022 13:10:00	69.7
16/4/2022 13:15:00	69.3
16/4/2022 13:20:00	70.9
16/4/2022 13:25:00	70
16/4/2022 13:30:00	71.7
16/4/2022 13:35:00	70.1
16/4/2022 13:40:00	82.3
16/4/2022 13:45:00	85.4
16/4/2022 13:50:00	70
16/4/2022 13:55:00	71.1
16/4/2022 14:00:00	71.7
16/4/2022 14:05:00	72.6
16/4/2022 14:10:00	72.8
16/4/2022 14:15:00	70.2
16/4/2022 14:20:00	72.6
16/4/2022 14:25:00	70.8
16/4/2022 14:30:00	70.5
16/4/2022 14:35:00	69.7
16/4/2022 14:40:00	73.5
16/4/2022 14:45:00	69.9
16/4/2022 14:50:00	68.9
16/4/2022 14:55:00	69.2
Sat, 16/4/2022, 15:00	69.1
16/4/2022 15:05:00	67.2
16/4/2022 15:10:00	68.9
16/4/2022 15:15:00	70.6
16/4/2022 15:20:00	68
16/4/2022 15:25:00	68.2
16/4/2022 15:30:00	67.5
16/4/2022 15:35:00	68.1
16/4/2022 15:40:00	68.4
16/4/2022 15:45:00	67.9
16/4/2022 15:50:00	68.1
16/4/2022 15:55:00	68.6

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
17/06/2022 11:56:37	49.5
17/06/2022 12:01:37	56.2
17/06/2022 12:06:37	48.4
17/06/2022 12:11:37	46.1
17/06/2022 12:16:37	54.5
17/06/2022 12:21:37	48.4
17/06/2022 12:26:37	49.6
17/06/2022 12:31:37	45.1
17/06/2022 12:36:37	46.3
17/06/2022 12:41:37	47.5
17/06/2022 12:46:37	50
17/06/2022 12:51:37	48.2
17/06/2022 12:56:37	46.8
17/06/2022 13:01:37	46.2
17/06/2022 13:06:37	46.2
17/06/2022 13:11:37	48.5
17/06/2022 13:16:37	49.5
17/06/2022 13:21:37	49.3
17/06/2022 13:26:37	53.6
17/06/2022 13:31:37	49.7
17/06/2022 13:36:37	46.5
17/06/2022 13:41:37	52.4
17/06/2022 13:46:37	54.5
17/06/2022 13:51:37	52
17/06/2022 13:56:37	47.1
17/06/2022 14:01:37	48.7
17/06/2022 14:06:37	58.7
17/06/2022 14:11:37	50
17/06/2022 14:16:37	51
17/06/2022 14:21:37	59.4
17/06/2022 14:26:37	51.9
17/06/2022 14:31:37	53.9
17/06/2022 14:36:37	53
17/06/2022 14:41:37	45.7
17/06/2022 14:46:37	47.3
17/06/2022 14:51:37	50.4
17/06/2022 14:56:37	47.3
17/06/2022 15:01:37	60.2
17/06/2022 15:06:37	48.5
17/06/2022 15:11:37	47.4
17/06/2022 15:16:37	49.8
17/06/2022 15:21:37	46.1
17/06/2022 15:26:37	53.8
17/06/2022 15:31:37	47.4
17/06/2022 15:36:37	47.9
17/06/2022 15:41:37	47.2
17/06/2022 15:46:37	47.2
17/06/2022 15:51:37	49.3
17/06/2022 15:56:37	47.6

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
16/4/2022 16:00:00	67.9
16/4/2022 16:05:00	68.6
16/4/2022 16:10:00	69.1
16/4/2022 16:15:00	68.9
16/4/2022 16:20:00	67.7
16/4/2022 16:25:00	67.9
16/4/2022 16:30:00	68.8
16/4/2022 16:35:00	67.8
16/4/2022 16:40:00	67.9
16/4/2022 16:45:00	68.7
16/4/2022 16:50:00	67.2
16/4/2022 16:55:00	65.9
16/4/2022 17:00:00	68.9
16/4/2022 17:05:00	67.3
16/4/2022 17:10:00	69.6
16/4/2022 17:15:00	67.2
16/4/2022 17:20:00	67.2
16/4/2022 17:25:00	68
16/4/2022 17:30:00	68.1
16/4/2022 17:35:00	68
16/4/2022 17:40:00	67.2
16/4/2022 17:45:00	68.6
16/4/2022 17:50:00	67.2
16/4/2022 17:55:00	67.6
16/4/2022 18:00:00	68.8
16/4/2022 18:05:00	67.7
16/4/2022 18:10:00	67.4
16/4/2022 18:15:00	68.8
16/4/2022 18:20:00	67.7
16/4/2022 18:25:00	68
16/4/2022 18:30:00	67.5
16/4/2022 18:35:00	68.4
16/4/2022 18:40:00	66.9
16/4/2022 18:45:00	68.5
16/4/2022 18:50:00	68
16/4/2022 18:55:00	68.1
Sat, 16/4/2022, 19:00	67.7
16/4/2022 19:05:00	67.4
16/4/2022 19:10:00	67.2
16/4/2022 19:15:00	67.2
16/4/2022 19:20:00	67.7
16/4/2022 19:25:00	67.3
16/4/2022 19:30:00	66.4
16/4/2022 19:35:00	65.5
16/4/2022 19:40:00	66.3
16/4/2022 19:45:00	66.7
16/4/2022 19:50:00	65.9
16/4/2022 19:55:00	66
16/4/2022 20:00:00	67.3

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
17/06/2022 16:01:37	53.3
17/06/2022 16:06:37	48
17/06/2022 16:11:37	50.2
17/06/2022 16:16:37	46.3
17/06/2022 16:21:37	50.9
17/06/2022 16:26:37	48.3
17/06/2022 16:31:37	58.9
17/06/2022 16:36:37	50.5
17/06/2022 16:41:37	54.8
17/06/2022 16:46:37	50.7
17/06/2022 16:51:37	48.3
17/06/2022 16:56:37	52
17/06/2022 17:01:37	48.9
17/06/2022 17:06:37	47.7
17/06/2022 17:11:37	53
17/06/2022 17:16:37	49.8
17/06/2022 17:21:37	49.8
17/06/2022 17:26:37	48.6
17/06/2022 17:31:37	48.1
17/06/2022 17:36:37	50.2
17/06/2022 17:41:37	47.1
17/06/2022 17:46:37	58.7
17/06/2022 17:51:37	49.5
17/06/2022 17:56:37	48
17/06/2022 18:01:37	51.1
17/06/2022 18:06:37	47.5
17/06/2022 18:11:37	49.7
17/06/2022 18:16:37	50.3
17/06/2022 18:21:37	55.5
17/06/2022 18:26:37	54.7
17/06/2022 18:31:37	50.2
17/06/2022 18:36:37	47.7
17/06/2022 18:41:37	51.8
17/06/2022 18:46:37	50
17/06/2022 18:51:37	59.9
17/06/2022 18:56:37	51.2
17/06/2022 19:01:37	48.8
17/06/2022 19:06:37	49.2
17/06/2022 19:11:37	51.1
17/06/2022 19:16:37	47.7
17/06/2022 19:21:37	46.4
17/06/2022 19:26:37	55.9
17/06/2022 19:31:37	47.4
17/06/2022 19:36:37	49.3
17/06/2022 19:41:37	50.3
17/06/2022 19:46:37	49.7
17/06/2022 19:51:37	53.7
17/06/2022 19:56:37	51.4
17/06/2022 20:01:37	49.7

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
16/4/2022 20:05:00	66.8
16/4/2022 20:10:00	66
16/4/2022 20:15:00	67.4
16/4/2022 20:20:00	65.9
16/4/2022 20:25:00	67.6
16/4/2022 20:30:00	65.6
16/4/2022 20:35:00	65.5
16/4/2022 20:40:00	66.1
16/4/2022 20:45:00	65.6
16/4/2022 20:50:00	66.9
16/4/2022 20:55:00	67
16/4/2022 21:00:00	66
16/4/2022 21:05:00	68.4
16/4/2022 21:10:00	65.2
16/4/2022 21:15:00	66.8
16/4/2022 21:20:00	65.6
16/4/2022 21:25:00	65.6
16/4/2022 21:30:00	65.9
16/4/2022 21:35:00	67.6
16/4/2022 21:40:00	66.1
16/4/2022 21:45:00	67.5
16/4/2022 21:50:00	66.4
16/4/2022 21:55:00	66.2
16/4/2022 22:00:00	65.5
16/4/2022 22:05:00	66
16/4/2022 22:10:00	68.2
16/4/2022 22:15:00	66.7
16/4/2022 22:20:00	65.2
16/4/2022 22:25:00	67.9
16/4/2022 22:30:00	65.1
16/4/2022 22:35:00	64.8
16/4/2022 22:40:00	66.6
16/4/2022 22:45:00	64.2
16/4/2022 22:50:00	65.9
16/4/2022 22:55:00	64.6
16/4/2022 23:00:00	65
16/4/2022 23:05:00	64.7
16/4/2022 23:10:00	64.8
16/4/2022 23:15:00	64.2
16/4/2022 23:20:00	64.7
16/4/2022 23:25:00	66
16/4/2022 23:30:00	65.6
16/4/2022 23:35:00	64.8
16/4/2022 23:40:00	64
16/4/2022 23:45:00	63.4
16/4/2022 23:50:00	65.3
16/4/2022 23:55:00	63.9
16/4/2022 00:00:00	60.9
17/4/2022 00:05:00	64.1

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
17/06/2022 20:06:37	50.9
17/06/2022 20:11:37	51.9
17/06/2022 20:16:37	53.2
17/06/2022 20:21:37	52.6
17/06/2022 20:26:37	56.4
17/06/2022 20:31:37	54.7
17/06/2022 20:36:37	52.8
17/06/2022 20:41:37	52.3
17/06/2022 20:46:37	52.8
17/06/2022 20:51:37	53.5
17/06/2022 20:56:37	53.9
17/06/2022 21:01:37	54.1
17/06/2022 21:06:37	55.5
17/06/2022 21:11:37	53.8
17/06/2022 21:16:37	53.9
17/06/2022 21:21:37	58.4
17/06/2022 21:26:37	49.1
17/06/2022 21:31:37	48
17/06/2022 21:36:37	48.3
17/06/2022 21:41:37	51
17/06/2022 21:46:37	51.2
17/06/2022 21:51:37	50.1
17/06/2022 21:56:37	53.2
17/06/2022 22:01:37	49.5
17/06/2022 22:06:37	48.9
17/06/2022 22:11:37	50.5
17/06/2022 22:16:37	52
17/06/2022 22:21:37	47.9
17/06/2022 22:26:37	47.3
17/06/2022 22:31:37	43.1
17/06/2022 22:36:37	46.9
17/06/2022 22:41:37	50.1
17/06/2022 22:46:37	48.2
17/06/2022 22:51:37	46.9
17/06/2022 22:56:37	47.8
17/06/2022 23:01:37	47.1
17/06/2022 23:06:37	46.7
17/06/2022 23:11:37	46.6
17/06/2022 23:16:37	48.9
17/06/2022 23:21:37	51.3
17/06/2022 23:26:37	47.1
17/06/2022 23:31:37	45.7
17/06/2022 23:36:37	46.5
17/06/2022 23:41:37	48.1
17/06/2022 23:46:37	50
17/06/2022 23:51:37	46.1
17/06/2022 23:56:37	48.1
18/06/2022 00:01:37	47.1
18/06/2022 00:06:37	41.6

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
17/4/2022 00:10:00	64
17/4/2022 00:15:00	62.4
17/4/2022 00:20:00	63.3
17/4/2022 00:25:00	62.7
17/4/2022 00:30:00	64.1
17/4/2022 00:35:00	61.2
17/4/2022 00:40:00	62.6
17/4/2022 00:45:00	61.2
17/4/2022 00:50:00	65.2
17/4/2022 00:55:00	62.1
17/4/2022 01:00:00	59.7
17/4/2022 01:05:00	61.1
17/4/2022 01:10:00	61.5
17/4/2022 01:15:00	62.2
17/4/2022 01:20:00	60.4
17/4/2022 01:25:00	59.5
17/4/2022 01:30:00	60
17/4/2022 01:35:00	59.3
17/4/2022 01:40:00	61.3
17/4/2022 01:45:00	62.5
17/4/2022 01:50:00	62.5
17/4/2022 01:55:00	60.2
17/4/2022 02:00:00	60.5
17/4/2022 02:05:00	62.3
17/4/2022 02:10:00	63.5
17/4/2022 02:15:00	61.7
17/4/2022 02:20:00	58.6
17/4/2022 02:25:00	62.4
17/4/2022 02:30:00	61.1
17/4/2022 02:35:00	59.1
17/4/2022 02:40:00	60.6
17/4/2022 02:45:00	61.1
17/4/2022 02:50:00	59.2
17/4/2022 02:55:00	58
Sun, 17/4/2022, 03:00	65.3
17/4/2022 03:05:00	59.2
17/4/2022 03:10:00	61.4
17/4/2022 03:15:00	60.2
17/4/2022 03:20:00	51.9
17/4/2022 03:25:00	61.6
17/4/2022 03:30:00	58.8
17/4/2022 03:35:00	58
17/4/2022 03:40:00	60.4
17/4/2022 03:45:00	63.5
17/4/2022 03:50:00	57.7
17/4/2022 03:55:00	59.7
17/4/2022 04:00:00	59.1
17/4/2022 04:05:00	58.4
17/4/2022 04:10:00	62.2

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
18/06/2022 00:11:37	42.1
18/06/2022 00:16:37	42.3
18/06/2022 00:21:37	42.1
18/06/2022 00:26:37	44.5
18/06/2022 00:31:37	47.2
18/06/2022 00:36:37	43.7
18/06/2022 00:41:37	42.8
18/06/2022 00:46:37	43.9
18/06/2022 00:51:37	43.4
18/06/2022 00:56:37	45.7
18/06/2022 01:01:37	44.8
18/06/2022 01:06:37	41.4
18/06/2022 01:11:37	42
18/06/2022 01:16:37	43
18/06/2022 01:21:37	45.4
18/06/2022 01:26:37	45.7
18/06/2022 01:31:37	45.2
18/06/2022 01:36:37	46.4
18/06/2022 01:41:37	44.2
18/06/2022 01:46:37	47.2
18/06/2022 01:51:37	45.4
18/06/2022 01:56:37	44.8
18/06/2022 02:01:37	44.6
18/06/2022 02:06:37	44.4
18/06/2022 02:11:37	46.5
18/06/2022 02:16:37	47.1
18/06/2022 02:21:37	47.1
18/06/2022 02:26:37	48.3
18/06/2022 02:31:37	46.8
18/06/2022 02:36:37	46.7
18/06/2022 02:41:37	46.3
18/06/2022 02:46:37	45.5
18/06/2022 02:51:37	46.5
18/06/2022 02:56:37	45.4
18/06/2022 03:01:37	45.4
18/06/2022 03:06:37	45.8
18/06/2022 03:11:37	45.2
18/06/2022 03:16:37	42.7
18/06/2022 03:21:37	42.7
18/06/2022 03:26:37	42.3
18/06/2022 03:31:37	45.6
18/06/2022 03:36:37	45.8
18/06/2022 03:41:37	45.2
18/06/2022 03:46:37	45.3
18/06/2022 03:51:37	45.8
18/06/2022 03:56:37	46.1
18/06/2022 04:01:37	48
18/06/2022 04:06:37	47.3
18/06/2022 04:11:37	45.9

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
17/4/2022 04:15:00	60
17/4/2022 04:20:00	58.9
17/4/2022 04:25:00	58.9
17/4/2022 04:30:00	60
17/4/2022 04:35:00	60.1
17/4/2022 04:40:00	58.8
17/4/2022 04:45:00	57.8
17/4/2022 04:50:00	59.6
17/4/2022 04:55:00	58.8
17/4/2022 05:00:00	60.6
17/4/2022 05:05:00	61.3
17/4/2022 05:10:00	58.1
17/4/2022 05:15:00	58.6
17/4/2022 05:20:00	60.1
17/4/2022 05:25:00	61.1
17/4/2022 05:30:00	60.2
17/4/2022 05:35:00	62
17/4/2022 05:40:00	61.7
17/4/2022 05:45:00	62.3
17/4/2022 05:50:00	63.4
17/4/2022 05:55:00	63.2
17/4/2022 06:00:00	61.1
17/4/2022 06:05:00	63.4
17/4/2022 06:10:00	62.2
17/4/2022 06:15:00	63
17/4/2022 06:20:00	64.4
17/4/2022 06:25:00	64.6
17/4/2022 06:30:00	65.6
17/4/2022 06:35:00	64.4
17/4/2022 06:40:00	65.4
17/4/2022 06:45:00	64.5
17/4/2022 06:50:00	65.8
17/4/2022 06:55:00	66
Sun, 17/4/2022, 07:00	65.5
17/4/2022 07:05:00	65.2
17/4/2022 07:10:00	65.5
17/4/2022 07:15:00	63.8
17/4/2022 07:20:00	65.2
17/4/2022 07:25:00	64.8
17/4/2022 07:30:00	65.6
17/4/2022 07:35:00	65.2
17/4/2022 07:40:00	66.4
17/4/2022 07:45:00	65.1
17/4/2022 07:50:00	66.4
17/4/2022 07:55:00	67
17/4/2022 08:00:00	67.1
17/4/2022 08:05:00	68.6
17/4/2022 08:10:00	67.2
17/4/2022 08:15:00	67

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
18/06/2022 04:16:37	47.3
18/06/2022 04:21:37	45.7
18/06/2022 04:26:37	53.7
18/06/2022 04:31:37	46.1
18/06/2022 04:36:37	45.7
18/06/2022 04:41:37	46.3
18/06/2022 04:46:37	43
18/06/2022 04:51:37	54.5
18/06/2022 04:56:37	44.5
18/06/2022 05:01:37	43.5
18/06/2022 05:06:37	46.6
18/06/2022 05:11:37	49.7
18/06/2022 05:16:37	51.8
18/06/2022 05:21:37	52.6
18/06/2022 05:26:37	54.7
18/06/2022 05:31:37	54.6
18/06/2022 05:36:37	53
18/06/2022 05:41:37	53.5
18/06/2022 05:46:37	55.5
18/06/2022 05:51:37	55.6
18/06/2022 05:56:37	51.4
18/06/2022 06:01:37	50.5
18/06/2022 06:06:37	50.7
18/06/2022 06:11:37	52.2
18/06/2022 06:16:37	48.8
18/06/2022 06:21:37	50.3
18/06/2022 06:26:37	49.4
18/06/2022 06:31:37	48.6
18/06/2022 06:36:37	48.8
18/06/2022 06:41:37	49.2
18/06/2022 06:46:37	50.8
18/06/2022 06:51:37	54
18/06/2022 06:56:37	51.4
18/06/2022 07:01:37	52.6
18/06/2022 07:06:37	49.2
18/06/2022 07:11:37	60.3
18/06/2022 07:16:37	55.2
18/06/2022 07:21:37	53.3
18/06/2022 07:26:37	53.1
18/06/2022 07:31:37	54.4
18/06/2022 07:36:37	54.6
18/06/2022 07:41:37	56.5
18/06/2022 07:46:37	50.6
18/06/2022 07:51:37	50.6
18/06/2022 07:56:37	52.5
18/06/2022 08:01:37	49.2
18/06/2022 08:06:37	52.5
18/06/2022 08:11:37	48.5
18/06/2022 08:16:37	50.6

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
17/4/2022 08:20:00	73
17/4/2022 08:25:00	80.4
17/4/2022 08:30:00	67.9
17/4/2022 08:35:00	74.7
17/4/2022 08:40:00	68.1
17/4/2022 08:45:00	67
17/4/2022 08:50:00	66.9
17/4/2022 08:55:00	68.1
17/4/2022 09:00:00	67.3
17/4/2022 09:05:00	66.2
17/4/2022 09:10:00	68.5
17/4/2022 09:15:00	65.8
17/4/2022 09:20:00	66.8
17/4/2022 09:25:00	67.6
17/4/2022 09:30:00	67.5
17/4/2022 09:35:00	67.1
17/4/2022 09:40:00	67.8
17/4/2022 09:45:00	68.7
17/4/2022 09:50:00	66.8
17/4/2022 09:55:00	67.2
17/4/2022 10:00:00	68.4
17/4/2022 10:05:00	66.9
17/4/2022 10:10:00	67.9
17/4/2022 10:15:00	68.5
17/4/2022 10:20:00	68.6
17/4/2022 10:25:00	67.8
17/4/2022 10:30:00	67.6
17/4/2022 10:35:00	66.8
17/4/2022 10:40:00	67.5
17/4/2022 10:45:00	70
17/4/2022 10:50:00	68.5
17/4/2022 10:55:00	68
17/4/2022 11:00:00	68.7
17/4/2022 11:05:00	68.3
17/4/2022 11:10:00	68.9
17/4/2022 11:15:00	67.9
17/4/2022 11:20:00	68
17/4/2022 11:25:00	67.5
17/4/2022 11:30:00	73.5
17/4/2022 11:35:00	68.8
17/4/2022 11:40:00	67.3
17/4/2022 11:45:00	67.6
17/4/2022 11:50:00	67.1
17/4/2022 11:55:00	68
17/4/2022 12:00:00	67.4
17/4/2022 12:05:00	66.8
17/4/2022 12:10:00	67.3
17/4/2022 12:15:00	66
17/4/2022 12:20:00	68.5

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
18/06/2022 08:21:37	50
18/06/2022 08:26:37	52.2
18/06/2022 08:31:37	54.6
18/06/2022 08:36:37	54.4
18/06/2022 08:41:37	49.6
18/06/2022 08:46:37	53.4
18/06/2022 08:51:37	51.8
18/06/2022 08:56:37	49.8
18/06/2022 09:01:37	52.8
18/06/2022 09:06:37	49.9
18/06/2022 09:11:37	50.3
18/06/2022 09:16:37	49.8
18/06/2022 09:21:37	48.6
18/06/2022 09:26:37	53.3
18/06/2022 09:31:37	47.7
18/06/2022 09:36:37	47.1
18/06/2022 09:41:37	51.5
18/06/2022 09:46:37	51.8
18/06/2022 09:51:37	48.1
18/06/2022 09:56:37	52
18/06/2022 10:01:37	47.4
18/06/2022 10:06:37	46.7
18/06/2022 10:11:37	50.1
18/06/2022 10:16:37	51.1
18/06/2022 10:21:37	51.1
18/06/2022 10:26:37	50
18/06/2022 10:31:37	51.6
18/06/2022 10:36:37	49.9
18/06/2022 10:41:37	48.6
18/06/2022 10:46:37	49.8
18/06/2022 10:51:37	49.4
18/06/2022 10:56:37	49.7
18/06/2022 11:01:37	47.5
18/06/2022 11:06:37	48.2
18/06/2022 11:11:37	48.9
18/06/2022 11:16:37	48.8
18/06/2022 11:21:37	53.6
18/06/2022 11:26:37	50.2
18/06/2022 11:31:37	46.8
18/06/2022 11:36:37	52.9
18/06/2022 11:41:37	48.7
18/06/2022 11:46:37	49.4
18/06/2022 11:51:37	52.3
18/06/2022 11:56:37	48.6
18/06/2022 12:01:37	47.4
18/06/2022 12:06:37	49.9
18/06/2022 12:11:37	49
18/06/2022 12:16:37	52.8
18/06/2022 12:21:37	50.1

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
17/4/2022 12:25:00	68.1
17/4/2022 12:30:00	68.2
17/4/2022 12:35:00	66.5
17/4/2022 12:40:00	68.2
17/4/2022 12:45:00	67.6
17/4/2022 12:50:00	67.4
17/4/2022 12:55:00	67.1
17/4/2022 13:00:00	67.4
17/4/2022 13:05:00	67.2
17/4/2022 13:10:00	67.9
17/4/2022 13:15:00	67.3
17/4/2022 13:20:00	68
17/4/2022 13:25:00	67.9
17/4/2022 13:30:00	68.1
17/4/2022 13:35:00	67.7
17/4/2022 13:40:00	67.6
17/4/2022 13:45:00	66.7
17/4/2022 13:50:00	67.9
17/4/2022 13:55:00	66.9
17/4/2022 14:00:00	69
17/4/2022 14:05:00	66.5
17/4/2022 14:10:00	67.1
17/4/2022 14:15:00	68
17/4/2022 14:20:00	67.6
17/4/2022 14:25:00	68.7
17/4/2022 14:30:00	67.5
17/4/2022 14:35:00	68
17/4/2022 14:40:00	72.1
17/4/2022 14:45:00	74.2
17/4/2022 14:50:00	74.8
17/4/2022 14:55:00	73.3
Sat, 17/4/2022, 15:00	72.3
17/4/2022 15:05:00	71.5
17/4/2022 15:10:00	68.9
17/4/2022 15:15:00	69.6
17/4/2022 15:20:00	69.5
17/4/2022 15:25:00	68.8
17/4/2022 15:30:00	69.7
17/4/2022 15:35:00	68.3
17/4/2022 15:40:00	69.7
17/4/2022 15:45:00	73.2
17/4/2022 15:50:00	69.5
17/4/2022 15:55:00	69.3
17/4/2022 16:00:00	68.8
17/4/2022 16:05:00	68.3
17/4/2022 16:10:00	67.5
17/4/2022 16:15:00	67.7
17/4/2022 16:20:00	68.8
17/4/2022 16:25:00	67.5

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
18/06/2022 12:26:37	48.4
18/06/2022 12:31:37	51.6
18/06/2022 12:36:37	45.6
18/06/2022 12:41:37	47.5
18/06/2022 12:46:37	48.7
18/06/2022 12:51:37	47.3
18/06/2022 12:56:37	48.5
18/06/2022 13:01:37	53.9
18/06/2022 13:06:37	46.3
18/06/2022 13:11:37	49.7
18/06/2022 13:16:37	50.2
18/06/2022 13:21:37	49.2
18/06/2022 13:26:37	51.8
18/06/2022 13:31:37	56.7
18/06/2022 13:36:37	47.7
18/06/2022 13:41:37	46.9
18/06/2022 13:46:37	49.8
18/06/2022 13:51:37	47.8
18/06/2022 13:56:37	43.7
18/06/2022 14:01:37	45.9
18/06/2022 14:06:37	47.2
18/06/2022 14:11:37	49.3
18/06/2022 14:16:37	48.4
18/06/2022 14:21:37	47.2
18/06/2022 14:26:37	45.2
18/06/2022 14:31:37	50.1
18/06/2022 14:36:37	51.9
18/06/2022 14:41:37	48.7
18/06/2022 14:46:37	48.4
18/06/2022 14:51:37	48.1
18/06/2022 14:56:37	49.7
18/06/2022 15:01:37	49.9
18/06/2022 15:06:37	49.8
18/06/2022 15:11:37	46.9
18/06/2022 15:16:37	49.3
18/06/2022 15:21:37	47.8
18/06/2022 15:26:37	49.8
18/06/2022 15:31:37	70.5
18/06/2022 15:36:37	50.4
18/06/2022 15:41:37	46.9
18/06/2022 15:46:37	52.5
18/06/2022 15:51:37	49.7
18/06/2022 15:56:37	52.2
18/06/2022 16:01:37	49.6
18/06/2022 16:06:37	65.7
18/06/2022 16:11:37	71.3
18/06/2022 16:16:37	50.1
18/06/2022 16:21:37	48.1
18/06/2022 16:26:37	55.4

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
17/4/2022 16:30:00	69.5
17/4/2022 16:35:00	67.8
17/4/2022 16:40:00	68.1
17/4/2022 16:45:00	67.7
17/4/2022 16:50:00	67.8
17/4/2022 16:55:00	67.8
17/4/2022 17:00:00	67.5
17/4/2022 17:05:00	68.9
17/4/2022 17:10:00	67.6
17/4/2022 17:15:00	69.1
17/4/2022 17:20:00	67.3
17/4/2022 17:25:00	68.5
17/4/2022 17:30:00	67.5
17/4/2022 17:35:00	67.3
17/4/2022 17:40:00	67.8
17/4/2022 17:45:00	68.2
17/4/2022 17:50:00	67.4
17/4/2022 17:55:00	67.9
17/4/2022 18:00:00	67.9
17/4/2022 18:05:00	68.5
17/4/2022 18:10:00	68.5
17/4/2022 18:15:00	66.8
17/4/2022 18:20:00	67.1
17/4/2022 18:25:00	68.4
17/4/2022 18:30:00	66.7
17/4/2022 18:35:00	68.1
17/4/2022 18:40:00	67.5
17/4/2022 18:45:00	66.7
17/4/2022 18:50:00	66.1
17/4/2022 18:55:00	66.2
Sun, 17/4/2022, 19:00	67.5
17/4/2022 19:05:00	66.2
17/4/2022 19:10:00	67.5
17/4/2022 19:15:00	67.5
17/4/2022 19:20:00	66.7
17/4/2022 19:25:00	67.7
17/4/2022 19:30:00	66.9
17/4/2022 19:35:00	66.1
17/4/2022 19:40:00	65.1
17/4/2022 19:45:00	67
17/4/2022 19:50:00	66.2
17/4/2022 19:55:00	67.2
17/4/2022 20:00:00	66.7
17/4/2022 20:05:00	66.7
17/4/2022 20:10:00	68.2
17/4/2022 20:15:00	67.1
17/4/2022 20:20:00	66.2
17/4/2022 20:25:00	67.4
17/4/2022 20:30:00	67.4

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
18/06/2022 16:31:37	49.6
18/06/2022 16:36:37	50.4
18/06/2022 16:41:37	52.6
18/06/2022 16:46:37	51.7
18/06/2022 16:51:37	48.5
18/06/2022 16:56:37	48.5
18/06/2022 17:01:37	51.4
18/06/2022 17:06:37	48.1
18/06/2022 17:11:37	46.2
18/06/2022 17:16:37	49.7
18/06/2022 17:21:37	47.3
18/06/2022 17:26:37	53.4
18/06/2022 17:31:37	44
18/06/2022 17:36:37	44.9
18/06/2022 17:41:37	50.6
18/06/2022 17:46:37	50
18/06/2022 17:51:37	47.8
18/06/2022 17:56:37	56.5
18/06/2022 18:01:37	50.3
18/06/2022 18:06:37	48.1
18/06/2022 18:11:37	46.5
18/06/2022 18:16:37	51.8
18/06/2022 18:21:37	55.5
18/06/2022 18:26:37	49.2
18/06/2022 18:31:37	47.4
18/06/2022 18:36:37	47.9
18/06/2022 18:41:37	48.9
18/06/2022 18:46:37	48.7
18/06/2022 18:51:37	46.8
18/06/2022 18:56:37	47.5
18/06/2022 19:01:37	45
18/06/2022 19:06:37	45.9
18/06/2022 19:11:37	47.4
18/06/2022 19:16:37	43.8
18/06/2022 19:21:37	48.7
18/06/2022 19:26:37	45.3
18/06/2022 19:31:37	45.2
18/06/2022 19:36:37	49.1
18/06/2022 19:41:37	50.6
18/06/2022 19:46:37	50
18/06/2022 19:51:37	50.5
18/06/2022 19:56:37	51
18/06/2022 20:01:37	52.6
18/06/2022 20:06:37	49.8
18/06/2022 20:11:37	51.2
18/06/2022 20:16:37	52.1
18/06/2022 20:21:37	50.4
18/06/2022 20:26:37	49.6
18/06/2022 20:31:37	49.7

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
17/4/2022 20:35:00	69.2
17/4/2022 20:40:00	68.8
17/4/2022 20:45:00	70.4
17/4/2022 20:50:00	71
17/4/2022 20:55:00	71.6
17/4/2022 21:00:00	70.9
17/4/2022 21:05:00	70.1
17/4/2022 21:10:00	70.5
17/4/2022 21:15:00	70.2
17/4/2022 21:20:00	69.6
17/4/2022 21:25:00	68.6
17/4/2022 21:30:00	69.6
17/4/2022 21:35:00	70.1
17/4/2022 21:40:00	69.6
17/4/2022 21:45:00	68.4
17/4/2022 21:50:00	69.4
17/4/2022 21:55:00	67.6
17/4/2022 22:00:00	66.2
17/4/2022 22:05:00	67.3
17/4/2022 22:10:00	66
17/4/2022 22:15:00	68.1
17/4/2022 22:20:00	67.2
17/4/2022 22:25:00	66.9
17/4/2022 22:30:00	66.8
17/4/2022 22:35:00	66.8
17/4/2022 22:40:00	64.8
17/4/2022 22:45:00	65.7
17/4/2022 22:50:00	66.6
17/4/2022 22:55:00	64.6
17/4/2022 23:00:00	63.3
17/4/2022 23:05:00	66.1
17/4/2022 23:10:00	66.3
17/4/2022 23:15:00	66
17/4/2022 23:20:00	64.2
17/4/2022 23:25:00	63.9
17/4/2022 23:30:00	64.3
17/4/2022 23:35:00	64
17/4/2022 23:40:00	65.2
17/4/2022 23:45:00	63.3
17/4/2022 23:50:00	63.1
17/4/2022 23:55:00	64
17/4/2022 00:00:00	62.5
18/4/2022 00:05:00	67.8
18/4/2022 00:10:00	62.3
18/4/2022 00:15:00	59.4
18/4/2022 00:20:00	59.2
18/4/2022 00:25:00	61.9
18/4/2022 00:30:00	68.5
18/4/2022 00:35:00	68.9

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
18/06/2022 20:36:37	48
18/06/2022 20:41:37	49.4
18/06/2022 20:46:37	50.5
18/06/2022 20:51:37	50.2
18/06/2022 20:56:37	48.7
18/06/2022 21:01:37	49.6
18/06/2022 21:06:37	48.7
18/06/2022 21:11:37	49.1
18/06/2022 21:16:37	49.2
18/06/2022 21:21:37	49.1
18/06/2022 21:26:37	48.6
18/06/2022 21:31:37	49
18/06/2022 21:36:37	48.3
18/06/2022 21:41:37	48.8
18/06/2022 21:46:37	48.8
18/06/2022 21:51:37	49.5
18/06/2022 21:56:37	48.1
18/06/2022 22:01:37	48.1
18/06/2022 22:06:37	46.9
18/06/2022 22:11:37	49
18/06/2022 22:16:37	46
18/06/2022 22:21:37	50
18/06/2022 22:26:37	47.7
18/06/2022 22:31:37	48.6
18/06/2022 22:36:37	54.8
18/06/2022 22:41:37	55.9
18/06/2022 22:46:37	55.2
18/06/2022 22:51:37	56.1
18/06/2022 22:56:37	54.3
18/06/2022 23:01:37	54.4
18/06/2022 23:06:37	54.2
18/06/2022 23:11:37	54.7
18/06/2022 23:16:37	54.5
18/06/2022 23:21:37	54
18/06/2022 23:26:37	54
18/06/2022 23:31:37	53.5
18/06/2022 23:36:37	54.3
18/06/2022 23:41:37	54
18/06/2022 23:46:37	54
18/06/2022 23:51:37	54.1
18/06/2022 23:56:37	53.8
19/06/2022 00:01:37	48.9
19/06/2022 00:06:37	53.9
19/06/2022 00:11:37	53.3
19/06/2022 00:16:37	53.4
19/06/2022 00:21:37	52.9
19/06/2022 00:26:37	53.1
19/06/2022 00:31:37	52.8
19/06/2022 00:36:37	53.5

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
18/4/2022 00:40:00	67.8
18/4/2022 00:45:00	67.6
18/4/2022 00:50:00	70.3
18/4/2022 00:55:00	72.9
18/4/2022 01:00:00	72.2
18/4/2022 01:05:00	72.9
18/4/2022 01:10:00	70.8
18/4/2022 01:15:00	72.9
18/4/2022 01:20:00	73.5
18/4/2022 01:25:00	72.4
18/4/2022 01:30:00	70.7
18/4/2022 01:35:00	67.2
18/4/2022 01:40:00	68.7
18/4/2022 01:45:00	68.2
18/4/2022 01:50:00	71.2
18/4/2022 01:55:00	71.8
18/4/2022 02:00:00	70.6
18/4/2022 02:05:00	68.5
18/4/2022 02:10:00	66.9
18/4/2022 02:15:00	66.8
18/4/2022 02:20:00	68.3
18/4/2022 02:25:00	64.1
18/4/2022 02:30:00	64.5
18/4/2022 02:35:00	63.7
18/4/2022 02:40:00	65.3
18/4/2022 02:45:00	66
18/4/2022 02:50:00	63.6
18/4/2022 02:55:00	62.2
Mon, 18/4/2022, 03:00	58.8
18/4/2022 03:05:00	58.6
18/4/2022 03:10:00	56.9
18/4/2022 03:15:00	62.8
18/4/2022 03:20:00	63.8
18/4/2022 03:25:00	65
18/4/2022 03:30:00	65.5
18/4/2022 03:35:00	61.3
18/4/2022 03:40:00	62
18/4/2022 03:45:00	60.2
18/4/2022 03:50:00	64.1
18/4/2022 03:55:00	63.1
18/4/2022 04:00:00	61.1
18/4/2022 04:05:00	62.8
18/4/2022 04:10:00	60.4
18/4/2022 04:15:00	58.1
18/4/2022 04:20:00	63.1
18/4/2022 04:25:00	60.7
18/4/2022 04:30:00	64.3
18/4/2022 04:35:00	60.7
18/4/2022 04:40:00	62.5

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
19/06/2022 00:41:37	54.1
19/06/2022 00:46:37	53.4
19/06/2022 00:51:37	53.1
19/06/2022 00:56:37	53.4
19/06/2022 01:01:37	53.1
19/06/2022 01:06:37	53.7
19/06/2022 01:11:37	53.6
19/06/2022 01:16:37	53.5
19/06/2022 01:21:37	43.3
19/06/2022 01:26:37	41.6
19/06/2022 01:31:37	44.1
19/06/2022 01:36:37	46.7
19/06/2022 01:41:37	43.3
19/06/2022 01:46:37	45.6
19/06/2022 01:51:37	43.9
19/06/2022 01:56:37	42.7
19/06/2022 02:01:37	43.1
19/06/2022 02:06:37	44.2
19/06/2022 02:11:37	43.4
19/06/2022 02:16:37	44.7
19/06/2022 02:21:37	43.6
19/06/2022 02:26:37	42.9
19/06/2022 02:31:37	42.7
19/06/2022 02:36:37	43.6
19/06/2022 02:41:37	44.4
19/06/2022 02:46:37	42.6
19/06/2022 02:51:37	42.2
19/06/2022 02:56:37	41.9
19/06/2022 03:01:37	48
19/06/2022 03:06:37	42.4
19/06/2022 03:11:37	45
19/06/2022 03:16:37	42.3
19/06/2022 03:21:37	43.3
19/06/2022 03:26:37	42
19/06/2022 03:31:37	41.5
19/06/2022 03:36:37	42.2
19/06/2022 03:41:37	41.8
19/06/2022 03:46:37	42.7
19/06/2022 03:51:37	42.4
19/06/2022 03:56:37	43.9
19/06/2022 04:01:37	42
19/06/2022 04:06:37	42.6
19/06/2022 04:11:37	43.8
19/06/2022 04:16:37	41.5
19/06/2022 04:21:37	43.1
19/06/2022 04:26:37	42.1
19/06/2022 04:31:37	42.5
19/06/2022 04:36:37	42.7
19/06/2022 04:41:37	42.5

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
18/4/2022 04:45:00	65.1
18/4/2022 04:50:00	63.2
18/4/2022 04:55:00	66.6
18/4/2022 05:00:00	64.9
18/4/2022 05:05:00	67.5
18/4/2022 05:10:00	66.2
18/4/2022 05:15:00	66
18/4/2022 05:20:00	64.9
18/4/2022 05:25:00	65
18/4/2022 05:30:00	63.1
18/4/2022 05:35:00	65
18/4/2022 05:40:00	63.9
18/4/2022 05:45:00	66.1
18/4/2022 05:50:00	68.6
18/4/2022 05:55:00	68.1
18/4/2022 06:00:00	68.4
18/4/2022 06:05:00	69.2
18/4/2022 06:10:00	67.9
18/4/2022 06:15:00	67.4
18/4/2022 06:20:00	67.3
18/4/2022 06:25:00	68.9
18/4/2022 06:30:00	69.1
18/4/2022 06:35:00	69.6
18/4/2022 06:40:00	68.9
18/4/2022 06:45:00	70.3
18/4/2022 06:50:00	71.7
18/4/2022 06:55:00	72.1
Mon, 18/4/2022, 07:00	71.6
18/4/2022 07:05:00	72.8
18/4/2022 07:10:00	71.8
18/4/2022 07:15:00	72.6
18/4/2022 07:20:00	72.5
18/4/2022 07:25:00	72.1
18/4/2022 07:30:00	71.4
18/4/2022 07:35:00	70.8
18/4/2022 07:40:00	70.4
18/4/2022 07:45:00	71.6
18/4/2022 07:50:00	70.5
18/4/2022 07:55:00	70.2
18/4/2022 08:00:00	70.2
18/4/2022 08:05:00	69.5
18/4/2022 08:10:00	67.6
18/4/2022 08:15:00	67.8
18/4/2022 08:20:00	68.8
18/4/2022 08:25:00	69.5
18/4/2022 08:30:00	70.8
18/4/2022 08:35:00	68.4
18/4/2022 08:40:00	71
18/4/2022 08:45:00	69.7

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
19/06/2022 04:46:37	43.3
19/06/2022 04:51:37	43.9
19/06/2022 04:56:37	44.4
19/06/2022 05:01:37	41.6
19/06/2022 05:06:37	41.2
19/06/2022 05:11:37	41.3
19/06/2022 05:16:37	41.1
19/06/2022 05:21:37	44
19/06/2022 05:26:37	40.9
19/06/2022 05:31:37	40.8
19/06/2022 05:36:37	41.7
19/06/2022 05:41:37	44.2
19/06/2022 05:46:37	43.2
19/06/2022 05:51:37	44.1
19/06/2022 05:56:37	43.7
19/06/2022 06:01:37	43.5
19/06/2022 06:06:37	45.4
19/06/2022 06:11:37	45.2
19/06/2022 06:16:37	46.5
19/06/2022 06:21:37	45.1
19/06/2022 06:26:37	46.5
19/06/2022 06:31:37	50.2
19/06/2022 06:36:37	49.4
19/06/2022 06:41:37	51
19/06/2022 06:46:37	52.1
19/06/2022 06:51:37	53.1
19/06/2022 06:56:37	53.5
19/06/2022 07:01:37	49.5
19/06/2022 07:06:37	47.7
19/06/2022 07:11:37	47.7
19/06/2022 07:16:37	49
19/06/2022 07:21:37	48.2
19/06/2022 07:26:37	51.2
19/06/2022 07:31:37	49.4
19/06/2022 07:36:37	51.7
19/06/2022 07:41:37	62.5
19/06/2022 07:46:37	59.5
19/06/2022 07:51:37	60.1
19/06/2022 07:56:37	49.6
19/06/2022 08:01:37	50.3
19/06/2022 08:06:37	48.7
19/06/2022 08:11:37	45.8
19/06/2022 08:16:37	46.8
19/06/2022 08:21:37	48.8
19/06/2022 08:26:37	48.5
19/06/2022 08:31:37	45.7
19/06/2022 08:36:37	50.7
19/06/2022 08:41:37	47.8
19/06/2022 08:46:37	47

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
18/4/2022 08:50:00	70.7
18/4/2022 08:55:00	71.7
18/4/2022 09:00:00	69.8
18/4/2022 09:05:00	69.5
18/4/2022 09:10:00	70.2
18/4/2022 09:15:00	70.2
18/4/2022 09:20:00	69.9
18/4/2022 09:25:00	69.5
18/4/2022 09:30:00	69.5
18/4/2022 09:35:00	68.7
18/4/2022 09:40:00	68.4
18/4/2022 09:45:00	69.7
18/4/2022 09:50:00	68.7
18/4/2022 09:55:00	68.5
18/4/2022 10:00:00	70.8
18/4/2022 10:05:00	70.7
18/4/2022 10:10:00	68.6
18/4/2022 10:15:00	68.3
18/4/2022 10:20:00	68.7
18/4/2022 10:25:00	67.4
18/4/2022 10:30:00	74.3
18/4/2022 10:35:00	73.2
18/4/2022 10:40:00	69.3
18/4/2022 10:45:00	67.7
18/4/2022 10:50:00	68.9
18/4/2022 10:55:00	68.3
18/4/2022 11:00:00	68.9
18/4/2022 11:05:00	69.4
18/4/2022 11:10:00	68.8
18/4/2022 11:15:00	67.9
18/4/2022 11:20:00	67.4
18/4/2022 11:25:00	67.9
18/4/2022 11:30:00	68.5
18/4/2022 11:35:00	68.1
18/4/2022 11:40:00	67.8
18/4/2022 11:45:00	69
18/4/2022 11:50:00	67.1
18/4/2022 11:55:00	67.4
18/4/2022 12:00:00	67
18/4/2022 12:05:00	68.6
18/4/2022 12:10:00	67
18/4/2022 12:15:00	68.1
18/4/2022 12:20:00	67
18/4/2022 12:25:00	67.6
18/4/2022 12:30:00	68.3
18/4/2022 12:35:00	67.2
18/4/2022 12:40:00	68.4
18/4/2022 12:45:00	68.5
18/4/2022 12:50:00	67.4

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
19/06/2022 08:51:37	48.6
19/06/2022 08:56:37	46.4
19/06/2022 09:01:37	48.1
19/06/2022 09:06:37	47.6
19/06/2022 09:11:37	46.2
19/06/2022 09:16:37	47.2
19/06/2022 09:21:37	47.6
19/06/2022 09:26:37	50.7
19/06/2022 09:31:37	50
19/06/2022 09:36:37	56
19/06/2022 09:41:37	55.5
19/06/2022 09:46:37	55
19/06/2022 09:51:37	53.1
19/06/2022 09:56:37	51.8
19/06/2022 10:01:37	51.8
19/06/2022 10:06:37	56
19/06/2022 10:11:37	48
19/06/2022 10:16:37	50.1
19/06/2022 10:21:37	49.6
19/06/2022 10:26:37	52.2
19/06/2022 10:31:37	47.6
19/06/2022 10:36:37	48.4
19/06/2022 10:41:37	49.4
19/06/2022 10:46:37	57.3
19/06/2022 10:51:37	58
19/06/2022 10:56:37	57
19/06/2022 11:01:37	55.5
19/06/2022 11:06:37	56.4
19/06/2022 11:11:37	54.9
19/06/2022 11:16:37	53.8
19/06/2022 11:21:37	57.1
19/06/2022 11:26:37	55.9
19/06/2022 11:31:37	56.9
19/06/2022 11:36:37	54.6
19/06/2022 11:41:37	58.6
19/06/2022 11:46:37	50.5
19/06/2022 11:51:37	49.2
19/06/2022 11:56:37	52.3
19/06/2022 12:01:37	48
19/06/2022 12:06:37	51.1
19/06/2022 12:11:37	48.9
19/06/2022 12:16:37	48.5
19/06/2022 12:21:37	52.3
19/06/2022 12:26:37	45.1
19/06/2022 12:31:37	59.2
19/06/2022 12:36:37	48.7
19/06/2022 12:41:37	51.2
19/06/2022 12:46:37	47.2
19/06/2022 12:51:37	50.7

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
18/4/2022 12:55:00	68.5
18/4/2022 13:00:00	68.6
18/4/2022 13:05:00	66.3
18/4/2022 13:10:00	68
18/4/2022 13:15:00	68.7
18/4/2022 13:20:00	67.7
18/4/2022 13:25:00	67.4
18/4/2022 13:30:00	68.4
18/4/2022 13:35:00	69.9
18/4/2022 13:40:00	67.6
18/4/2022 13:45:00	67.1
18/4/2022 13:50:00	68.5
18/4/2022 13:55:00	67.9
18/4/2022 14:00:00	69.6
18/4/2022 14:05:00	68.6
18/4/2022 14:10:00	68.9
18/4/2022 14:15:00	67.7
18/4/2022 14:20:00	67.3
18/4/2022 14:25:00	68.7
18/4/2022 14:30:00	67.3
18/4/2022 14:35:00	69.8
18/4/2022 14:40:00	67.1
18/4/2022 14:45:00	70
18/4/2022 14:50:00	69.8
18/4/2022 14:55:00	67.4
Mon, 18/4/2022, 15:00	67
18/4/2022 15:05:00	66.2
18/4/2022 15:10:00	68.4
18/4/2022 15:15:00	67.3
18/4/2022 15:20:00	69.1
18/4/2022 15:25:00	67.6
18/4/2022 15:30:00	66.9
18/4/2022 15:35:00	68.5
18/4/2022 15:40:00	66.4
18/4/2022 15:45:00	68.3
18/4/2022 15:50:00	66.3
18/4/2022 15:55:00	66.9
18/4/2022 16:00:00	67.6
18/4/2022 16:05:00	67.2
18/4/2022 16:10:00	67.5
18/4/2022 16:15:00	68.2
18/4/2022 16:20:00	67
18/4/2022 16:25:00	68.4
18/4/2022 16:30:00	66.4
18/4/2022 16:35:00	67.6
18/4/2022 16:40:00	66.8
18/4/2022 16:45:00	67.2
18/4/2022 16:50:00	68.2
18/4/2022 16:55:00	72

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
19/06/2022 12:56:37	45.5
19/06/2022 13:01:37	54.3
19/06/2022 13:06:37	49.2
19/06/2022 13:11:37	49.2
19/06/2022 13:16:37	48.8
19/06/2022 13:21:37	51.7
19/06/2022 13:26:37	55
19/06/2022 13:31:37	48
19/06/2022 13:36:37	51.7
19/06/2022 13:41:37	52.4
19/06/2022 13:46:37	49.1
19/06/2022 13:51:37	51.4
19/06/2022 13:56:37	51
19/06/2022 14:01:37	49.9
19/06/2022 14:06:37	50.2
19/06/2022 14:11:37	47.2
19/06/2022 14:16:37	49.8
19/06/2022 14:21:37	50.4
19/06/2022 14:26:37	46.4
19/06/2022 14:31:37	48.9
19/06/2022 14:36:37	51.9
19/06/2022 14:41:37	53.1
19/06/2022 14:46:37	47.8
19/06/2022 14:51:37	45.8
19/06/2022 14:56:37	50.8
19/06/2022 15:01:37	47.6
19/06/2022 15:06:37	48.2
19/06/2022 15:11:37	46.7
19/06/2022 15:16:37	52.4
19/06/2022 15:21:37	47.9
19/06/2022 15:26:37	48.1
19/06/2022 15:31:37	48.2
19/06/2022 15:36:37	50.5
19/06/2022 15:41:37	50.2
19/06/2022 15:46:37	49.1
19/06/2022 15:51:37	49.1
19/06/2022 15:56:37	55.5
19/06/2022 16:01:37	48.3
19/06/2022 16:06:37	48.8
19/06/2022 16:11:37	61.1
19/06/2022 16:16:37	50.8
19/06/2022 16:21:37	50.4
19/06/2022 16:26:37	51.4
19/06/2022 16:31:37	50.1
19/06/2022 16:36:37	47.8
19/06/2022 16:41:37	48
19/06/2022 16:46:37	48.2
19/06/2022 16:51:37	47.8
19/06/2022 16:56:37	49.5

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
18/4/2022 17:00:00	68.4
18/4/2022 17:05:00	67.1
18/4/2022 17:10:00	68.4
18/4/2022 17:15:00	69.3
18/4/2022 17:20:00	68.3
18/4/2022 17:25:00	68.3
18/4/2022 17:30:00	67.9
18/4/2022 17:35:00	67.8
18/4/2022 17:40:00	68.8
18/4/2022 17:45:00	68.1
18/4/2022 17:50:00	67.7
18/4/2022 17:55:00	68.4
18/4/2022 18:00:00	69.2
18/4/2022 18:05:00	67.9
18/4/2022 18:10:00	68.9
18/4/2022 18:15:00	69.6
18/4/2022 18:20:00	69.2
18/4/2022 18:25:00	68.4
18/4/2022 18:30:00	68.5
18/4/2022 18:35:00	68.7
18/4/2022 18:40:00	68.1
18/4/2022 18:45:00	67.8
18/4/2022 18:50:00	68.5
18/4/2022 18:55:00	68.3
Mon, 18/4/2022, 19:00	67.3
18/4/2022 19:05:00	67.4
18/4/2022 19:10:00	68.5
18/4/2022 19:15:00	67.5
18/4/2022 19:20:00	65.8
18/4/2022 19:25:00	66.5
18/4/2022 19:30:00	67.8
18/4/2022 19:35:00	65.8
18/4/2022 19:40:00	66.3
18/4/2022 19:45:00	66.2
18/4/2022 19:50:00	65.5
18/4/2022 19:55:00	66.9
18/4/2022 20:00:00	67.6
18/4/2022 20:05:00	67.9
18/4/2022 20:10:00	64.2
18/4/2022 20:15:00	67.5
18/4/2022 20:20:00	65.6
18/4/2022 20:25:00	66.8
18/4/2022 20:30:00	65.9
18/4/2022 20:35:00	66.2
18/4/2022 20:40:00	64.9
18/4/2022 20:45:00	67.1
18/4/2022 20:50:00	64.6
18/4/2022 20:55:00	64.9
18/4/2022 21:00:00	65.4

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
19/06/2022 17:01:37	45.7
19/06/2022 17:06:37	48.9
19/06/2022 17:11:37	57.7
19/06/2022 17:16:37	52.9
19/06/2022 17:21:37	52.3
19/06/2022 17:26:37	51.2
19/06/2022 17:31:37	51.1
19/06/2022 17:36:37	50.8
19/06/2022 17:41:37	51.9
19/06/2022 17:46:37	47.1
19/06/2022 17:51:37	47.8
19/06/2022 17:56:37	45.6
19/06/2022 18:01:37	53.7
19/06/2022 18:06:37	43.9
19/06/2022 18:11:37	51.3
19/06/2022 18:16:37	47.7
19/06/2022 18:21:37	48.9
19/06/2022 18:26:37	50.2
19/06/2022 18:31:37	46.6
19/06/2022 18:36:37	54.8
19/06/2022 18:41:37	52.2
19/06/2022 18:46:37	52
19/06/2022 18:51:37	63.1
19/06/2022 18:56:37	62.8
19/06/2022 19:01:37	59.7
19/06/2022 19:06:37	61.1
19/06/2022 19:11:37	56.4
19/06/2022 19:16:37	54.7
19/06/2022 19:21:37	55.9
19/06/2022 19:26:37	61.9
19/06/2022 19:31:37	50
19/06/2022 19:36:37	61.6
19/06/2022 19:41:37	52.7
19/06/2022 19:46:37	55.8
19/06/2022 19:51:37	57
19/06/2022 19:56:37	59
19/06/2022 20:01:37	57.4
19/06/2022 20:06:37	59.6
19/06/2022 20:11:37	58.1
19/06/2022 20:16:37	59.3
19/06/2022 20:21:37	58.6
19/06/2022 20:26:37	58.7
19/06/2022 20:31:37	58.7
19/06/2022 20:36:37	59.3
19/06/2022 20:41:37	58.9
19/06/2022 20:46:37	58
19/06/2022 20:51:37	58.3
19/06/2022 20:56:37	59.8
19/06/2022 21:01:37	60.2

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
18/4/2022 21:05:00	65.6
18/4/2022 21:10:00	66.7
18/4/2022 21:15:00	65.2
18/4/2022 21:20:00	65.3
18/4/2022 21:25:00	65.6
18/4/2022 21:30:00	64.2
18/4/2022 21:35:00	65.1
18/4/2022 21:40:00	66.2
18/4/2022 21:45:00	64.5
18/4/2022 21:50:00	66.1
18/4/2022 21:55:00	64.8
18/4/2022 22:00:00	65.1
18/4/2022 22:05:00	64.5
18/4/2022 22:10:00	65.3
18/4/2022 22:15:00	63.9
18/4/2022 22:20:00	65.6
18/4/2022 22:25:00	65
18/4/2022 22:30:00	63.7
18/4/2022 22:35:00	65.2
18/4/2022 22:40:00	65
18/4/2022 22:45:00	64.1
18/4/2022 22:50:00	61.9
18/4/2022 22:55:00	65.9
18/4/2022 23:00:00	63.3
18/4/2022 23:05:00	61.9
18/4/2022 23:10:00	64.5
18/4/2022 23:15:00	63.2
18/4/2022 23:20:00	66
18/4/2022 23:25:00	63.3
18/4/2022 23:30:00	64.4
18/4/2022 23:35:00	62.3
18/4/2022 23:40:00	64.2
18/4/2022 23:45:00	62.7
18/4/2022 23:50:00	62.9
18/4/2022 23:55:00	62.2
18/4/2022 00:00:00	61.7
19/4/2022 00:05:00	62.3
19/4/2022 00:10:00	62
19/4/2022 00:15:00	60.3
19/4/2022 00:20:00	60.5
19/4/2022 00:25:00	58.6
19/4/2022 00:30:00	62.7
19/4/2022 00:35:00	60.2
19/4/2022 00:40:00	61.4
19/4/2022 00:45:00	61.2
19/4/2022 00:50:00	60.9
19/4/2022 00:55:00	58.3
19/4/2022 01:00:00	54.2
19/4/2022 01:05:00	57.9

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
19/06/2022 21:06:37	59.3
19/06/2022 21:11:37	54.8
19/06/2022 21:16:37	56.1
19/06/2022 21:21:37	54.8
19/06/2022 21:26:37	54.4
19/06/2022 21:31:37	53.3
19/06/2022 21:36:37	54.5
19/06/2022 21:41:37	50.3
19/06/2022 21:46:37	53.6
19/06/2022 21:51:37	51.3
19/06/2022 21:56:37	51.7
19/06/2022 22:01:37	52.1
19/06/2022 22:06:37	47.9
19/06/2022 22:11:37	47.4
19/06/2022 22:16:37	48.7
19/06/2022 22:21:37	47.3
19/06/2022 22:26:37	46.2
19/06/2022 22:31:37	47.3
19/06/2022 22:36:37	46.8
19/06/2022 22:41:37	46.7
19/06/2022 22:46:37	45.4
19/06/2022 22:51:37	43
19/06/2022 22:56:37	43.6
19/06/2022 23:01:37	44.8
19/06/2022 23:06:37	55.8
19/06/2022 23:11:37	56.8
19/06/2022 23:16:37	65.6
19/06/2022 23:21:37	74.1
19/06/2022 23:26:37	67.9
19/06/2022 23:31:37	64.9
19/06/2022 23:36:37	59.9
19/06/2022 23:41:37	57
19/06/2022 23:46:37	55.6
19/06/2022 23:51:37	52.7
19/06/2022 23:56:37	50.8
20/06/2022 00:01:37	52.7
20/06/2022 00:06:37	52.2
20/06/2022 00:11:37	55.9
20/06/2022 00:16:37	55.3
20/06/2022 00:21:37	53.8
20/06/2022 00:26:37	55.6
20/06/2022 00:31:37	58.4
20/06/2022 00:36:37	55.1
20/06/2022 00:41:37	55.1
20/06/2022 00:46:37	54.8
20/06/2022 00:51:37	54.2
20/06/2022 00:56:37	48.9
20/06/2022 01:01:37	50.1
20/06/2022 01:06:37	52

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
19/4/2022 01:10:00	59.5
19/4/2022 01:15:00	61.1
19/4/2022 01:20:00	58.9
19/4/2022 01:25:00	68.9
19/4/2022 01:30:00	58.7
19/4/2022 01:35:00	56.1
19/4/2022 01:40:00	58.5
19/4/2022 01:45:00	61.5
19/4/2022 01:50:00	59.6
19/4/2022 01:55:00	58.7
19/4/2022 02:00:00	60.1
19/4/2022 02:05:00	57.4
19/4/2022 02:10:00	60.3
19/4/2022 02:15:00	60.2
19/4/2022 02:20:00	58.9
19/4/2022 02:25:00	58.3
19/4/2022 02:30:00	57.9
19/4/2022 02:35:00	57.9
19/4/2022 02:40:00	56.3
19/4/2022 02:45:00	57.8
19/4/2022 02:50:00	60.7
19/4/2022 02:55:00	56.8
Tue, 19/4/2022, 03:00	57.3
19/4/2022 03:05:00	55.9
19/4/2022 03:10:00	55.9
19/4/2022 03:15:00	56
19/4/2022 03:20:00	58
19/4/2022 03:25:00	60.1
19/4/2022 03:30:00	55.2
19/4/2022 03:35:00	60.2
19/4/2022 03:40:00	56.4
19/4/2022 03:45:00	55.5
19/4/2022 03:50:00	59.1
19/4/2022 03:55:00	56.7
19/4/2022 04:00:00	58.5
19/4/2022 04:05:00	54.9
19/4/2022 04:10:00	58.3
19/4/2022 04:15:00	53.8
19/4/2022 04:20:00	59.3
19/4/2022 04:25:00	55.9
19/4/2022 04:30:00	57.7
19/4/2022 04:35:00	58
19/4/2022 04:40:00	56.3
19/4/2022 04:45:00	58.9
19/4/2022 04:50:00	59.1
19/4/2022 04:55:00	59.6
19/4/2022 05:00:00	59.1
19/4/2022 05:05:00	60.4
19/4/2022 05:10:00	57.6

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
20/06/2022 01:11:37	45.9
20/06/2022 01:16:37	46.3
20/06/2022 01:21:37	47.1
20/06/2022 01:26:37	46.6
20/06/2022 01:31:37	48.5
20/06/2022 01:36:37	45.4
20/06/2022 01:41:37	43
20/06/2022 01:46:37	45
20/06/2022 01:51:37	46.4
20/06/2022 01:56:37	43.9
20/06/2022 02:01:37	46
20/06/2022 02:06:37	47.5
20/06/2022 02:11:37	46.2
20/06/2022 02:16:37	58.3
20/06/2022 02:21:37	62.8
20/06/2022 02:26:37	75.6
20/06/2022 02:31:37	72.2
20/06/2022 02:36:37	68
20/06/2022 02:41:37	69.4
20/06/2022 02:46:37	75
20/06/2022 02:51:37	78.1
20/06/2022 02:56:37	75.6
20/06/2022 03:01:37	75.4
20/06/2022 03:06:37	73.2
20/06/2022 03:11:37	72.7
20/06/2022 03:16:37	70.1
20/06/2022 03:21:37	66.1
20/06/2022 03:26:37	64.2
20/06/2022 03:31:37	59
20/06/2022 03:36:37	58.9
20/06/2022 03:41:37	66.4
20/06/2022 03:46:37	57.9
20/06/2022 03:51:37	59.5
20/06/2022 03:56:37	57.6
20/06/2022 04:01:37	59
20/06/2022 04:06:37	60.9
20/06/2022 04:11:37	61.2
20/06/2022 04:16:37	61.3
20/06/2022 04:21:37	59.7
20/06/2022 04:26:37	59.5
20/06/2022 04:31:37	59.8
20/06/2022 04:36:37	60.8
20/06/2022 04:41:37	59.8
20/06/2022 04:46:37	55.6
20/06/2022 04:51:37	57.1
20/06/2022 04:56:37	54.4
20/06/2022 05:01:37	52.4
20/06/2022 05:06:37	50.6
20/06/2022 05:11:37	48.9

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
19/4/2022 05:15:00	59.4
19/4/2022 05:20:00	57.3
19/4/2022 05:25:00	60.9
19/4/2022 05:30:00	60.5
19/4/2022 05:35:00	61.3
19/4/2022 05:40:00	63.8
19/4/2022 05:45:00	64.5
19/4/2022 05:50:00	63.7
19/4/2022 05:55:00	64.2
19/4/2022 06:00:00	63.6
19/4/2022 06:05:00	63.6
19/4/2022 06:10:00	63.2
19/4/2022 06:15:00	63.8
19/4/2022 06:20:00	65.1
19/4/2022 06:25:00	64
19/4/2022 06:30:00	64.2
19/4/2022 06:35:00	64.8
19/4/2022 06:40:00	67.2
19/4/2022 06:45:00	66.5
19/4/2022 06:50:00	68.5
19/4/2022 06:55:00	69.5
Tue, 19/4/2022, 07:00	67.9
19/4/2022 07:05:00	68.7
19/4/2022 07:10:00	68.6
19/4/2022 07:15:00	68.7
19/4/2022 07:20:00	69.6
19/4/2022 07:25:00	69.8
19/4/2022 07:30:00	68.9
19/4/2022 07:35:00	70.5
19/4/2022 07:40:00	68.6
19/4/2022 07:45:00	68.6
19/4/2022 07:50:00	68.4
19/4/2022 07:55:00	68.4
19/4/2022 08:00:00	67.4
19/4/2022 08:05:00	67
19/4/2022 08:10:00	66.4
19/4/2022 08:15:00	67.3
19/4/2022 08:20:00	69.1
19/4/2022 08:25:00	69.9
19/4/2022 08:30:00	68.6
19/4/2022 08:35:00	68.4
19/4/2022 08:40:00	68.4
19/4/2022 08:45:00	70.1
19/4/2022 08:50:00	68.9
19/4/2022 08:55:00	71.1
19/4/2022 09:00:00	69.2
19/4/2022 09:05:00	67.5
19/4/2022 09:10:00	69.1
19/4/2022 09:15:00	69.3

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
20/06/2022 05:16:37	48.7
20/06/2022 05:21:37	47.5
20/06/2022 05:26:37	47.8
20/06/2022 05:31:37	47.3
20/06/2022 05:36:37	47.4
20/06/2022 05:41:37	49.8
20/06/2022 05:46:37	48.5
20/06/2022 05:51:37	49
20/06/2022 05:56:37	48.1
20/06/2022 06:01:37	56.6
20/06/2022 06:06:37	47.8
20/06/2022 06:11:37	48.1
20/06/2022 06:16:37	48.1
20/06/2022 06:21:37	51.7
20/06/2022 06:26:37	49.6
20/06/2022 06:31:37	51.7
20/06/2022 06:36:37	49.7
20/06/2022 06:41:37	51.3
20/06/2022 06:46:37	53
20/06/2022 06:51:37	52.5
20/06/2022 06:56:37	54
20/06/2022 07:01:37	53.2
20/06/2022 07:06:37	52.8
20/06/2022 07:11:37	54.8
20/06/2022 07:16:37	71.2
20/06/2022 07:21:37	65.7
20/06/2022 07:26:37	65.8
20/06/2022 07:31:37	76.6
20/06/2022 07:36:37	77.1
20/06/2022 07:41:37	74.7
20/06/2022 07:46:37	79.3
20/06/2022 07:51:37	75.9
20/06/2022 07:56:37	73.4
20/06/2022 08:01:37	73.7
20/06/2022 08:06:37	73
20/06/2022 08:11:37	66.9
20/06/2022 08:16:37	73.7
20/06/2022 08:21:37	61.2
20/06/2022 08:26:37	58.4
20/06/2022 08:31:37	56
20/06/2022 08:36:37	56.2
20/06/2022 08:41:37	54.3
20/06/2022 08:46:37	54.9
20/06/2022 08:51:37	57.6
20/06/2022 08:56:37	54.8
20/06/2022 09:01:37	56.5
20/06/2022 09:06:37	55.3
20/06/2022 09:11:37	59.4
20/06/2022 09:16:37	56

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
19/4/2022 09:20:00	69.3
19/4/2022 09:25:00	68.1
19/4/2022 09:30:00	67.8
19/4/2022 09:35:00	67.7
19/4/2022 09:40:00	67
19/4/2022 09:45:00	67.5
19/4/2022 09:50:00	67.2
19/4/2022 09:55:00	67.4
19/4/2022 10:00:00	66.7
19/4/2022 10:05:00	66.9
19/4/2022 10:10:00	67.5
19/4/2022 10:15:00	66.9
19/4/2022 10:20:00	67.6
19/4/2022 10:25:00	66.7
19/4/2022 10:30:00	65.8
19/4/2022 10:35:00	67.7
19/4/2022 10:40:00	67.2
19/4/2022 10:45:00	69.1
19/4/2022 10:50:00	67.3
19/4/2022 10:55:00	68.3
19/4/2022 11:00:00	67.4
19/4/2022 11:05:00	67.1
19/4/2022 11:10:00	68
19/4/2022 11:15:00	68.9
19/4/2022 11:20:00	67.9
19/4/2022 11:25:00	66.7
19/4/2022 11:30:00	66.6
19/4/2022 11:35:00	67.2
19/4/2022 11:40:00	67.9
19/4/2022 11:45:00	66.6
19/4/2022 11:50:00	67.3
19/4/2022 11:55:00	66.6
19/4/2022 12:00:00	68
19/4/2022 12:05:00	65.7
19/4/2022 12:10:00	68.3
19/4/2022 12:15:00	67.2
19/4/2022 12:20:00	66.7
19/4/2022 12:25:00	67.4
19/4/2022 12:30:00	66.4
19/4/2022 12:35:00	67.2
19/4/2022 12:40:00	67.4
19/4/2022 12:45:00	67.8
19/4/2022 12:50:00	66.2
19/4/2022 12:55:00	66.5
19/4/2022 13:00:00	66.8
19/4/2022 13:05:00	68.2
19/4/2022 13:10:00	65.2
19/4/2022 13:15:00	66.6
19/4/2022 13:20:00	67.7

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
20/06/2022 09:21:37	64.9
20/06/2022 09:26:37	56.2
20/06/2022 09:31:37	58.9
20/06/2022 09:36:37	54.8
20/06/2022 09:41:37	54
20/06/2022 09:46:37	57.8
20/06/2022 09:51:37	60.5
20/06/2022 09:56:37	54.2
20/06/2022 10:01:37	57.3
20/06/2022 10:06:37	59.4
20/06/2022 10:11:37	59.1
20/06/2022 10:16:37	62.2
20/06/2022 10:21:37	61.3
20/06/2022 10:26:37	63.1
20/06/2022 10:31:37	65.1
20/06/2022 10:36:37	65.4
20/06/2022 10:41:37	67.5
20/06/2022 10:46:37	62.8
20/06/2022 10:51:37	62
20/06/2022 10:56:37	68
20/06/2022 11:01:37	60
20/06/2022 11:06:37	59.6
20/06/2022 11:11:37	62.5
20/06/2022 11:16:37	58.6
20/06/2022 11:21:37	56.4
20/06/2022 11:26:37	57.1
20/06/2022 11:31:37	54.8
20/06/2022 11:36:37	56
20/06/2022 11:41:37	55
20/06/2022 11:46:37	54.1
20/06/2022 11:51:37	53
20/06/2022 11:56:37	56.9
20/06/2022 12:01:37	53.3
20/06/2022 12:06:37	54.6
20/06/2022 12:11:37	53.5
20/06/2022 12:16:37	56
20/06/2022 12:21:37	53
20/06/2022 12:26:37	54.5
20/06/2022 12:31:37	50.8
20/06/2022 12:36:37	54.6
20/06/2022 12:41:37	50.6
20/06/2022 12:46:37	49.7
20/06/2022 12:51:37	55
20/06/2022 12:56:37	57.5
20/06/2022 13:01:37	52.9
20/06/2022 13:06:37	57.3
20/06/2022 13:11:37	52.4
20/06/2022 13:16:37	63.4
20/06/2022 13:21:37	52.2

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
19/4/2022 13:25:00	66.8
19/4/2022 13:30:00	66.5
19/4/2022 13:35:00	68.8
19/4/2022 13:40:00	74.2
19/4/2022 13:45:00	74
19/4/2022 13:50:00	76.1
19/4/2022 13:55:00	72.9
19/4/2022 14:00:00	71.4
19/4/2022 14:05:00	69.4
19/4/2022 14:10:00	69.2
19/4/2022 14:15:00	69.2
19/4/2022 14:20:00	69.2
19/4/2022 14:25:00	69.5
19/4/2022 14:30:00	67.5
19/4/2022 14:35:00	68.5
19/4/2022 14:40:00	67.7
19/4/2022 14:45:00	67.6
19/4/2022 14:50:00	68
19/4/2022 14:55:00	68.5
Tue, 19/4/2022, 15:00	66.5
19/4/2022 15:05:00	66.7
19/4/2022 15:10:00	68.7
19/4/2022 15:15:00	68.4
19/4/2022 15:20:00	68.4
19/4/2022 15:25:00	67.5
19/4/2022 15:30:00	68.4
19/4/2022 15:35:00	67.2
19/4/2022 15:40:00	67.1
19/4/2022 15:45:00	68.9
19/4/2022 15:50:00	67.2
19/4/2022 15:55:00	66.7
19/4/2022 16:00:00	67.4
19/4/2022 16:05:00	67.3
19/4/2022 16:10:00	66.8
19/4/2022 16:15:00	67.2
19/4/2022 16:20:00	66.8
19/4/2022 16:25:00	68
19/4/2022 16:30:00	68.8
19/4/2022 16:35:00	66.9
19/4/2022 16:40:00	68.3
19/4/2022 16:45:00	68.2
19/4/2022 16:50:00	67.6
19/4/2022 16:55:00	69
19/4/2022 17:00:00	68.7
19/4/2022 17:05:00	69.1
19/4/2022 17:10:00	70.4
19/4/2022 17:15:00	68.9
19/4/2022 17:20:00	70.2
19/4/2022 17:25:00	70.3

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
20/06/2022 13:26:37	55.1
20/06/2022 13:31:37	59.4
20/06/2022 13:36:37	63.3
20/06/2022 13:41:37	50.5
20/06/2022 13:46:37	52.3
20/06/2022 13:51:37	55.2
20/06/2022 13:56:37	51.7
20/06/2022 14:01:37	52
20/06/2022 14:06:37	74.4
20/06/2022 14:11:37	53.5
20/06/2022 14:16:37	58.7
20/06/2022 14:21:37	48.3
20/06/2022 14:26:37	50.1
20/06/2022 14:31:37	51.1
20/06/2022 14:36:37	48.9
20/06/2022 14:41:37	51.4
20/06/2022 14:46:37	54.4
20/06/2022 14:51:37	49.9
20/06/2022 14:56:37	49.3
20/06/2022 15:01:37	49.5
20/06/2022 15:06:37	49.9
20/06/2022 15:11:37	49.2
20/06/2022 15:16:37	50.4
20/06/2022 15:21:37	50.3
20/06/2022 15:26:37	52.1
20/06/2022 15:31:37	52.4
20/06/2022 15:36:37	50.5
20/06/2022 15:41:37	51.2
20/06/2022 15:46:37	50.8
20/06/2022 15:51:37	51
20/06/2022 15:56:37	52.2
20/06/2022 16:01:37	53.9
20/06/2022 16:06:37	53.4
20/06/2022 16:11:37	52.9
20/06/2022 16:16:37	49.1
20/06/2022 16:21:37	52.1
20/06/2022 16:26:37	52.8
20/06/2022 16:31:37	57.1
20/06/2022 16:36:37	52.8
20/06/2022 16:41:37	52.9
20/06/2022 16:46:37	51.3
20/06/2022 16:51:37	46.7
20/06/2022 16:56:37	52.5
20/06/2022 17:01:37	53.5
20/06/2022 17:06:37	50.3
20/06/2022 17:11:37	50.3
20/06/2022 17:16:37	53.5
20/06/2022 17:21:37	52.7
20/06/2022 17:26:37	58.8

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
19/4/2022 17:30:00	70
19/4/2022 17:35:00	70
19/4/2022 17:40:00	69.4
19/4/2022 17:45:00	70.4
19/4/2022 17:50:00	69.2
19/4/2022 17:55:00	69.4
19/4/2022 18:00:00	70.4
19/4/2022 18:05:00	69.9
19/4/2022 18:10:00	69.7
19/4/2022 18:15:00	70
19/4/2022 18:20:00	71.5
19/4/2022 18:25:00	70.3
19/4/2022 18:30:00	71.2
19/4/2022 18:35:00	71.5
19/4/2022 18:40:00	70.7
19/4/2022 18:45:00	69.8
19/4/2022 18:50:00	70
19/4/2022 18:55:00	70.6
Tue, 19/4/2022, 19:00	68.6
19/4/2022 19:05:00	69.2
19/4/2022 19:10:00	68.5
19/4/2022 19:15:00	68.7
19/4/2022 19:20:00	69
19/4/2022 19:25:00	69.6
19/4/2022 19:30:00	69.8
19/4/2022 19:35:00	68.7
19/4/2022 19:40:00	69.3
19/4/2022 19:45:00	69.8
19/4/2022 19:50:00	68.4
19/4/2022 19:55:00	68.6
19/4/2022 20:00:00	69.8
19/4/2022 20:05:00	67.8
19/4/2022 20:10:00	67.6
19/4/2022 20:15:00	70.7
19/4/2022 20:20:00	66.2
19/4/2022 20:25:00	67
19/4/2022 20:30:00	67
19/4/2022 20:35:00	67.9
19/4/2022 20:40:00	70.7
19/4/2022 20:45:00	67
19/4/2022 20:50:00	68
19/4/2022 20:55:00	66
19/4/2022 21:00:00	66.1
19/4/2022 21:05:00	66.9
19/4/2022 21:10:00	66.6
19/4/2022 21:15:00	66.5
19/4/2022 21:20:00	65.3
19/4/2022 21:25:00	65.6
19/4/2022 21:30:00	66.2

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
20/06/2022 17:31:37	53
20/06/2022 17:36:37	48.3
20/06/2022 17:41:37	57
20/06/2022 17:46:37	51.6
20/06/2022 17:51:37	49.4
20/06/2022 17:56:37	48.4
20/06/2022 18:01:37	50.7
20/06/2022 18:06:37	53.1
20/06/2022 18:11:37	48
20/06/2022 18:16:37	57.4
20/06/2022 18:21:37	48.2
20/06/2022 18:26:37	53.3
20/06/2022 18:31:37	53.6
20/06/2022 18:36:37	48.3
20/06/2022 18:41:37	50.1
20/06/2022 18:46:37	50.1
20/06/2022 18:51:37	46.7
20/06/2022 18:56:37	53.2
20/06/2022 19:01:37	48.2
20/06/2022 19:06:37	54.5
20/06/2022 19:11:37	48.2
20/06/2022 19:16:37	65.7
20/06/2022 19:21:37	60.5
20/06/2022 19:26:37	69
20/06/2022 19:31:37	50.6
20/06/2022 19:36:37	63.8
20/06/2022 19:41:37	49.8
20/06/2022 19:46:37	55.9
20/06/2022 19:51:37	57.9
20/06/2022 19:56:37	69.3
20/06/2022 20:01:37	63.9
20/06/2022 20:06:37	60
20/06/2022 20:11:37	60.4
20/06/2022 20:16:37	59.6
20/06/2022 20:21:37	57.1
20/06/2022 20:26:37	58.3
20/06/2022 20:31:37	56.9
20/06/2022 20:36:37	56.2
20/06/2022 20:41:37	56.3
20/06/2022 20:46:37	55.1
20/06/2022 20:51:37	58.1
20/06/2022 20:56:37	55.1
20/06/2022 21:01:37	52.2
20/06/2022 21:06:37	52.1
20/06/2022 21:11:37	54.3
20/06/2022 21:16:37	57.1
20/06/2022 21:21:37	56.6
20/06/2022 21:26:37	56.1
20/06/2022 21:31:37	56.1

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
19/4/2022 21:35:00	66.5
19/4/2022 21:40:00	66.9
19/4/2022 21:45:00	66.2
19/4/2022 21:50:00	66.7
19/4/2022 21:55:00	65.6
19/4/2022 22:00:00	66.3
19/4/2022 22:05:00	66.5
19/4/2022 22:10:00	66.2
19/4/2022 22:15:00	66.1
19/4/2022 22:20:00	65.8
19/4/2022 22:25:00	66.2
19/4/2022 22:30:00	64.3
19/4/2022 22:35:00	65.4
19/4/2022 22:40:00	65.9
19/4/2022 22:45:00	64.3
19/4/2022 22:50:00	65.1
19/4/2022 22:55:00	63
19/4/2022 23:00:00	64.3
19/4/2022 23:05:00	64.4
19/4/2022 23:10:00	71
19/4/2022 23:15:00	62.9
19/4/2022 23:20:00	64
19/4/2022 23:25:00	63.3
19/4/2022 23:30:00	64.6
19/4/2022 23:35:00	63.3
19/4/2022 23:40:00	64
19/4/2022 23:45:00	62
19/4/2022 23:50:00	64.4
19/4/2022 23:55:00	62.7
19/4/2022 00:00:00	61.6
20/4/2022 00:05:00	64.9
20/4/2022 00:10:00	61.4
20/4/2022 00:15:00	62
20/4/2022 00:20:00	62.6
20/4/2022 00:25:00	61.2
20/4/2022 00:30:00	60.8
20/4/2022 00:35:00	60.1
20/4/2022 00:40:00	61.9
20/4/2022 00:45:00	61.5
20/4/2022 00:50:00	62.4
20/4/2022 00:55:00	58.7
20/4/2022 01:00:00	58.7
20/4/2022 01:05:00	59.4
20/4/2022 01:10:00	59.9
20/4/2022 01:15:00	59.7
20/4/2022 01:20:00	60.3
20/4/2022 01:25:00	57.3
20/4/2022 01:30:00	58
20/4/2022 01:35:00	57.8

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
20/06/2022 21:36:37	56.1
20/06/2022 21:41:37	56.5
20/06/2022 21:46:37	56.2
20/06/2022 21:51:37	56
20/06/2022 21:56:37	56.2
20/06/2022 22:01:37	55.7
20/06/2022 22:06:37	55.9
20/06/2022 22:11:37	55.7
20/06/2022 22:16:37	56.2
20/06/2022 22:21:37	55.1
20/06/2022 22:26:37	55.5
20/06/2022 22:31:37	56.1
20/06/2022 22:36:37	55.6
20/06/2022 22:41:37	55.3
20/06/2022 22:46:37	58
20/06/2022 22:51:37	55.3
20/06/2022 22:56:37	55.3
20/06/2022 23:01:37	54.9
20/06/2022 23:06:37	55.6
20/06/2022 23:11:37	55
20/06/2022 23:16:37	54.8
20/06/2022 23:21:37	55.2
20/06/2022 23:26:37	54.8
20/06/2022 23:31:37	55.5
20/06/2022 23:36:37	56.2
20/06/2022 23:41:37	55.1
20/06/2022 23:46:37	59
20/06/2022 23:51:37	54.5
20/06/2022 23:56:37	54.5
21/06/2022 00:01:37	54.2
21/06/2022 00:06:37	53
21/06/2022 00:11:37	46
21/06/2022 00:16:37	45.9
21/06/2022 00:21:37	48.2
21/06/2022 00:26:37	46.1
21/06/2022 00:31:37	46.1
21/06/2022 00:36:37	45.7
21/06/2022 00:41:37	46.5
21/06/2022 00:46:37	47.4
21/06/2022 00:51:37	46.1
21/06/2022 00:56:37	46.3
21/06/2022 01:01:37	46.2
21/06/2022 01:06:37	47
21/06/2022 01:11:37	47.1
21/06/2022 01:16:37	46.6
21/06/2022 01:21:37	49
21/06/2022 01:26:37	46.5
21/06/2022 01:31:37	46.4
21/06/2022 01:36:37	46.3

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
20/4/2022 01:40:00	58.3
20/4/2022 01:45:00	57.4
20/4/2022 01:50:00	56.3
20/4/2022 01:55:00	60.7
20/4/2022 02:00:00	62.2
20/4/2022 02:05:00	56.6
20/4/2022 02:10:00	61.1
20/4/2022 02:15:00	56.5
20/4/2022 02:20:00	55
20/4/2022 02:25:00	58.5
20/4/2022 02:30:00	58.9
20/4/2022 02:35:00	56.2
20/4/2022 02:40:00	59.8
20/4/2022 02:45:00	64.1
20/4/2022 02:50:00	56.8
20/4/2022 02:55:00	57.3
Wed, 20/4/2022, 03:00	60
20/4/2022 03:05:00	62.9
20/4/2022 03:10:00	60.5
20/4/2022 03:15:00	61.3
20/4/2022 03:20:00	60.4
20/4/2022 03:25:00	56.7
20/4/2022 03:30:00	55.1
20/4/2022 03:35:00	56.1
20/4/2022 03:40:00	57.9
20/4/2022 03:45:00	54.4
20/4/2022 03:50:00	55.7
20/4/2022 03:55:00	57.9
20/4/2022 04:00:00	55.4
20/4/2022 04:05:00	62.3
20/4/2022 04:10:00	56.5
20/4/2022 04:15:00	56.8
20/4/2022 04:20:00	59.1
20/4/2022 04:25:00	58.3
20/4/2022 04:30:00	59.5
20/4/2022 04:35:00	56.9
20/4/2022 04:40:00	59.1
20/4/2022 04:45:00	58.8
20/4/2022 04:50:00	55.6
20/4/2022 04:55:00	60.1
20/4/2022 05:00:00	61.5
20/4/2022 05:05:00	60.5
20/4/2022 05:10:00	56.2
20/4/2022 05:15:00	59.1
20/4/2022 05:20:00	60.9
20/4/2022 05:25:00	56.1
20/4/2022 05:30:00	59.4
20/4/2022 05:35:00	60.6
20/4/2022 05:40:00	62.7

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
21/06/2022 01:41:37	47.3
21/06/2022 01:46:37	45.7
21/06/2022 01:51:37	46
21/06/2022 01:56:37	45.8
21/06/2022 02:01:37	50.3
21/06/2022 02:06:37	46.8
21/06/2022 02:11:37	45.7
21/06/2022 02:16:37	46.1
21/06/2022 02:21:37	46
21/06/2022 02:26:37	48.8
21/06/2022 02:31:37	46
21/06/2022 02:36:37	46.2
21/06/2022 02:41:37	44.6
21/06/2022 02:46:37	43.7
21/06/2022 02:51:37	44.7
21/06/2022 02:56:37	44.6
21/06/2022 03:01:37	43.8
21/06/2022 03:06:37	46.5
21/06/2022 03:11:37	45.1
21/06/2022 03:16:37	44.3
21/06/2022 03:21:37	43.9
21/06/2022 03:26:37	44.4
21/06/2022 03:31:37	47.8
21/06/2022 03:36:37	43.6
21/06/2022 03:41:37	44.1
21/06/2022 03:46:37	42.2
21/06/2022 03:51:37	45.4
21/06/2022 03:56:37	42.7
21/06/2022 04:01:37	44.7
21/06/2022 04:06:37	44.1
21/06/2022 04:11:37	44
21/06/2022 04:16:37	43.3
21/06/2022 04:21:37	41.4
21/06/2022 04:26:37	45.8
21/06/2022 04:31:37	44.8
21/06/2022 04:36:37	45.5
21/06/2022 04:41:37	47
21/06/2022 04:46:37	46.7
21/06/2022 04:51:37	45.9
21/06/2022 04:56:37	47.2
21/06/2022 05:01:37	46.4
21/06/2022 05:06:37	45.6
21/06/2022 05:11:37	45.5
21/06/2022 05:16:37	46.8
21/06/2022 05:21:37	46.7
21/06/2022 05:26:37	47.3
21/06/2022 05:31:37	47.6
21/06/2022 05:36:37	46.8
21/06/2022 05:41:37	49.7

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
20/4/2022 05:45:00	64
20/4/2022 05:50:00	65.1
20/4/2022 05:55:00	64.6
20/4/2022 06:00:00	64.5
20/4/2022 06:05:00	64.5
20/4/2022 06:10:00	65.1
20/4/2022 06:15:00	64.8
20/4/2022 06:20:00	63.7
20/4/2022 06:25:00	65.7
20/4/2022 06:30:00	65.8
20/4/2022 06:35:00	65.2
20/4/2022 06:40:00	67.2
20/4/2022 06:45:00	67.6
20/4/2022 06:50:00	68.4
20/4/2022 06:55:00	68.4
Wed, 20/4/2022, 07:00	68.9
20/4/2022 07:05:00	69.3
20/4/2022 07:10:00	69.4
20/4/2022 07:15:00	69.9
20/4/2022 07:20:00	69.4
20/4/2022 07:25:00	69.2
20/4/2022 07:30:00	68.9
20/4/2022 07:35:00	69.1
20/4/2022 07:40:00	69.2
20/4/2022 07:45:00	68
20/4/2022 07:50:00	69.1
20/4/2022 07:55:00	69
20/4/2022 08:00:00	69.4
20/4/2022 08:05:00	69.1
20/4/2022 08:10:00	68.6
20/4/2022 08:15:00	68.3
20/4/2022 08:20:00	68
20/4/2022 08:25:00	66.9
20/4/2022 08:30:00	66.7
20/4/2022 08:35:00	67.7
20/4/2022 08:40:00	68.5
20/4/2022 08:45:00	68.2
20/4/2022 08:50:00	68.7
20/4/2022 08:55:00	68.4
20/4/2022 09:00:00	69.2
20/4/2022 09:05:00	68.6
20/4/2022 09:10:00	69.4
20/4/2022 09:15:00	69.4
20/4/2022 09:20:00	70.7
20/4/2022 09:25:00	67.7
20/4/2022 09:30:00	68.2
20/4/2022 09:35:00	68.3
20/4/2022 09:40:00	68.9
20/4/2022 09:45:00	69.3

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
21/06/2022 05:46:37	46.6
21/06/2022 05:51:37	47.1
21/06/2022 05:56:37	49.3
21/06/2022 06:01:37	49.4
21/06/2022 06:06:37	47.4
21/06/2022 06:11:37	49.8
21/06/2022 06:16:37	50.2
21/06/2022 06:21:37	50.9
21/06/2022 06:26:37	49.8
21/06/2022 06:31:37	50.8
21/06/2022 06:36:37	50.8
21/06/2022 06:41:37	57.1
21/06/2022 06:46:37	53.6
21/06/2022 06:51:37	56.9
21/06/2022 06:56:37	52.7
21/06/2022 07:01:37	53.8
21/06/2022 07:06:37	54.9
21/06/2022 07:11:37	52
21/06/2022 07:16:37	52.2
21/06/2022 07:21:37	58.3
21/06/2022 07:26:37	52
21/06/2022 07:31:37	51.8
21/06/2022 07:36:37	53.2
21/06/2022 07:41:37	49.8
21/06/2022 07:46:37	51.4
21/06/2022 07:51:37	54.4
21/06/2022 07:56:37	51.8
21/06/2022 08:01:37	52.1
21/06/2022 08:06:37	54.4
21/06/2022 08:11:37	48.8
21/06/2022 08:16:37	51.9
21/06/2022 08:21:37	50.5
21/06/2022 08:26:37	51.9
21/06/2022 08:31:37	49.4
21/06/2022 08:36:37	51.1
21/06/2022 08:41:37	56
21/06/2022 08:46:37	50.4
21/06/2022 08:51:37	60.5
21/06/2022 08:56:37	53.4
21/06/2022 09:01:37	50.3
21/06/2022 09:06:37	51.7
21/06/2022 09:11:37	50.3
21/06/2022 09:16:37	50.9
21/06/2022 09:21:37	48.6
21/06/2022 09:26:37	60
21/06/2022 09:31:37	57.1
21/06/2022 09:36:37	61.1
21/06/2022 09:41:37	75.2
21/06/2022 09:46:37	70.7

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
20/4/2022 09:50:00	70.2
20/4/2022 09:55:00	67.2
20/4/2022 10:00:00	68.4
20/4/2022 10:05:00	67.6
20/4/2022 10:10:00	69.1
20/4/2022 10:15:00	67.7
20/4/2022 10:20:00	68.7
20/4/2022 10:25:00	69.6
20/4/2022 10:30:00	67.2
20/4/2022 10:35:00	68
20/4/2022 10:40:00	67
20/4/2022 10:45:00	68.4
20/4/2022 10:50:00	67.4
20/4/2022 10:55:00	67.7
20/4/2022 11:00:00	67.5
20/4/2022 11:05:00	67.6
20/4/2022 11:10:00	67.2
20/4/2022 11:15:00	67.7
20/4/2022 11:20:00	67.6
20/4/2022 11:25:00	67.5
20/4/2022 11:30:00	66.8
20/4/2022 11:35:00	66.8
20/4/2022 11:40:00	66.9
20/4/2022 11:45:00	67.6
20/4/2022 11:50:00	67.5
20/4/2022 11:55:00	66.6
20/4/2022 12:00:00	66.7
20/4/2022 12:05:00	67.9
20/4/2022 12:10:00	66.4
20/4/2022 12:15:00	68.9
20/4/2022 12:20:00	67.9
20/4/2022 12:25:00	67.4
20/4/2022 12:30:00	66.1
20/4/2022 12:35:00	66.4
20/4/2022 12:40:00	67.5
20/4/2022 12:45:00	66.5
20/4/2022 12:50:00	67.6
20/4/2022 12:55:00	67.7
20/4/2022 13:00:00	66.4
20/4/2022 13:05:00	69.9
20/4/2022 13:10:00	66.8
20/4/2022 13:15:00	66.9
20/4/2022 13:20:00	68.5
20/4/2022 13:25:00	67.9
20/4/2022 13:30:00	70.8
20/4/2022 13:35:00	68.2
20/4/2022 13:40:00	66.2
20/4/2022 13:45:00	66.8
20/4/2022 13:50:00	68.4

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
21/06/2022 09:51:37	60.7
21/06/2022 09:56:37	57.1
21/06/2022 10:01:37	55.7
21/06/2022 10:06:37	56.5
21/06/2022 10:11:37	69.6
21/06/2022 10:16:37	64.9
21/06/2022 10:21:37	67.1
21/06/2022 10:26:37	64.9
21/06/2022 10:31:37	62.5
21/06/2022 10:36:37	59.5
21/06/2022 10:41:37	61.7
21/06/2022 10:46:37	57.7
21/06/2022 10:51:37	55.9
21/06/2022 10:56:37	57.3
21/06/2022 11:01:37	60.9
21/06/2022 11:06:37	59
21/06/2022 11:11:37	56
21/06/2022 11:16:37	53.4
21/06/2022 11:21:37	51.1
21/06/2022 11:26:37	51.9
21/06/2022 11:31:37	52
21/06/2022 11:36:37	55.4
21/06/2022 11:41:37	47.5
21/06/2022 11:46:37	51.1
21/06/2022 11:51:37	50.2
21/06/2022 11:56:37	49.6
21/06/2022 12:01:37	51.5
21/06/2022 12:06:37	50.2
21/06/2022 12:11:37	50.8
21/06/2022 12:16:37	49.5
21/06/2022 12:21:37	48.3
21/06/2022 12:26:37	49.7
21/06/2022 12:31:37	48.5
21/06/2022 12:36:37	50.5
21/06/2022 12:41:37	51.3
21/06/2022 12:46:37	52.8
21/06/2022 12:51:37	48.7
21/06/2022 12:56:37	54.3
21/06/2022 13:01:37	54.2
21/06/2022 13:06:37	51.1
21/06/2022 13:11:37	50.3
21/06/2022 13:16:37	56.5
21/06/2022 13:21:37	63.3
21/06/2022 13:26:37	49.2
21/06/2022 13:31:37	48
21/06/2022 13:36:37	49.9
21/06/2022 13:41:37	50
21/06/2022 13:46:37	50.8
21/06/2022 13:51:37	49.3

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
20/4/2022 13:55:00	67.6
20/4/2022 14:00:00	66.2
20/4/2022 14:05:00	66.5
20/4/2022 14:10:00	67.2
20/4/2022 14:15:00	67.1
20/4/2022 14:20:00	66.9
20/4/2022 14:25:00	67.1
20/4/2022 14:30:00	69.4
20/4/2022 14:35:00	67.4
20/4/2022 14:40:00	67.3
20/4/2022 14:45:00	66.9
20/4/2022 14:50:00	66.5
20/4/2022 14:55:00	67.3
Wed, 20/4/2022, 15:00	67.7
20/4/2022 15:05:00	66.6
20/4/2022 15:10:00	66.5
20/4/2022 15:15:00	67.7
20/4/2022 15:20:00	66.9
20/4/2022 15:25:00	68.3
20/4/2022 15:30:00	67.4
20/4/2022 15:35:00	67
20/4/2022 15:40:00	65.7
20/4/2022 15:45:00	66.5
20/4/2022 15:50:00	66.4
20/4/2022 15:55:00	66.3
20/4/2022 16:00:00	67.2
20/4/2022 16:05:00	67.2
20/4/2022 16:10:00	67.3
20/4/2022 16:15:00	67.8
20/4/2022 16:20:00	67.4
20/4/2022 16:25:00	67.1
20/4/2022 16:30:00	67.5
20/4/2022 16:35:00	67.2
20/4/2022 16:40:00	67.2
20/4/2022 16:45:00	67.7
20/4/2022 16:50:00	68.3
20/4/2022 16:55:00	67.2
20/4/2022 17:00:00	69
20/4/2022 17:05:00	69.9
20/4/2022 17:10:00	68.6
20/4/2022 17:15:00	68
20/4/2022 17:20:00	68.3
20/4/2022 17:25:00	68.6
20/4/2022 17:30:00	69.2
20/4/2022 17:35:00	68.7
20/4/2022 17:40:00	69.4
20/4/2022 17:45:00	68.5
20/4/2022 17:50:00	68.5
20/4/2022 17:55:00	69.6

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
21/06/2022 13:56:37	47.2
21/06/2022 14:01:37	51.6
21/06/2022 14:06:37	50.3
21/06/2022 14:11:37	47
21/06/2022 14:16:37	47
21/06/2022 14:21:37	49.7
21/06/2022 14:26:37	56.7
21/06/2022 14:31:37	50.6
21/06/2022 14:36:37	45.5
21/06/2022 14:41:37	48.4
21/06/2022 14:46:37	54.8
21/06/2022 14:51:37	49
21/06/2022 14:56:37	50.9
21/06/2022 15:01:37	55.8
21/06/2022 15:06:37	46.8
21/06/2022 15:11:37	58.1
21/06/2022 15:16:37	51.1
21/06/2022 15:21:37	49.4
21/06/2022 15:26:37	53
21/06/2022 15:31:37	48.9
21/06/2022 15:36:37	49.8
21/06/2022 15:41:37	50.6
21/06/2022 15:46:37	48.1
21/06/2022 15:51:37	50.1
21/06/2022 15:56:37	54.3
21/06/2022 16:01:37	54
21/06/2022 16:06:37	50.4
21/06/2022 16:11:37	49.3
21/06/2022 16:16:37	54.6
21/06/2022 16:21:37	54
21/06/2022 16:26:37	51.4
21/06/2022 16:31:37	51.6
21/06/2022 16:36:37	52.3
21/06/2022 16:41:37	55.3
21/06/2022 16:46:37	57.2
21/06/2022 16:51:37	52.3
21/06/2022 16:56:37	50.1
21/06/2022 17:01:37	55.9
21/06/2022 17:06:37	46.1
21/06/2022 17:11:37	49.8
21/06/2022 17:16:37	55.6
21/06/2022 17:21:37	51
21/06/2022 17:26:37	49.6
21/06/2022 17:31:37	49.6
21/06/2022 17:36:37	54.1
21/06/2022 17:41:37	49.6
21/06/2022 17:46:37	58.5
21/06/2022 17:51:37	50.2
21/06/2022 17:56:37	49.9

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
20/4/2022 18:00:00	69.2
20/4/2022 18:05:00	68.2
20/4/2022 18:10:00	69.1
20/4/2022 18:15:00	70.8
20/4/2022 18:20:00	69.3
20/4/2022 18:25:00	68.9
20/4/2022 18:30:00	69.6
20/4/2022 18:35:00	70.5
20/4/2022 18:40:00	69.2
20/4/2022 18:45:00	68.4
20/4/2022 18:50:00	67.9
20/4/2022 18:55:00	68.7
Wed, 20/4/2022, 19:00	68.9
20/4/2022 19:05:00	68.4
20/4/2022 19:10:00	68
20/4/2022 19:15:00	67
20/4/2022 19:20:00	67.6
20/4/2022 19:25:00	67
20/4/2022 19:30:00	67
20/4/2022 19:35:00	66.1
20/4/2022 19:40:00	66.8
20/4/2022 19:45:00	67
20/4/2022 19:50:00	66.4
20/4/2022 19:55:00	66.7
20/4/2022 20:00:00	66.2
20/4/2022 20:05:00	67.1
20/4/2022 20:10:00	68.6
20/4/2022 20:15:00	66.4
20/4/2022 20:20:00	65.1
20/4/2022 20:25:00	65.5
20/4/2022 20:30:00	65.2
20/4/2022 20:35:00	65.5
20/4/2022 20:40:00	65.5
20/4/2022 20:45:00	66.6
20/4/2022 20:50:00	65.5
20/4/2022 20:55:00	64.2
20/4/2022 21:00:00	66.7
20/4/2022 21:05:00	66.4
20/4/2022 21:10:00	68.2
20/4/2022 21:15:00	65.4
20/4/2022 21:20:00	67.1
20/4/2022 21:25:00	65
20/4/2022 21:30:00	66.1
20/4/2022 21:35:00	65
20/4/2022 21:40:00	65.2
20/4/2022 21:45:00	64.3
20/4/2022 21:50:00	65.2
20/4/2022 21:55:00	64.9
20/4/2022 22:00:00	64.6

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
21/06/2022 18:01:37	49.6
21/06/2022 18:06:37	50.5
21/06/2022 18:11:37	50.5
21/06/2022 18:16:37	52.5
21/06/2022 18:21:37	58.1
21/06/2022 18:26:37	51.1
21/06/2022 18:31:37	52
21/06/2022 18:36:37	52
21/06/2022 18:41:37	50.1
21/06/2022 18:46:37	49.4
21/06/2022 18:51:37	51.5
21/06/2022 18:56:37	48.4
21/06/2022 19:01:37	47.9
21/06/2022 19:06:37	54.5
21/06/2022 19:11:37	53.1
21/06/2022 19:16:37	50.6
21/06/2022 19:21:37	53.6
21/06/2022 19:26:37	52.3
21/06/2022 19:31:37	51.7
21/06/2022 19:36:37	50.5
21/06/2022 19:41:37	54.2
21/06/2022 19:46:37	71.5
21/06/2022 19:51:37	54.1
21/06/2022 19:56:37	61.2
21/06/2022 20:01:37	64.4
21/06/2022 20:06:37	57.4
21/06/2022 20:11:37	57.8
21/06/2022 20:16:37	57.6
21/06/2022 20:21:37	58.7
21/06/2022 20:26:37	58.0
21/06/2022 20:31:37	57.9
21/06/2022 20:36:37	57.0
21/06/2022 20:41:37	58.6
21/06/2022 20:46:37	54.2
21/06/2022 20:51:37	54.2
21/06/2022 20:56:37	54.6
21/06/2022 21:01:37	56.8
21/06/2022 21:06:37	52.6
21/06/2022 21:11:37	57.8
21/06/2022 21:16:37	53.9
21/06/2022 21:21:37	53.5
21/06/2022 21:26:37	53.7
21/06/2022 21:31:37	53.1
21/06/2022 21:36:37	53.2
21/06/2022 21:41:37	50.9
21/06/2022 21:46:37	58.2
21/06/2022 21:51:37	57.9
21/06/2022 21:56:37	57.8
21/06/2022 22:01:37	58.2

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
20/4/2022 22:05:00	64.9
20/4/2022 22:10:00	63.7
20/4/2022 22:15:00	66
20/4/2022 22:20:00	65
20/4/2022 22:25:00	64.3
20/4/2022 22:30:00	64.9
20/4/2022 22:35:00	64.8
20/4/2022 22:40:00	63
20/4/2022 22:45:00	63.3
20/4/2022 22:50:00	63.4
20/4/2022 22:55:00	65.7
20/4/2022 23:00:00	63.3
20/4/2022 23:05:00	63.2
20/4/2022 23:10:00	67.7
20/4/2022 23:15:00	63.8
20/4/2022 23:20:00	61.3
20/4/2022 23:25:00	62.8
20/4/2022 23:30:00	66.2
20/4/2022 23:35:00	63.9
20/4/2022 23:40:00	64.4
20/4/2022 23:45:00	62
20/4/2022 23:50:00	64.7
20/4/2022 23:55:00	63.4
20/4/2022 00:00:00	61.1
21/4/2022 00:05:00	62.2
21/4/2022 00:10:00	60.4
21/4/2022 00:15:00	60.7
21/4/2022 00:20:00	62.5
21/4/2022 00:25:00	60.4
21/4/2022 00:30:00	59.7
21/4/2022 00:35:00	60.1
21/4/2022 00:40:00	58.9
21/4/2022 00:45:00	62.3
21/4/2022 00:50:00	61.2
21/4/2022 00:55:00	59.9
21/4/2022 01:00:00	62.9
21/4/2022 01:05:00	59.4
21/4/2022 01:10:00	58.4
21/4/2022 01:15:00	61.8
21/4/2022 01:20:00	60
21/4/2022 01:25:00	59.2
21/4/2022 01:30:00	56.8
21/4/2022 01:35:00	61.9
21/4/2022 01:40:00	59.8
21/4/2022 01:45:00	59.9
21/4/2022 01:50:00	59
21/4/2022 01:55:00	59.8
21/4/2022 02:00:00	54.9
21/4/2022 02:05:00	57.2

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
21/06/2022 22:06:37	57.8
21/06/2022 22:11:37	58.0
21/06/2022 22:16:37	58.6
21/06/2022 22:21:37	57.7
21/06/2022 22:26:37	57.7
21/06/2022 22:31:37	57.8
21/06/2022 22:36:37	57.9
21/06/2022 22:41:37	58.0
21/06/2022 22:46:37	59.6
21/06/2022 22:51:37	57.8
21/06/2022 22:56:37	57.6
21/06/2022 23:01:37	57.2
21/06/2022 23:06:37	57.3
21/06/2022 23:11:37	57.2
21/06/2022 23:16:37	57.6
21/06/2022 23:21:37	57.3
21/06/2022 23:26:37	58.6
21/06/2022 23:31:37	57.9
21/06/2022 23:36:37	57.2
21/06/2022 23:41:37	57.0
21/06/2022 23:46:37	57.1
21/06/2022 23:51:37	56.8
21/06/2022 23:56:37	57.2
22/06/2022 00:01:37	57.0
22/06/2022 00:06:37	56.8
22/06/2022 00:11:37	45.0
22/06/2022 00:16:37	46.4
22/06/2022 00:21:37	46.5
22/06/2022 00:26:37	47.0
22/06/2022 00:31:37	48.2
22/06/2022 00:36:37	46.0
22/06/2022 00:41:37	46.4
22/06/2022 00:46:37	46.9
22/06/2022 00:51:37	46.5
22/06/2022 00:56:37	45.5
22/06/2022 01:01:37	44.9
22/06/2022 01:06:37	44.0
22/06/2022 01:11:37	44.2
22/06/2022 01:16:37	43.5
22/06/2022 01:21:37	43.6
22/06/2022 01:26:37	42.8
22/06/2022 01:31:37	42.6
22/06/2022 01:36:37	43.4
22/06/2022 01:41:37	44.5
22/06/2022 01:46:37	42.5
22/06/2022 01:51:37	44.3
22/06/2022 01:56:37	45.3
22/06/2022 02:01:37	45.3
22/06/2022 02:06:37	43.3

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
21/4/2022 02:10:00	58.9
21/4/2022 02:15:00	57.2
21/4/2022 02:20:00	57.6
21/4/2022 02:25:00	57.5
21/4/2022 02:30:00	60
21/4/2022 02:35:00	57.9
21/4/2022 02:40:00	57
21/4/2022 02:45:00	57.3
21/4/2022 02:50:00	61.1
21/4/2022 02:55:00	59.9
Thu, 21/4/2022, 03:00	57.7
21/4/2022 03:05:00	56.2
21/4/2022 03:10:00	61
21/4/2022 03:15:00	53.6
21/4/2022 03:20:00	57.6
21/4/2022 03:25:00	60.8
21/4/2022 03:30:00	60.2
21/4/2022 03:35:00	57.9
21/4/2022 03:40:00	54.3
21/4/2022 03:45:00	57.9
21/4/2022 03:50:00	56.7
21/4/2022 03:55:00	57
21/4/2022 04:00:00	57.6
21/4/2022 04:05:00	57.5
21/4/2022 04:10:00	58.6
21/4/2022 04:15:00	56.2
21/4/2022 04:20:00	61.4
21/4/2022 04:25:00	58.7
21/4/2022 04:30:00	59.5
21/4/2022 04:35:00	56.7
21/4/2022 04:40:00	57.9
21/4/2022 04:45:00	56.7
21/4/2022 04:50:00	60.6
21/4/2022 04:55:00	59.7
21/4/2022 05:00:00	59.2
21/4/2022 05:05:00	59.2
21/4/2022 05:10:00	58.4
21/4/2022 05:15:00	57.7
21/4/2022 05:20:00	61.4
21/4/2022 05:25:00	58
21/4/2022 05:30:00	59
21/4/2022 05:35:00	61.8
21/4/2022 05:40:00	62.4
21/4/2022 05:45:00	64
21/4/2022 05:50:00	64.1
21/4/2022 05:55:00	64.4
21/4/2022 06:00:00	64.4
21/4/2022 06:05:00	62.7
21/4/2022 06:10:00	63.4

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
22/06/2022 02:11:37	44.6
22/06/2022 02:16:37	46.6
22/06/2022 02:21:37	47.0
22/06/2022 02:26:37	46.1
22/06/2022 02:31:37	45.5
22/06/2022 02:36:37	44.3
22/06/2022 02:41:37	44.8
22/06/2022 02:46:37	44.7
22/06/2022 02:51:37	47.0
22/06/2022 02:56:37	48.7
22/06/2022 03:01:37	45.6
22/06/2022 03:06:37	46.2
22/06/2022 03:11:37	45.6
22/06/2022 03:16:37	44.2
22/06/2022 03:21:37	44.9
22/06/2022 03:26:37	47.7
22/06/2022 03:31:37	43.9
22/06/2022 03:36:37	44.5
22/06/2022 03:41:37	44.5
22/06/2022 03:46:37	61.5
22/06/2022 03:51:37	53.6
22/06/2022 03:56:37	47.4
22/06/2022 04:01:37	47.3
22/06/2022 04:06:37	46.9
22/06/2022 04:11:37	47.5
22/06/2022 04:16:37	46.4
22/06/2022 04:21:37	46.1
22/06/2022 04:26:37	46.7
22/06/2022 04:31:37	49.3
22/06/2022 04:36:37	46.8
22/06/2022 04:41:37	46.2
22/06/2022 04:46:37	47.4
22/06/2022 04:51:37	46.7
22/06/2022 04:56:37	46.0
22/06/2022 05:01:37	47.9
22/06/2022 05:06:37	46.7
22/06/2022 05:11:37	47.2
22/06/2022 05:16:37	46.8
22/06/2022 05:21:37	46.3
22/06/2022 05:26:37	45.9
22/06/2022 05:31:37	45.5
22/06/2022 05:36:37	45.6
22/06/2022 05:41:37	49.2
22/06/2022 05:46:37	45.7
22/06/2022 05:51:37	49.7
22/06/2022 05:56:37	47.4
22/06/2022 06:01:37	48.9
22/06/2022 06:06:37	46.2
22/06/2022 06:11:37	49.1

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
21/4/2022 06:15:00	64.2
21/4/2022 06:20:00	64.5
21/4/2022 06:25:00	65.2
21/4/2022 06:30:00	66.4
21/4/2022 06:35:00	64.8
21/4/2022 06:40:00	65.9
21/4/2022 06:45:00	67.5
21/4/2022 06:50:00	67.6
21/4/2022 06:55:00	68.7
Thu, 21/4/2022, 07:00	67.2
21/4/2022 07:05:00	69.3
21/4/2022 07:10:00	68.3
21/4/2022 07:15:00	69.1
21/4/2022 07:20:00	69.9
21/4/2022 07:25:00	67.5
21/4/2022 07:30:00	68.5
21/4/2022 07:35:00	68.9
21/4/2022 07:40:00	69.3
21/4/2022 07:45:00	69
21/4/2022 07:50:00	69.4
21/4/2022 07:55:00	68.9
21/4/2022 08:00:00	71.8
21/4/2022 08:05:00	70
21/4/2022 08:10:00	69.9
21/4/2022 08:15:00	66.4
21/4/2022 08:20:00	66.9
21/4/2022 08:25:00	70.3
21/4/2022 08:30:00	69.4
21/4/2022 08:35:00	68.7
21/4/2022 08:40:00	69.7
21/4/2022 08:45:00	69
21/4/2022 08:50:00	68.8
21/4/2022 08:55:00	69.1
21/4/2022 09:00:00	69.5
21/4/2022 09:05:00	71.7
21/4/2022 09:10:00	72.2
21/4/2022 09:15:00	75.3
21/4/2022 09:20:00	75
21/4/2022 09:25:00	75.8
21/4/2022 09:30:00	77.3
21/4/2022 09:35:00	76.9
21/4/2022 09:40:00	75.7
21/4/2022 09:45:00	75.1
21/4/2022 09:50:00	73.1
21/4/2022 09:55:00	72.5
21/4/2022 10:00:00	70.8
21/4/2022 10:05:00	70.4
21/4/2022 10:10:00	70
21/4/2022 10:15:00	70.2

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
22/06/2022 06:16:37	48.9
22/06/2022 06:21:37	48.5
22/06/2022 06:26:37	51.0
22/06/2022 06:31:37	51.3
22/06/2022 06:36:37	50.7
22/06/2022 06:41:37	54.5
22/06/2022 06:46:37	54.6
22/06/2022 06:51:37	55.2
22/06/2022 06:56:37	53.8
22/06/2022 07:01:37	52.4
22/06/2022 07:06:37	55.2
22/06/2022 07:11:37	55.7
22/06/2022 07:16:37	52.3
22/06/2022 07:21:37	52.5
22/06/2022 07:26:37	52.0
22/06/2022 07:31:37	53.5
22/06/2022 07:36:37	55.8
22/06/2022 07:41:37	50.4
22/06/2022 07:46:37	48.8
22/06/2022 07:51:37	51.6
22/06/2022 07:56:37	50.6
22/06/2022 08:01:37	51.2
22/06/2022 08:06:37	50.6
22/06/2022 08:11:37	51.3
22/06/2022 08:16:37	54.3
22/06/2022 08:21:37	54.7
22/06/2022 08:26:37	49.2
22/06/2022 08:31:37	52.2
22/06/2022 08:36:37	65.8
22/06/2022 08:41:37	53.8
22/06/2022 08:46:37	59.2
22/06/2022 08:51:37	58.6
22/06/2022 08:56:37	53.2
22/06/2022 09:01:37	55.9
22/06/2022 09:06:37	56.9
22/06/2022 09:11:37	56.3
22/06/2022 09:16:37	53.3
22/06/2022 09:21:37	54.0
22/06/2022 09:26:37	52.0
22/06/2022 09:31:37	50.3
22/06/2022 09:36:37	51.3
22/06/2022 09:41:37	52.5
22/06/2022 09:46:37	51.3
22/06/2022 09:51:37	57.5
22/06/2022 09:56:37	49.8
22/06/2022 10:01:37	49.1
22/06/2022 10:06:37	51.7
22/06/2022 10:11:37	49.5
22/06/2022 10:16:37	51.4

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
21/4/2022 10:20:00	69.5
21/4/2022 10:25:00	69.1
21/4/2022 10:30:00	68
21/4/2022 10:35:00	69.1
21/4/2022 10:40:00	68
21/4/2022 10:45:00	68.2
21/4/2022 10:50:00	68.7
21/4/2022 10:55:00	68.6
21/4/2022 11:00:00	68.4
21/4/2022 11:05:00	67.6
21/4/2022 11:10:00	67.9
21/4/2022 11:15:00	69.6
21/4/2022 11:20:00	70.9
21/4/2022 11:25:00	70.9
21/4/2022 11:30:00	71.5
21/4/2022 11:35:00	70.6
21/4/2022 11:40:00	70.1
21/4/2022 11:45:00	70.5
21/4/2022 11:50:00	71.1
21/4/2022 11:55:00	69.9
21/4/2022 12:00:00	71.5
21/4/2022 12:05:00	71.1
21/4/2022 12:10:00	68.9
21/4/2022 12:15:00	70.7
21/4/2022 12:20:00	69.4
21/4/2022 12:25:00	70.8
21/4/2022 12:30:00	69.9
21/4/2022 12:35:00	69.5
21/4/2022 12:40:00	66.7
21/4/2022 12:45:00	68.4
21/4/2022 12:50:00	69.9
21/4/2022 12:55:00	68.6
21/4/2022 13:00:00	68.9
21/4/2022 13:05:00	68.8
21/4/2022 13:10:00	68.4
21/4/2022 13:15:00	68.7
21/4/2022 13:20:00	67.8
21/4/2022 13:25:00	66.8
21/4/2022 13:30:00	66.6
21/4/2022 13:35:00	66.7
21/4/2022 13:40:00	67.3
21/4/2022 13:45:00	68.5
21/4/2022 13:50:00	69.6
21/4/2022 13:55:00	67.7
21/4/2022 14:00:00	68.2
21/4/2022 14:05:00	67.8
21/4/2022 14:10:00	67.6
21/4/2022 14:15:00	66.8
21/4/2022 14:20:00	67.1

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
22/06/2022 10:21:37	55.0
22/06/2022 10:26:37	48.1
22/06/2022 10:31:37	59.0
22/06/2022 10:36:37	50.2
22/06/2022 10:41:37	56.9
22/06/2022 10:46:37	54.6
22/06/2022 10:51:37	49.0
22/06/2022 10:56:37	54.5
22/06/2022 11:01:37	50.2
22/06/2022 11:06:37	51.4
22/06/2022 11:11:37	53.1
22/06/2022 11:16:37	53.2
22/06/2022 11:21:37	48.4
22/06/2022 11:26:37	49.2
22/06/2022 11:31:37	49.8
22/06/2022 11:36:37	49.1
22/06/2022 11:41:37	51.3
22/06/2022 11:46:37	49.3
22/06/2022 11:51:37	57.6
22/06/2022 11:56:37	52.5
22/06/2022 12:01:37	50
22/06/2022 12:06:37	48.2
22/06/2022 12:11:37	51.9
22/06/2022 12:16:37	49.8
22/06/2022 12:21:37	50.2
22/06/2022 12:26:37	47.5
22/06/2022 12:31:37	49.8
22/06/2022 12:36:37	47.8
22/06/2022 12:41:37	52.2
22/06/2022 12:46:37	49.7
22/06/2022 12:51:37	47.2
22/06/2022 12:56:37	48.1
22/06/2022 13:01:37	48.7
22/06/2022 13:06:37	47.8
22/06/2022 13:11:37	46.7
22/06/2022 13:16:37	49.7
22/06/2022 13:21:37	49.2
22/06/2022 13:26:37	54.1
22/06/2022 13:31:37	47.8
22/06/2022 13:36:37	49.7
22/06/2022 13:41:37	50.5
22/06/2022 13:46:37	47.4
22/06/2022 13:51:37	49.5
22/06/2022 13:56:37	47.6
22/06/2022 14:01:37	48.4
22/06/2022 14:06:37	47.6
22/06/2022 14:11:37	47.6
22/06/2022 14:16:37	53.3
22/06/2022 14:21:37	51.1

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)
21/4/2022 14:25:00	67.2
21/4/2022 14:30:00	66.2
21/4/2022 14:35:00	68
21/4/2022 14:40:00	68
21/4/2022 14:45:00	67
21/4/2022 14:50:00	68.3
21/4/2022 14:55:00	68

Raw Noise Data from Station N1
15 - 22 June 2022

Date & Time	Leq (dBA)
22/06/2022 14:26:37	49.5
22/06/2022 14:31:37	53.8
22/06/2022 14:36:37	53.7
22/06/2022 14:41:37	50.2
22/06/2022 14:46:37	58.9

Raw Noise Data from Station N2
14 - 21 April 2022

Date & Time	Leq (dBA)

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
7/4/2022 15:00:00	52.9
7/4/2022 15:05:01	52.4
7/4/2022 15:10:01	52.2
7/4/2022 15:15:01	51.8
7/4/2022 15:20:01	53.6
7/4/2022 15:25:01	52.6
7/4/2022 15:30:01	52.5
7/4/2022 15:35:01	52.7
7/4/2022 15:40:01	53.3
7/4/2022 15:45:01	52
7/4/2022 15:50:01	54.3
7/4/2022 15:55:01	53.8
7/4/2022 16:00:01	52.1
7/4/2022 16:05:01	53.1
7/4/2022 16:10:01	52.7
7/4/2022 16:15:01	52.6
7/4/2022 16:20:01	53.3
7/4/2022 16:25:01	53.1
7/4/2022 16:30:01	53.2
7/4/2022 16:35:01	54
7/4/2022 16:40:01	54.4
7/4/2022 16:45:01	54.1
7/4/2022 16:50:01	53.9
7/4/2022 16:55:01	53.5
7/4/2022 17:00:01	54.2
7/4/2022 17:05:01	54.2
7/4/2022 17:10:01	53.5
7/4/2022 17:15:01	54.3
7/4/2022 17:20:01	53.8
7/4/2022 17:25:01	54.5
7/4/2022 17:30:01	53.7
7/4/2022 17:35:01	54.6
7/4/2022 17:40:01	54.3
7/4/2022 17:45:01	54.3
7/4/2022 17:50:01	54.1
7/4/2022 17:55:01	54.4
7/4/2022 18:00:01	55.2
7/4/2022 18:05:01	53.9
7/4/2022 18:10:01	54.7
7/4/2022 18:15:01	54.4
7/4/2022 18:20:01	54.4
7/4/2022 18:25:01	54.5
7/4/2022 18:30:01	54.9
7/4/2022 18:35:01	54.8
7/4/2022 18:40:01	54.1
7/4/2022 18:45:01	55.1
7/4/2022 18:50:01	54
7/4/2022 18:55:01	53.9
Thu, 7/4/2022, 19:00	54.4

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
7/6/2022 12:03:32	49.3
7/6/2022 12:08:32	64.4
7/6/2022 12:13:32	46.6
7/6/2022 12:18:32	56.6
7/6/2022 12:23:32	47.6
7/6/2022 12:28:32	45.6
7/6/2022 12:33:32	45.4
7/6/2022 12:38:32	46
7/6/2022 12:43:32	48.2
7/6/2022 12:48:32	46.3
7/6/2022 12:53:32	60.5
7/6/2022 12:58:32	53.1
7/6/2022 13:03:32	50.6
7/6/2022 13:08:32	55.2
7/6/2022 13:13:32	58.6
7/6/2022 13:18:32	48
7/6/2022 13:23:32	57.9
7/6/2022 13:28:32	48.9
7/6/2022 13:33:32	49.3
7/6/2022 13:38:32	45.9
7/6/2022 13:43:32	45.6
7/6/2022 13:48:32	44.5
7/6/2022 13:53:32	51.9
7/6/2022 13:58:32	50.7
7/6/2022 14:03:32	52.5
7/6/2022 14:08:32	49
7/6/2022 14:13:32	61.1
7/6/2022 14:18:32	47.1
7/6/2022 14:23:32	56.5
7/6/2022 14:28:32	67.4
7/6/2022 14:33:32	47.3
7/6/2022 14:38:32	44.4
7/6/2022 14:43:32	44.1
7/6/2022 14:48:32	48.2
7/6/2022 14:53:32	82
7/6/2022 14:58:32	45.9
7/6/2022 15:03:32	51.6
7/6/2022 15:08:32	55.1
7/6/2022 15:13:32	50
7/6/2022 15:18:32	51
7/6/2022 15:23:32	56.6
7/6/2022 15:28:32	45.7
7/6/2022 15:33:32	52.7
7/6/2022 15:38:32	48.9
7/6/2022 15:43:32	46.2
7/6/2022 15:48:32	47.4
7/6/2022 15:53:32	48.9
7/6/2022 15:58:32	44.7
7/6/2022 16:03:32	62.4

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
7/4/2022 19:05:01	53.7
7/4/2022 19:10:01	54.1
7/4/2022 19:15:01	54.2
7/4/2022 19:20:01	53.8
7/4/2022 19:25:01	53.8
7/4/2022 19:30:01	54
7/4/2022 19:35:01	53.6
7/4/2022 19:40:01	53.2
7/4/2022 19:45:01	54.2
7/4/2022 19:50:01	54.5
7/4/2022 19:55:01	55.5
7/4/2022 20:00:01	54.6
7/4/2022 20:05:01	55.1
7/4/2022 20:10:01	55.8
7/4/2022 20:15:01	55.6
7/4/2022 20:20:01	56.5
7/4/2022 20:25:01	56.2
7/4/2022 20:30:01	54.1
7/4/2022 20:35:01	57.8
7/4/2022 20:40:01	57.9
7/4/2022 20:45:01	57.8
7/4/2022 20:50:01	57.5
7/4/2022 20:55:01	57.7
7/4/2022 21:00:01	57.5
7/4/2022 21:05:01	57.8
7/4/2022 21:10:01	57.8
7/4/2022 21:15:01	57.8
7/4/2022 21:20:01	57.9
7/4/2022 21:25:01	57.2
7/4/2022 21:30:01	57.6
7/4/2022 21:35:01	56.2
7/4/2022 21:40:01	56.8
7/4/2022 21:45:01	57.6
7/4/2022 21:50:01	57.5
7/4/2022 21:55:01	57.5
7/4/2022 22:00:01	57.3
7/4/2022 22:05:01	57.5
7/4/2022 22:10:01	57.5
7/4/2022 22:15:01	57.7
7/4/2022 22:20:01	59.7
7/4/2022 22:25:01	57.8
7/4/2022 22:30:01	57.7
7/4/2022 22:35:01	56.5
7/4/2022 22:40:01	54.4
7/4/2022 22:45:01	54.5
7/4/2022 22:50:01	53.4
7/4/2022 22:55:01	55.3
7/4/2022 23:00:01	53
7/4/2022 23:05:01	53.1

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
7/6/2022 16:08:32	64.1
7/6/2022 16:13:32	45
7/6/2022 16:18:32	44.8
7/6/2022 16:23:32	48.8
7/6/2022 16:28:32	51.5
7/6/2022 16:33:32	45.5
7/6/2022 16:38:32	47.8
7/6/2022 16:43:32	46.4
7/6/2022 16:48:32	45.2
7/6/2022 16:53:32	49.9
7/6/2022 16:58:32	48
7/6/2022 17:03:32	48.1
7/6/2022 17:08:32	47.3
7/6/2022 17:13:32	53.9
7/6/2022 17:18:32	49.8
7/6/2022 17:23:32	47.6
7/6/2022 17:28:32	45.9
7/6/2022 17:33:32	53.1
7/6/2022 17:38:32	49
7/6/2022 17:43:32	46
7/6/2022 17:48:32	48.3
7/6/2022 17:53:32	45.1
7/6/2022 17:58:32	47.6
7/6/2022 18:03:32	46.3
7/6/2022 18:08:32	46
7/6/2022 18:13:32	48.2
7/6/2022 18:18:32	46.1
7/6/2022 18:23:32	44.9
7/6/2022 18:28:32	47.2
7/6/2022 18:33:32	48.6
7/6/2022 18:38:32	45
7/6/2022 18:43:32	45.1
7/6/2022 18:48:32	49.7
7/6/2022 18:53:32	48.5
7/6/2022 18:58:32	47.2
7/6/2022 19:03:32	46.5
7/6/2022 19:08:32	49.1
7/6/2022 19:13:32	48.3
7/6/2022 19:18:32	49.4
7/6/2022 19:23:32	47.6
7/6/2022 19:28:32	55.8
7/6/2022 19:33:32	48.4
7/6/2022 19:38:32	46.5
7/6/2022 19:43:32	48.2
7/6/2022 19:48:32	47.7
7/6/2022 19:53:32	47.5
7/6/2022 19:58:32	46
7/6/2022 20:03:32	46
7/6/2022 20:08:32	50

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
7/4/2022 23:10:01	53.5
7/4/2022 23:15:01	53.7
7/4/2022 23:20:01	53.8
7/4/2022 23:25:01	53.3
7/4/2022 23:30:01	54
7/4/2022 23:35:01	53.9
7/4/2022 23:40:01	53.5
7/4/2022 23:45:01	52.3
7/4/2022 23:50:01	52.9
7/4/2022 23:55:01	52.2
8/4/2022 00:00:01	51.4
8/4/2022 00:05:01	52
8/4/2022 00:10:01	51.4
8/4/2022 00:15:01	50.8
8/4/2022 00:20:01	51.4
8/4/2022 00:25:01	51.2
8/4/2022 00:30:01	50.3
8/4/2022 00:35:01	50.3
8/4/2022 00:40:01	50.7
8/4/2022 00:45:01	50
8/4/2022 00:50:01	52.5
8/4/2022 00:55:01	55.3
8/4/2022 01:00:01	55.3
8/4/2022 01:05:01	55.3
8/4/2022 01:10:01	55.9
8/4/2022 01:15:01	55.8
8/4/2022 01:20:01	55.3
8/4/2022 01:25:01	55.3
8/4/2022 01:30:01	55.5
8/4/2022 01:35:01	55.6
8/4/2022 01:40:01	55.5
8/4/2022 01:45:01	55.4
8/4/2022 01:50:01	55.3
8/4/2022 01:55:01	55.4
8/4/2022 02:00:01	55.6
8/4/2022 02:05:01	55.3
8/4/2022 02:10:01	55.3
8/4/2022 02:15:01	55
8/4/2022 02:20:01	53.4
8/4/2022 02:25:01	55
8/4/2022 02:30:01	54.9
8/4/2022 02:35:01	54.1
8/4/2022 02:40:01	54.4
8/4/2022 02:45:01	54.9
8/4/2022 02:50:01	55.1
8/4/2022 02:55:01	55.2
Fri, 8/4/2022, 03:00	55
8/4/2022 03:05:01	54.9
8/4/2022 03:10:01	55

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
7/6/2022 20:13:32	47.5
7/6/2022 20:18:32	47.6
7/6/2022 20:23:32	48.9
7/6/2022 20:28:32	50.9
7/6/2022 20:33:32	46.7
7/6/2022 20:38:32	49.4
7/6/2022 20:43:32	47.9
7/6/2022 20:48:32	48.4
7/6/2022 20:53:32	46.4
7/6/2022 20:58:32	49.7
7/6/2022 21:03:32	49
7/6/2022 21:08:32	47.6
7/6/2022 21:13:32	52.2
7/6/2022 21:18:32	47.4
7/6/2022 21:23:32	47
7/6/2022 21:28:32	49
7/6/2022 21:33:32	46.3
7/6/2022 21:38:32	48.5
7/6/2022 21:43:32	52.2
7/6/2022 21:48:32	46.4
7/6/2022 21:53:32	45.8
7/6/2022 21:58:32	45.8
7/6/2022 22:03:32	54.6
7/6/2022 22:08:32	48
7/6/2022 22:13:32	46
7/6/2022 22:18:32	46.8
7/6/2022 22:23:32	46.5
7/6/2022 22:28:32	46
7/6/2022 22:33:32	46
7/6/2022 22:38:32	48.5
7/6/2022 22:43:32	46.8
7/6/2022 22:48:32	45.9
7/6/2022 22:53:32	45.2
7/6/2022 22:58:32	50
7/6/2022 23:03:32	45.3
7/6/2022 23:08:32	44.5
7/6/2022 23:13:32	45.3
7/6/2022 23:18:32	52.1
7/6/2022 23:23:32	44.6
7/6/2022 23:28:32	44.5
7/6/2022 23:33:32	45.2
7/6/2022 23:38:32	45.3
7/6/2022 23:43:32	44.6
7/6/2022 23:48:32	45.8
7/6/2022 23:53:32	45.8
7/6/2022 23:58:32	45.1
8/6/2022 00:03:32	45
8/6/2022 00:08:32	47.3
8/6/2022 00:13:32	48.5

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
8/4/2022 03:15:01	54.9
8/4/2022 03:20:01	55
8/4/2022 03:25:01	55
8/4/2022 03:30:01	55.1
8/4/2022 03:35:01	55.3
8/4/2022 03:40:01	55.1
8/4/2022 03:45:01	55.3
8/4/2022 03:50:01	55.1
8/4/2022 03:55:01	54.7
8/4/2022 04:00:01	55.2
8/4/2022 04:05:01	55
8/4/2022 04:10:01	55.2
8/4/2022 04:15:01	54.9
8/4/2022 04:20:01	54.9
8/4/2022 04:25:01	51.1
8/4/2022 04:30:01	50.3
8/4/2022 04:35:01	50.8
8/4/2022 04:40:01	51.6
8/4/2022 04:45:01	53.8
8/4/2022 04:50:01	53.2
8/4/2022 04:55:01	53.5
8/4/2022 05:00:01	53.3
8/4/2022 05:05:01	52.8
8/4/2022 05:10:01	51.8
8/4/2022 05:15:01	53.6
8/4/2022 05:20:01	52.8
8/4/2022 05:25:01	52.1
8/4/2022 05:30:01	52.1
8/4/2022 05:35:01	53.4
8/4/2022 05:40:01	55.7
8/4/2022 05:45:01	56.7
8/4/2022 05:50:01	57
8/4/2022 05:55:01	57.1
8/4/2022 06:00:01	57.3
8/4/2022 06:05:01	58.1
8/4/2022 06:10:01	58.2
8/4/2022 06:15:01	58.9
8/4/2022 06:20:01	58.6
8/4/2022 06:25:01	58.5
8/4/2022 06:30:01	59
8/4/2022 06:35:01	58.8
8/4/2022 06:40:01	59.4
8/4/2022 06:45:01	58.5
8/4/2022 06:50:01	57.4
8/4/2022 06:55:01	57.5
Fri, 8/4/2022, 07:00	57.6
8/4/2022 07:05:01	56.4
8/4/2022 07:10:01	55.6
8/4/2022 07:15:01	55.9

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
8/6/2022 00:18:32	48.1
8/6/2022 00:23:32	44.2
8/6/2022 00:28:32	43.7
8/6/2022 00:33:32	44.5
8/6/2022 00:38:32	48.8
8/6/2022 00:43:32	47.7
8/6/2022 00:48:32	46.2
8/6/2022 00:53:32	48.9
8/6/2022 00:58:32	44.6
8/6/2022 01:03:32	48.2
8/6/2022 01:08:32	44.6
8/6/2022 01:13:32	51
8/6/2022 01:18:32	51.3
8/6/2022 01:23:32	44.6
8/6/2022 01:28:32	48
8/6/2022 01:33:32	47.8
8/6/2022 01:38:32	45.4
8/6/2022 01:43:32	44.6
8/6/2022 01:48:32	43.9
8/6/2022 01:53:32	45.1
8/6/2022 01:58:32	43.4
8/6/2022 02:03:32	46.8
8/6/2022 02:08:32	47.9
8/6/2022 02:13:32	45.9
8/6/2022 02:18:32	47.3
8/6/2022 02:23:32	47.2
8/6/2022 02:28:32	46.9
8/6/2022 02:33:32	47.2
8/6/2022 02:38:32	46.9
8/6/2022 02:43:32	46.6
8/6/2022 02:48:32	47.1
8/6/2022 02:53:32	44.6
8/6/2022 02:58:32	47
8/6/2022 03:03:32	47.4
8/6/2022 03:08:32	48.1
8/6/2022 03:13:32	48.6
8/6/2022 03:18:32	46.7
8/6/2022 03:23:32	48.6
8/6/2022 03:28:32	44.7
8/6/2022 03:33:32	47.2
8/6/2022 03:38:32	45
8/6/2022 03:43:32	44.7
8/6/2022 03:48:32	47.7
8/6/2022 03:53:32	46.1
8/6/2022 03:58:32	51.8
8/6/2022 04:03:32	44.4
8/6/2022 04:08:32	44.3
8/6/2022 04:13:32	47
8/6/2022 04:18:32	43.9

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
8/4/2022 07:20:01	55.3
8/4/2022 07:25:01	55.8
8/4/2022 07:30:01	56.3
8/4/2022 07:35:01	55.6
8/4/2022 07:40:01	55.1
8/4/2022 07:45:01	55.4
8/4/2022 07:50:01	55.5
8/4/2022 07:55:01	54.7
8/4/2022 08:00:01	56.1
8/4/2022 08:05:01	55.4
8/4/2022 08:10:01	54.1
8/4/2022 08:15:01	53.9
8/4/2022 08:20:01	54.3
8/4/2022 08:25:01	54.6
8/4/2022 08:30:01	54.1
8/4/2022 08:35:01	54.3
8/4/2022 08:40:01	55.5
8/4/2022 08:45:01	54.8
8/4/2022 08:50:01	60.2
8/4/2022 08:55:01	57.4
8/4/2022 09:00:01	61
8/4/2022 09:05:01	58.9
8/4/2022 09:10:01	54.9
8/4/2022 09:15:01	55.3
8/4/2022 09:20:01	55.6
8/4/2022 09:25:01	54.2
8/4/2022 09:30:01	54.2
8/4/2022 09:35:01	53.5
8/4/2022 09:40:01	53.3
8/4/2022 09:45:01	54.7
8/4/2022 09:50:01	56.1
8/4/2022 09:55:01	54.1
8/4/2022 10:00:01	54.9
8/4/2022 10:05:01	52.9
8/4/2022 10:10:01	52.8
8/4/2022 10:15:01	54.3
8/4/2022 10:20:01	52.3
8/4/2022 10:25:01	52.2
8/4/2022 10:30:01	52.8
8/4/2022 10:35:01	52.9
8/4/2022 10:40:01	52.4
8/4/2022 10:45:01	51.8
8/4/2022 10:50:01	53.9
8/4/2022 10:55:01	51.1
8/4/2022 11:00:01	53.7
8/4/2022 11:05:01	54
8/4/2022 11:10:01	52.2
8/4/2022 11:15:01	54.7
8/4/2022 11:20:01	53.3

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
8/6/2022 04:23:32	50.8
8/6/2022 04:28:32	44.6
8/6/2022 04:33:32	44.4
8/6/2022 04:38:32	44.1
8/6/2022 04:43:32	44.3
8/6/2022 04:48:32	44.7
8/6/2022 04:53:32	45.2
8/6/2022 04:58:32	44.7
8/6/2022 05:03:32	44.4
8/6/2022 05:08:32	49.2
8/6/2022 05:13:32	46.1
8/6/2022 05:18:32	45.4
8/6/2022 05:23:32	45.3
8/6/2022 05:28:32	45.3
8/6/2022 05:33:32	47.3
8/6/2022 05:38:32	45.5
8/6/2022 05:43:32	46.4
8/6/2022 05:48:32	46.3
8/6/2022 05:53:32	46.3
8/6/2022 05:58:32	46
8/6/2022 06:03:32	46.8
8/6/2022 06:08:32	49.7
8/6/2022 06:13:32	48.8
8/6/2022 06:18:32	50.4
8/6/2022 06:23:32	52.9
8/6/2022 06:28:32	58.1
8/6/2022 06:33:32	49.7
8/6/2022 06:38:32	49.4
8/6/2022 06:43:32	60.4
8/6/2022 06:48:32	51.6
8/6/2022 06:53:32	50.5
8/6/2022 06:58:32	57.7
8/6/2022 07:03:32	51.3
8/6/2022 07:08:32	51.9
8/6/2022 07:13:32	49.6
8/6/2022 07:18:32	59.6
8/6/2022 07:23:32	48.1
8/6/2022 07:28:32	48.9
8/6/2022 07:33:32	49.4
8/6/2022 07:38:32	50
8/6/2022 07:43:32	48.5
8/6/2022 07:48:32	49.4
8/6/2022 07:53:32	48.9
8/6/2022 07:58:32	50.2
8/6/2022 08:03:32	50.1
8/6/2022 08:08:32	57.7
8/6/2022 08:13:32	48.1
8/6/2022 08:18:32	48.8
8/6/2022 08:23:32	48.9

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
8/4/2022 11:25:01	51.3
8/4/2022 11:30:01	52.7
8/4/2022 11:35:01	53.6
8/4/2022 11:40:01	54
8/4/2022 11:45:01	51.9
8/4/2022 11:50:01	51.8
8/4/2022 11:55:01	67.5
8/4/2022 12:00:01	54
8/4/2022 12:05:01	66.4
8/4/2022 12:10:01	57.4
8/4/2022 12:15:01	59.4
8/4/2022 12:20:01	57.5
8/4/2022 12:25:01	54.8
8/4/2022 12:30:01	55.9
8/4/2022 12:35:01	59.1
8/4/2022 12:40:01	54.9
8/4/2022 12:45:01	55.3
8/4/2022 12:50:01	57.7
8/4/2022 12:55:01	61
8/4/2022 13:00:01	53.9
8/4/2022 13:05:01	56
8/4/2022 13:10:01	54.8
8/4/2022 13:15:01	53.9
8/4/2022 13:20:01	55.9
8/4/2022 13:25:01	52.1
8/4/2022 13:30:01	52.6
8/4/2022 13:35:01	53.4
8/4/2022 13:40:01	53.5
8/4/2022 13:45:01	56.4
8/4/2022 13:50:01	54.9
8/4/2022 13:55:01	53.5
8/4/2022 14:00:01	53.8
8/4/2022 14:05:01	54.3
8/4/2022 14:10:01	53.9
8/4/2022 14:15:01	52.9
8/4/2022 14:20:01	53.6
8/4/2022 14:25:01	54.9
8/4/2022 14:30:01	57.6
8/4/2022 14:35:01	55.1
8/4/2022 14:40:01	53.6
8/4/2022 14:45:01	52.8
8/4/2022 14:50:01	54.7
8/4/2022 14:55:01	54.7
Fri, 8/4/2022, 15:00	52.1
8/4/2022 15:05:01	53
8/4/2022 15:10:01	52
8/4/2022 15:15:01	52.7
8/4/2022 15:20:01	51.9
8/4/2022 15:25:01	52.3

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
8/6/2022 08:28:32	54.1
8/6/2022 08:33:32	47.4
8/6/2022 08:38:32	46
8/6/2022 08:43:32	46.9
8/6/2022 08:48:32	47.5
8/6/2022 08:53:32	46.7
8/6/2022 08:58:32	46.6
8/6/2022 09:03:32	47
8/6/2022 09:08:32	45.1
8/6/2022 09:13:32	47.2
8/6/2022 09:18:32	45.1
8/6/2022 09:23:32	46.2
8/6/2022 09:28:32	55.4
8/6/2022 09:33:32	48.2
8/6/2022 09:38:32	52
8/6/2022 09:43:32	43.6
8/6/2022 09:48:32	47.2
8/6/2022 09:53:32	47.3
8/6/2022 09:58:32	46.2
8/6/2022 10:03:32	44.1
8/6/2022 10:08:32	53.8
8/6/2022 10:13:32	45.6
8/6/2022 10:18:32	63.1
8/6/2022 10:23:32	45.1
8/6/2022 10:28:32	47.9
8/6/2022 10:33:32	45
8/6/2022 10:38:32	42.9
8/6/2022 10:43:32	43.7
8/6/2022 10:48:32	45.1
8/6/2022 10:53:32	49.6
8/6/2022 10:58:32	46.3
8/6/2022 11:03:32	44.8
8/6/2022 11:08:32	43.9
8/6/2022 11:13:32	54.5
8/6/2022 11:18:32	44.2
8/6/2022 11:23:32	42.7
8/6/2022 11:28:32	46.7
8/6/2022 11:33:32	46.6
8/6/2022 11:38:32	63.2
8/6/2022 11:43:32	47.7
8/6/2022 11:48:32	68.1
8/6/2022 11:53:32	50.1
8/6/2022 11:58:32	46.2
8/6/2022 12:03:32	43.1
8/6/2022 12:08:32	42.8
8/6/2022 12:13:32	42.7
8/6/2022 12:18:32	42.6
8/6/2022 12:23:32	44.1
8/6/2022 12:28:32	42.9

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
8/4/2022 15:30:01	53.5
8/4/2022 15:35:01	53
8/4/2022 15:40:01	54
8/4/2022 15:45:01	52.8
8/4/2022 15:50:01	52.9
8/4/2022 15:55:01	52.1
8/4/2022 16:00:01	53.1
8/4/2022 16:05:01	64.7
8/4/2022 16:10:01	63.4
8/4/2022 16:15:01	53.9
8/4/2022 16:20:01	56.6
8/4/2022 16:25:01	56.9
8/4/2022 16:30:01	55.7
8/4/2022 16:35:01	60
8/4/2022 16:40:01	58.4
8/4/2022 16:45:01	59.9
8/4/2022 16:50:01	58.6
8/4/2022 16:55:01	56.9
8/4/2022 17:00:01	58.9
8/4/2022 17:05:01	60.4
8/4/2022 17:10:01	58.4
8/4/2022 17:15:01	58.7
8/4/2022 17:20:01	56.4
8/4/2022 17:25:01	54.9
8/4/2022 17:30:01	55.9
8/4/2022 17:35:01	56.9
8/4/2022 17:40:01	55.6
8/4/2022 17:45:01	56.1
8/4/2022 17:50:01	54.7
8/4/2022 17:55:01	53.8
8/4/2022 18:00:01	54.1
8/4/2022 18:05:01	53.9
8/4/2022 18:10:01	54.5
8/4/2022 18:15:01	53.5
8/4/2022 18:20:01	53.9
8/4/2022 18:25:01	54.4
8/4/2022 18:30:01	54.2
8/4/2022 18:35:01	54.2
8/4/2022 18:40:01	54.7
8/4/2022 18:45:01	54.1
8/4/2022 18:50:01	52.9
8/4/2022 18:55:01	54.5
Fri, 8/4/2022, 19:00	54.7
8/4/2022 19:05:01	54.2
8/4/2022 19:10:01	52.5
8/4/2022 19:15:01	53.4
8/4/2022 19:20:01	53.1
8/4/2022 19:25:01	53.2
8/4/2022 19:30:01	53.6

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
8/6/2022 12:33:32	50
8/6/2022 12:38:32	53.4
8/6/2022 12:43:32	47.6
8/6/2022 12:48:32	46.5
8/6/2022 12:53:32	48.7
8/6/2022 12:58:32	63.5
8/6/2022 13:03:32	53.3
8/6/2022 13:08:32	52.3
8/6/2022 13:13:32	48.1
8/6/2022 13:18:32	46.9
8/6/2022 13:23:32	48.9
8/6/2022 13:28:32	49.4
8/6/2022 13:33:32	46.8
8/6/2022 13:38:32	50.3
8/6/2022 13:43:32	44.6
8/6/2022 13:48:32	47.4
8/6/2022 13:53:32	50.7
8/6/2022 13:58:32	49.7
8/6/2022 14:03:32	44.6
8/6/2022 14:08:32	46.5
8/6/2022 14:13:32	47.8
8/6/2022 14:18:32	55.7
8/6/2022 14:23:32	44.3
8/6/2022 14:28:32	64.3
8/6/2022 14:33:32	46.8
8/6/2022 14:38:32	48
8/6/2022 14:43:32	44.7
8/6/2022 14:48:32	53.3
8/6/2022 14:53:32	46.7
8/6/2022 14:58:32	46.9
8/6/2022 15:03:32	57.4
8/6/2022 15:08:32	48.9
8/6/2022 15:13:32	50.5
8/6/2022 15:18:32	45.2
8/6/2022 15:23:32	47.4
8/6/2022 15:28:32	45.3
8/6/2022 15:33:32	46.5
8/6/2022 15:38:32	45.1
8/6/2022 15:43:32	49.6
8/6/2022 15:48:32	47.1
8/6/2022 15:53:32	47
8/6/2022 15:58:32	49.4
8/6/2022 16:03:32	46.4
8/6/2022 16:08:32	50.9
8/6/2022 16:13:32	56.3
8/6/2022 16:18:32	47.3
8/6/2022 16:23:32	46.7
8/6/2022 16:28:32	49.7
8/6/2022 16:33:32	51.2

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
8/4/2022 19:35:01	53.5
8/4/2022 19:40:01	52.2
8/4/2022 19:45:01	53.1
8/4/2022 19:50:01	52.1
8/4/2022 19:55:01	52.8
8/4/2022 20:00:01	51.9
8/4/2022 20:05:01	52.8
8/4/2022 20:10:01	52.4
8/4/2022 20:15:01	52.1
8/4/2022 20:20:01	53
8/4/2022 20:25:01	52.9
8/4/2022 20:30:01	53.6
8/4/2022 20:35:01	52.6
8/4/2022 20:40:01	53.3
8/4/2022 20:45:01	52.9
8/4/2022 20:50:01	52.9
8/4/2022 20:55:01	53.9
8/4/2022 21:00:01	53.6
8/4/2022 21:05:01	54
8/4/2022 21:10:01	53.2
8/4/2022 21:15:01	53.8
8/4/2022 21:20:01	53.2
8/4/2022 21:25:01	54.6
8/4/2022 21:30:01	53.1
8/4/2022 21:35:01	53.4
8/4/2022 21:40:01	53.4
8/4/2022 21:45:01	53.5
8/4/2022 21:50:01	53.1
8/4/2022 21:55:01	52.9
8/4/2022 22:00:01	53.9
8/4/2022 22:05:01	53.6
8/4/2022 22:10:01	53.7
8/4/2022 22:15:01	54
8/4/2022 22:20:01	54.6
8/4/2022 22:25:01	54.8
8/4/2022 22:30:01	55
8/4/2022 22:35:01	55.5
8/4/2022 22:40:01	55.1
8/4/2022 22:45:01	55.1
8/4/2022 22:50:01	54.8
8/4/2022 22:55:01	55.1
8/4/2022 23:00:01	54.6
8/4/2022 23:05:01	54.7
8/4/2022 23:10:01	55.3
8/4/2022 23:15:01	54.8
8/4/2022 23:20:01	54.7
8/4/2022 23:25:01	53.5
8/4/2022 23:30:01	53.8
8/4/2022 23:35:01	54.3

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
8/6/2022 16:38:32	46.4
8/6/2022 16:43:32	49.3
8/6/2022 16:48:32	55.8
8/6/2022 16:53:32	60.2
8/6/2022 16:58:32	49.4
8/6/2022 17:03:32	49.1
8/6/2022 17:08:32	51.5
8/6/2022 17:13:32	47.4
8/6/2022 17:18:32	46.9
8/6/2022 17:23:32	46.7
8/6/2022 17:28:32	51.1
8/6/2022 17:33:32	47.8
8/6/2022 17:38:32	49.3
8/6/2022 17:43:32	47.6
8/6/2022 17:48:32	48.3
8/6/2022 17:53:32	53.7
8/6/2022 17:58:32	50.4
8/6/2022 18:03:32	51.8
8/6/2022 18:08:32	49.9
8/6/2022 18:13:32	50.2
8/6/2022 18:18:32	52.4
8/6/2022 18:23:32	52.3
8/6/2022 18:28:32	45.4
8/6/2022 18:33:32	49.4
8/6/2022 18:38:32	47.9
8/6/2022 18:43:32	50.8
8/6/2022 18:48:32	48.8
8/6/2022 18:53:32	48.8
8/6/2022 18:58:32	51.9
8/6/2022 19:03:32	44.3
8/6/2022 19:08:32	45.8
8/6/2022 19:13:32	46
8/6/2022 19:18:32	45.3
8/6/2022 19:23:32	44.9
8/6/2022 19:28:32	53.1
8/6/2022 19:33:32	50.9
8/6/2022 19:38:32	46.8
8/6/2022 19:43:32	51.5
8/6/2022 19:48:32	55.4
8/6/2022 19:53:32	55.1
8/6/2022 19:58:32	53.2
8/6/2022 20:03:32	50.1
8/6/2022 20:08:32	52.8
8/6/2022 20:13:32	51
8/6/2022 20:18:32	55.8
8/6/2022 20:23:32	56.3
8/6/2022 20:28:32	55.4
8/6/2022 20:33:32	55.4
8/6/2022 20:38:32	55.3

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
8/4/2022 23:40:01	54.2
8/4/2022 23:45:01	53.6
8/4/2022 23:50:01	52.8
8/4/2022 23:55:01	52.9
9/4/2022 00:00:01	51.8
9/4/2022 00:05:01	51.6
9/4/2022 00:10:01	52.1
9/4/2022 00:15:01	51.9
9/4/2022 00:20:01	51.7
9/4/2022 00:25:01	51.1
9/4/2022 00:30:01	50.8
9/4/2022 00:35:01	50.8
9/4/2022 00:40:01	51.4
9/4/2022 00:45:01	51.5
9/4/2022 00:50:01	51.7
9/4/2022 00:55:01	50.9
9/4/2022 01:00:01	50.7
9/4/2022 01:05:01	51
9/4/2022 01:10:01	51.2
9/4/2022 01:15:01	51.2
9/4/2022 01:20:01	51.8
9/4/2022 01:25:01	51.3
9/4/2022 01:30:01	51
9/4/2022 01:35:01	50.8
9/4/2022 01:40:01	51.3
9/4/2022 01:45:01	51
9/4/2022 01:50:01	51.5
9/4/2022 01:55:01	51.5
9/4/2022 02:00:01	50.9
9/4/2022 02:05:01	51.1
9/4/2022 02:10:01	50.9
9/4/2022 02:15:01	50.2
9/4/2022 02:20:01	50.5
9/4/2022 02:25:01	50.1
9/4/2022 02:30:01	49.6
9/4/2022 02:35:01	49.9
9/4/2022 02:40:01	49.5
9/4/2022 02:45:01	50.1
9/4/2022 02:50:01	50.2
9/4/2022 02:55:01	49.1
Sat, 9/4/2022, 03:00	49.4
9/4/2022 03:05:01	50.1
9/4/2022 03:10:01	49.9
9/4/2022 03:15:01	50.3
9/4/2022 03:20:01	49.5
9/4/2022 03:25:01	51
9/4/2022 03:30:01	50.1
9/4/2022 03:35:01	50.4
9/4/2022 03:40:01	49.7

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
8/6/2022 20:43:32	56.6
8/6/2022 20:48:32	56.5
8/6/2022 20:53:32	54.9
8/6/2022 20:58:32	56.9
8/6/2022 21:03:32	57.6
8/6/2022 21:08:32	57.1
8/6/2022 21:13:32	57.5
8/6/2022 21:18:32	55.3
8/6/2022 21:23:32	54.4
8/6/2022 21:28:32	53.1
8/6/2022 21:33:32	55.1
8/6/2022 21:38:32	47.9
8/6/2022 21:43:32	52.1
8/6/2022 21:48:32	57
8/6/2022 21:53:32	55.8
8/6/2022 21:58:32	55.1
8/6/2022 22:03:32	59.8
8/6/2022 22:08:32	63.3
8/6/2022 22:13:32	61.1
8/6/2022 22:18:32	65.8
8/6/2022 22:23:32	53.9
8/6/2022 22:28:32	53.4
8/6/2022 22:33:32	50.6
8/6/2022 22:38:32	52.7
8/6/2022 22:43:32	47.9
8/6/2022 22:48:32	47.8
8/6/2022 22:53:32	51.6
8/6/2022 22:58:32	48.2
8/6/2022 23:03:32	48.6
8/6/2022 23:08:32	49.3
8/6/2022 23:13:32	50.5
8/6/2022 23:18:32	50
8/6/2022 23:23:32	49.4
8/6/2022 23:28:32	49.4
8/6/2022 23:33:32	50.8
8/6/2022 23:38:32	50
8/6/2022 23:43:32	48.7
8/6/2022 23:48:32	47.9
8/6/2022 23:53:32	48.1
8/6/2022 23:58:32	48.2
9/6/2022 00:03:32	49.3
9/6/2022 00:08:32	48.7
9/6/2022 00:13:32	47.2
9/6/2022 00:18:32	47.4
9/6/2022 00:23:32	47.5
9/6/2022 00:28:32	49.8
9/6/2022 00:33:32	47.3
9/6/2022 00:38:32	47.4
9/6/2022 00:43:32	47.1

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
9/4/2022 03:45:01	49.6
9/4/2022 03:50:01	49.5
9/4/2022 03:55:01	49.1
9/4/2022 04:00:01	50.7
9/4/2022 04:05:01	50
9/4/2022 04:10:01	49.7
9/4/2022 04:15:01	49.4
9/4/2022 04:20:01	49.2
9/4/2022 04:25:01	49.5
9/4/2022 04:30:01	49.7
9/4/2022 04:35:01	49.8
9/4/2022 04:40:01	48.4
9/4/2022 04:45:01	49.4
9/4/2022 04:50:01	49.3
9/4/2022 04:55:01	50.1
9/4/2022 05:00:01	49.8
9/4/2022 05:05:01	50
9/4/2022 05:10:01	50.3
9/4/2022 05:15:01	50.6
9/4/2022 05:20:01	52.8
9/4/2022 05:25:01	52.7
9/4/2022 05:30:01	55.6
9/4/2022 05:35:01	61
9/4/2022 05:40:01	54.3
9/4/2022 05:45:01	56.1
9/4/2022 05:50:01	61.1
9/4/2022 05:55:01	54
9/4/2022 06:00:01	53.3
9/4/2022 06:05:01	53.4
9/4/2022 06:10:01	53.1
9/4/2022 06:15:01	53.6
9/4/2022 06:20:01	54.1
9/4/2022 06:25:01	54.2
9/4/2022 06:30:01	54.7
9/4/2022 06:35:01	55.5
9/4/2022 06:40:01	54.4
9/4/2022 06:45:01	55.8
9/4/2022 06:50:01	55.3
9/4/2022 06:55:01	55
Sat, 9/4/2022, 07:00	55.1
9/4/2022 07:05:01	54.6
9/4/2022 07:10:01	56.3
9/4/2022 07:15:01	52.9
9/4/2022 07:20:01	52.8
9/4/2022 07:25:01	53.8
9/4/2022 07:30:01	52.3
9/4/2022 07:35:01	54.1
9/4/2022 07:40:01	56.2
9/4/2022 07:45:01	52.7

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
9/6/2022 00:48:32	46.4
9/6/2022 00:53:32	46.3
9/6/2022 00:58:32	47.4
9/6/2022 01:03:32	47.7
9/6/2022 01:08:32	47.8
9/6/2022 01:13:32	47.2
9/6/2022 01:18:32	47.3
9/6/2022 01:23:32	46.5
9/6/2022 01:28:32	46.5
9/6/2022 01:33:32	46.7
9/6/2022 01:38:32	47.2
9/6/2022 01:43:32	46.1
9/6/2022 01:48:32	46.3
9/6/2022 01:53:32	46.1
9/6/2022 01:58:32	47.3
9/6/2022 02:03:32	46.8
9/6/2022 02:08:32	47.4
9/6/2022 02:13:32	46.6
9/6/2022 02:18:32	45.9
9/6/2022 02:23:32	46.3
9/6/2022 02:28:32	50.3
9/6/2022 02:33:32	46.6
9/6/2022 02:38:32	46.6
9/6/2022 02:43:32	45.8
9/6/2022 02:48:32	46.9
9/6/2022 02:53:32	47.4
9/6/2022 02:58:32	47.8
9/6/2022 03:03:32	47.4
9/6/2022 03:08:32	47.5
9/6/2022 03:13:32	47.1
9/6/2022 03:18:32	48.2
9/6/2022 03:23:32	48.1
9/6/2022 03:28:32	47.4
9/6/2022 03:33:32	47.5
9/6/2022 03:38:32	46.3
9/6/2022 03:43:32	45.4
9/6/2022 03:48:32	46.4
9/6/2022 03:53:32	46.1
9/6/2022 03:58:32	46.9
9/6/2022 04:03:32	48.2
9/6/2022 04:08:32	46.4
9/6/2022 04:13:32	46.8
9/6/2022 04:18:32	48.6
9/6/2022 04:23:32	46.5
9/6/2022 04:28:32	47.1
9/6/2022 04:33:32	50
9/6/2022 04:38:32	46.4
9/6/2022 04:43:32	46.6
9/6/2022 04:48:32	46.1

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
9/4/2022 07:50:01	52.9
9/4/2022 07:55:01	54
9/4/2022 08:00:01	53.4
9/4/2022 08:05:01	51.8
9/4/2022 08:10:01	54.9
9/4/2022 08:15:01	54.5
9/4/2022 08:20:01	54.2
9/4/2022 08:25:01	53.8
9/4/2022 08:30:01	55.1
9/4/2022 08:35:01	54.2
9/4/2022 08:40:01	54.5
9/4/2022 08:45:01	54.4
9/4/2022 08:50:01	53.2
9/4/2022 08:55:01	54
9/4/2022 09:00:01	55.4
9/4/2022 09:05:01	54
9/4/2022 09:10:01	53.6
9/4/2022 09:15:01	54
9/4/2022 09:20:01	53.9
9/4/2022 09:25:01	54
9/4/2022 09:30:01	53.4
9/4/2022 09:35:01	54.6
9/4/2022 09:40:01	54
9/4/2022 09:45:01	54.5
9/4/2022 09:50:01	53.1
9/4/2022 09:55:01	53.4
9/4/2022 10:00:01	55.2
9/4/2022 10:05:01	56.3
9/4/2022 10:10:01	56.4
9/4/2022 10:15:01	56.8
9/4/2022 10:20:01	56.1
9/4/2022 10:25:01	56
9/4/2022 10:30:01	55.9
9/4/2022 10:35:01	56.4
9/4/2022 10:40:01	56.4
9/4/2022 10:45:01	55.6
9/4/2022 10:50:01	56.5
9/4/2022 10:55:01	57.1
9/4/2022 11:00:01	56.5
9/4/2022 11:05:01	57
9/4/2022 11:10:01	57.1
9/4/2022 11:15:01	56.3
9/4/2022 11:20:01	55.3
9/4/2022 11:25:01	56.4
9/4/2022 11:30:01	56.2
9/4/2022 11:35:01	55.8
9/4/2022 11:40:01	54
9/4/2022 11:45:01	52.9
9/4/2022 11:50:01	53.8

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
9/6/2022 04:53:32	46.3
9/6/2022 04:58:32	45.6
9/6/2022 05:03:32	49.3
9/6/2022 05:08:32	46.3
9/6/2022 05:13:32	45.8
9/6/2022 05:18:32	47.2
9/6/2022 05:23:32	48.5
9/6/2022 05:28:32	46.3
9/6/2022 05:33:32	46.6
9/6/2022 05:38:32	46.7
9/6/2022 05:43:32	47.6
9/6/2022 05:48:32	50.8
9/6/2022 05:53:32	50.6
9/6/2022 05:58:32	50
9/6/2022 06:03:32	49.1
9/6/2022 06:08:32	52.4
9/6/2022 06:13:32	57.9
9/6/2022 06:18:32	59.1
9/6/2022 06:23:32	52.6
9/6/2022 06:28:32	60.3
9/6/2022 06:33:32	55.6
9/6/2022 06:38:32	58.8
9/6/2022 06:43:32	55.3
9/6/2022 06:48:32	57.3
9/6/2022 06:53:32	55.7
9/6/2022 06:58:32	53.9
9/6/2022 07:03:32	53.3
9/6/2022 07:08:32	53.6
9/6/2022 07:13:32	51.9
9/6/2022 07:18:32	51.3
9/6/2022 07:23:32	50
9/6/2022 07:28:32	50.2
9/6/2022 07:33:32	53.6
9/6/2022 07:38:32	49.1
9/6/2022 07:43:32	49.9
9/6/2022 07:48:32	49.6
9/6/2022 07:53:32	49.6
9/6/2022 07:58:32	48.9
9/6/2022 08:03:32	49.8
9/6/2022 08:08:32	51
9/6/2022 08:13:32	50.9
9/6/2022 08:18:32	48
9/6/2022 08:23:32	47.8
9/6/2022 08:28:32	50.1
9/6/2022 08:33:32	46.6
9/6/2022 08:38:32	48.6
9/6/2022 08:43:32	50.3
9/6/2022 08:48:32	53.1
9/6/2022 08:53:32	47.8

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
9/4/2022 11:55:01	53
9/4/2022 12:00:01	53.5
9/4/2022 12:05:01	53.7
9/4/2022 12:10:01	53
9/4/2022 12:15:01	53.2
9/4/2022 12:20:01	53.7
9/4/2022 12:25:01	53.4
9/4/2022 12:30:01	52.3
9/4/2022 12:35:01	53.9
9/4/2022 12:40:01	53.8
9/4/2022 12:45:01	52.1
9/4/2022 12:50:01	56.2
9/4/2022 12:55:01	54.4
9/4/2022 13:00:01	54.3
9/4/2022 13:05:01	54.3
9/4/2022 13:10:01	54.6
9/4/2022 13:15:01	55
9/4/2022 13:20:01	53.9
9/4/2022 13:25:01	54
9/4/2022 13:30:01	54.5
9/4/2022 13:35:01	53.3
9/4/2022 13:40:01	54.3
9/4/2022 13:45:01	55.1
9/4/2022 13:50:01	53.8
9/4/2022 13:55:01	53.7
9/4/2022 14:00:01	53.1
9/4/2022 14:05:01	52.6
9/4/2022 14:10:01	53.3
9/4/2022 14:15:01	53.3
9/4/2022 14:20:01	53.6
9/4/2022 14:25:01	54
9/4/2022 14:30:01	54.1
9/4/2022 14:35:01	53.2
9/4/2022 14:40:01	51.8
9/4/2022 14:45:01	53.6
9/4/2022 14:50:01	53.6
9/4/2022 14:55:01	52
Sat, 9/4/2022, 15:00	53.2
9/4/2022 15:05:01	53.7
9/4/2022 15:10:01	53
9/4/2022 15:15:01	54.1
9/4/2022 15:20:01	55.4
9/4/2022 15:25:01	54.6
9/4/2022 15:30:01	60
9/4/2022 15:35:01	53.7
9/4/2022 15:40:01	54.2
9/4/2022 15:45:01	53.9
9/4/2022 15:50:01	54.4
9/4/2022 15:55:01	53.8

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
9/6/2022 08:58:32	49.9
9/6/2022 09:03:32	46.2
9/6/2022 09:08:32	49.4
9/6/2022 09:13:32	48.7
9/6/2022 09:18:32	52.1
9/6/2022 09:23:32	50.5
9/6/2022 09:28:32	45.8
9/6/2022 09:33:32	50.8
9/6/2022 09:38:32	50.3
9/6/2022 09:43:32	50.2
9/6/2022 09:48:32	47
9/6/2022 09:53:32	47.2
9/6/2022 09:58:32	45.8
9/6/2022 10:03:32	46.9
9/6/2022 10:08:32	50.5
9/6/2022 10:13:32	46.9
9/6/2022 10:18:32	44
9/6/2022 10:23:32	45.8
9/6/2022 10:28:32	48.1
9/6/2022 10:33:32	45.4
9/6/2022 10:38:32	43
9/6/2022 10:43:32	48.3
9/6/2022 10:48:32	46.6
9/6/2022 10:53:32	45.5
9/6/2022 10:58:32	59.2
9/6/2022 11:03:32	45.2
9/6/2022 11:08:32	44.6
9/6/2022 11:13:32	45.7
9/6/2022 11:18:32	53.3
9/6/2022 11:23:32	56
9/6/2022 11:28:32	50.4
9/6/2022 11:33:32	53.1
9/6/2022 11:38:32	54.6
9/6/2022 11:43:32	47.3
9/6/2022 11:48:32	49.2
9/6/2022 11:53:32	51.7
9/6/2022 11:58:32	46.1
9/6/2022 12:03:32	45
9/6/2022 12:08:32	44.3
9/6/2022 12:13:32	45
9/6/2022 12:18:32	46
9/6/2022 12:23:32	44.1
9/6/2022 12:28:32	45.8
9/6/2022 12:33:32	51.9
9/6/2022 12:38:32	44.6
9/6/2022 12:43:32	47.8
9/6/2022 12:48:32	45.2
9/6/2022 12:53:32	45.6
9/6/2022 12:58:32	47.8

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
9/4/2022 16:00:01	53.3
9/4/2022 16:05:01	54
9/4/2022 16:10:01	53.8
9/4/2022 16:15:01	53.7
9/4/2022 16:20:01	53.6
9/4/2022 16:25:01	54.1
9/4/2022 16:30:01	52.7
9/4/2022 16:35:01	53.9
9/4/2022 16:40:01	53.7
9/4/2022 16:45:01	54
9/4/2022 16:50:01	54.1
9/4/2022 16:55:01	53.8
9/4/2022 17:00:01	55
9/4/2022 17:05:01	52.6
9/4/2022 17:10:01	54.5
9/4/2022 17:15:01	53.9
9/4/2022 17:20:01	53.9
9/4/2022 17:25:01	54.3
9/4/2022 17:30:01	53.4
9/4/2022 17:35:01	53.3
9/4/2022 17:40:01	53.7
9/4/2022 17:45:01	53.1
9/4/2022 17:50:01	53.5
9/4/2022 17:55:01	53.3
9/4/2022 18:00:01	54.4
9/4/2022 18:05:01	54.1
9/4/2022 18:10:01	53.2
9/4/2022 18:15:01	54.3
9/4/2022 18:20:01	53.9
9/4/2022 18:25:01	53.3
9/4/2022 18:30:01	54.4
9/4/2022 18:35:01	52.9
9/4/2022 18:40:01	52.5
9/4/2022 18:45:01	53.5
9/4/2022 18:50:01	52.3
9/4/2022 18:55:01	53.3
Sat, 9/4/2022, 19:00	53.1
9/4/2022 19:05:01	52.4
9/4/2022 19:10:01	51.7
9/4/2022 19:15:01	53.4
9/4/2022 19:20:01	52.3
9/4/2022 19:25:01	53.4
9/4/2022 19:30:01	53.3
9/4/2022 19:35:01	52.1
9/4/2022 19:40:01	52.1
9/4/2022 19:45:01	52.9
9/4/2022 19:50:01	52.1
9/4/2022 19:55:01	53.1
9/4/2022 20:00:01	54.2

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
9/6/2022 13:03:32	47.5
9/6/2022 13:08:32	49.6
9/6/2022 13:13:32	46.1
9/6/2022 13:18:32	46
9/6/2022 13:23:32	59.7
9/6/2022 13:28:32	45.7
9/6/2022 13:33:32	50.3
9/6/2022 13:38:32	47.9
9/6/2022 13:43:32	57.1
9/6/2022 13:48:32	48.1
9/6/2022 13:53:32	53.9
9/6/2022 13:58:32	48.1
9/6/2022 14:03:32	50.1
9/6/2022 14:08:32	51.1
9/6/2022 14:13:32	50.2
9/6/2022 14:18:32	51.4
9/6/2022 14:23:32	54.7
9/6/2022 14:28:32	57.2
9/6/2022 14:33:32	52.8
9/6/2022 14:38:32	52.2
9/6/2022 14:43:32	50.1
9/6/2022 14:48:32	49.7
9/6/2022 14:53:32	51.6
9/6/2022 14:58:32	52.6
9/6/2022 15:03:32	51.2
9/6/2022 15:08:32	47.8
9/6/2022 15:13:32	53.9
9/6/2022 15:18:32	43.5
9/6/2022 15:23:32	58
9/6/2022 15:28:32	45.8
9/6/2022 15:33:32	44.6
9/6/2022 15:38:32	49.4
9/6/2022 15:43:32	47.3
9/6/2022 15:48:32	47.4
9/6/2022 15:53:32	45.5
9/6/2022 15:58:32	58.8
9/6/2022 16:03:32	44.6
9/6/2022 16:08:32	55.4
9/6/2022 16:13:32	47.5
9/6/2022 16:18:32	47.1
9/6/2022 16:23:32	45.2
9/6/2022 16:28:32	47.3
9/6/2022 16:33:32	50.1
9/6/2022 16:38:32	49.5
9/6/2022 16:43:32	46.4
9/6/2022 16:48:32	45.1
9/6/2022 16:53:32	46.6
9/6/2022 16:58:32	47.2
9/6/2022 17:03:32	44.5

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
9/4/2022 20:05:01	53.3
9/4/2022 20:10:01	53.1
9/4/2022 20:15:01	52.6
9/4/2022 20:20:01	53.6
9/4/2022 20:25:01	53
9/4/2022 20:30:01	52.5
9/4/2022 20:35:01	53
9/4/2022 20:40:01	53.5
9/4/2022 20:45:01	52.2
9/4/2022 20:50:01	53
9/4/2022 20:55:01	52.3
9/4/2022 21:00:01	52.9
9/4/2022 21:05:01	53.3
9/4/2022 21:10:01	53.1
9/4/2022 21:15:01	52.9
9/4/2022 21:20:01	53.1
9/4/2022 21:25:01	54.7
9/4/2022 21:30:01	54.7
9/4/2022 21:35:01	54.9
9/4/2022 21:40:01	56.1
9/4/2022 21:45:01	56
9/4/2022 21:50:01	56.3
9/4/2022 21:55:01	56.2
9/4/2022 22:00:01	55.8
9/4/2022 22:05:01	56.1
9/4/2022 22:10:01	56.5
9/4/2022 22:15:01	56.5
9/4/2022 22:20:01	56.2
9/4/2022 22:25:01	56.3
9/4/2022 22:30:01	56.5
9/4/2022 22:35:01	56.2
9/4/2022 22:40:01	57.2
9/4/2022 22:45:01	56.1
9/4/2022 22:50:01	55
9/4/2022 22:55:01	55.6
9/4/2022 23:00:01	55.4
9/4/2022 23:05:01	55.3
9/4/2022 23:10:01	54.8
9/4/2022 23:15:01	53.7
9/4/2022 23:20:01	54.4
9/4/2022 23:25:01	54.3
9/4/2022 23:30:01	53.5
9/4/2022 23:35:01	53.3
9/4/2022 23:40:01	53.3
9/4/2022 23:45:01	52.3
9/4/2022 23:50:01	53.2
9/4/2022 23:55:01	52.8
10/4/2022 00:00:01	52.5
10/4/2022 00:05:01	52.9

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
9/6/2022 17:08:32	48.4
9/6/2022 17:13:32	51.2
9/6/2022 17:18:32	47.5
9/6/2022 17:23:32	47.5
9/6/2022 17:28:32	48.7
9/6/2022 17:33:32	53
9/6/2022 17:38:32	52.9
9/6/2022 17:43:32	45.7
9/6/2022 17:48:32	49.9
9/6/2022 17:53:32	46.5
9/6/2022 17:58:32	46.7
9/6/2022 18:03:32	44
9/6/2022 18:08:32	46.6
9/6/2022 18:13:32	49.2
9/6/2022 18:18:32	47.9
9/6/2022 18:23:32	48.3
9/6/2022 18:28:32	50.5
9/6/2022 18:33:32	57.8
9/6/2022 18:38:32	63.9
9/6/2022 18:43:32	70.6
9/6/2022 18:48:32	63.8
9/6/2022 18:53:32	66.2
9/6/2022 18:58:32	63.5
9/6/2022 19:03:32	51.8
9/6/2022 19:08:32	50.6
9/6/2022 19:13:32	48.5
9/6/2022 19:18:32	48.6
9/6/2022 19:23:32	47.4
9/6/2022 19:28:32	47.3
9/6/2022 19:33:32	46.3
9/6/2022 19:38:32	48.2
9/6/2022 19:43:32	46.2
9/6/2022 19:48:32	49.2
9/6/2022 19:53:32	48.2
9/6/2022 19:58:32	47.3
9/6/2022 20:03:32	49.3
9/6/2022 20:08:32	47.5
9/6/2022 20:13:32	48.3
9/6/2022 20:18:32	50.1
9/6/2022 20:23:32	49.5
9/6/2022 20:28:32	50.6
9/6/2022 20:33:32	49.9
9/6/2022 20:38:32	49.6
9/6/2022 20:43:32	48.9
9/6/2022 20:48:32	46.7
9/6/2022 20:53:32	45.4
9/6/2022 20:58:32	45.4
9/6/2022 21:03:32	45.1
9/6/2022 21:08:32	45.7

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
10/4/2022 00:10:01	52.4
10/4/2022 00:15:01	51.8
10/4/2022 00:20:01	52.5
10/4/2022 00:25:01	51.9
10/4/2022 00:30:01	51.1
10/4/2022 00:35:01	51.6
10/4/2022 00:40:01	51.6
10/4/2022 00:45:01	55.6
10/4/2022 00:50:01	54.9
10/4/2022 00:55:01	54.4
10/4/2022 01:00:01	54.7
10/4/2022 01:05:01	54.4
10/4/2022 01:10:01	54.1
10/4/2022 01:15:01	53.9
10/4/2022 01:20:01	54.1
10/4/2022 01:25:01	54.1
10/4/2022 01:30:01	54.4
10/4/2022 01:35:01	51
10/4/2022 01:40:01	50.7
10/4/2022 01:45:01	50.9
10/4/2022 01:50:01	52.3
10/4/2022 01:55:01	58.3
10/4/2022 02:00:01	52.6
10/4/2022 02:05:01	50.7
10/4/2022 02:10:01	50.9
10/4/2022 02:15:01	55.6
10/4/2022 02:20:01	56.2
10/4/2022 02:25:01	53.2
10/4/2022 02:30:01	50
10/4/2022 02:35:01	50
10/4/2022 02:40:01	50.3
10/4/2022 02:45:01	54
10/4/2022 02:50:01	52.5
10/4/2022 02:55:01	52.6
Sun, 10/4/2022, 03:00	52.3
10/4/2022 03:05:01	52.5
10/4/2022 03:10:01	52.4
10/4/2022 03:15:01	52.7
10/4/2022 03:20:01	52.9
10/4/2022 03:25:01	52.5
10/4/2022 03:30:01	52.7
10/4/2022 03:35:01	52.3
10/4/2022 03:40:01	52.5
10/4/2022 03:45:01	52.4
10/4/2022 03:50:01	52.4
10/4/2022 03:55:01	52.3
10/4/2022 04:00:01	52.4
10/4/2022 04:05:01	53.7
10/4/2022 04:10:01	52.5

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
9/6/2022 21:13:32	48.1
9/6/2022 21:18:32	46.8
9/6/2022 21:23:32	45.1
9/6/2022 21:28:32	47.4
9/6/2022 21:33:32	49.4
9/6/2022 21:38:32	46
9/6/2022 21:43:32	46.5
9/6/2022 21:48:32	50.8
9/6/2022 21:53:32	46.7
9/6/2022 21:58:32	47.1
9/6/2022 22:03:32	48
9/6/2022 22:08:32	47.1
9/6/2022 22:13:32	46.3
9/6/2022 22:18:32	47.5
9/6/2022 22:23:32	48
9/6/2022 22:28:32	47
9/6/2022 22:33:32	47.9
9/6/2022 22:38:32	47
9/6/2022 22:43:32	47.2
9/6/2022 22:48:32	46.6
9/6/2022 22:53:32	46.8
9/6/2022 22:58:32	46.6
9/6/2022 23:03:32	47.2
9/6/2022 23:08:32	46.4
9/6/2022 23:13:32	49.4
9/6/2022 23:18:32	46.5
9/6/2022 23:23:32	46
9/6/2022 23:28:32	46.2
9/6/2022 23:33:32	45.6
9/6/2022 23:38:32	47
9/6/2022 23:43:32	46.6
9/6/2022 23:48:32	46.7
9/6/2022 23:53:32	46.5
9/6/2022 23:58:32	47
10/6/2022 00:03:32	46.2
10/6/2022 00:08:32	48.2
10/6/2022 00:13:32	45.9
10/6/2022 00:18:32	47
10/6/2022 00:23:32	47.5
10/6/2022 00:28:32	46.5
10/6/2022 00:33:32	46.6
10/6/2022 00:38:32	46.5
10/6/2022 00:43:32	45.7
10/6/2022 00:48:32	47.8
10/6/2022 00:53:32	49.3
10/6/2022 00:58:32	46.2
10/6/2022 01:03:32	46.2
10/6/2022 01:08:32	47.6
10/6/2022 01:13:32	47.3

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
10/4/2022 04:15:01	52.7
10/4/2022 04:20:01	52.8
10/4/2022 04:25:01	53
10/4/2022 04:30:01	52.8
10/4/2022 04:35:01	54.1
10/4/2022 04:40:01	50.9
10/4/2022 04:45:01	51
10/4/2022 04:50:01	51
10/4/2022 04:55:01	51.7
10/4/2022 05:00:01	52.2
10/4/2022 05:05:01	52.1
10/4/2022 05:10:01	52.5
10/4/2022 05:15:01	51.8
10/4/2022 05:20:01	52
10/4/2022 05:25:01	51.9
10/4/2022 05:30:01	52.8
10/4/2022 05:35:01	51.5
10/4/2022 05:40:01	51.8
10/4/2022 05:45:01	52.6
10/4/2022 05:50:01	52.1
10/4/2022 05:55:01	53
10/4/2022 06:00:01	52.1
10/4/2022 06:05:01	52.4
10/4/2022 06:10:01	53.5
10/4/2022 06:15:01	52.4
10/4/2022 06:20:01	53.2
10/4/2022 06:25:01	52.8
10/4/2022 06:30:01	53.5
10/4/2022 06:35:01	53.8
10/4/2022 06:40:01	54.2
10/4/2022 06:45:01	53.5
10/4/2022 06:50:01	54.4
10/4/2022 06:55:01	53.8
Sun, 10/4/2022, 07:00	53.2
10/4/2022 07:05:01	52.8
10/4/2022 07:10:01	52.6
10/4/2022 07:15:01	53.1
10/4/2022 07:20:01	56
10/4/2022 07:25:01	55.1
10/4/2022 07:30:01	52.7
10/4/2022 07:35:01	52.4
10/4/2022 07:40:01	53.3
10/4/2022 07:45:01	54.6
10/4/2022 07:50:01	54.1
10/4/2022 07:55:01	53.4
10/4/2022 08:00:01	53.3
10/4/2022 08:05:01	53
10/4/2022 08:10:01	52.6
10/4/2022 08:15:01	51.8

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
10/6/2022 01:18:32	44.9
10/6/2022 01:23:32	47.5
10/6/2022 01:28:32	45.7
10/6/2022 01:33:32	46.2
10/6/2022 01:38:32	46.2
10/6/2022 01:43:32	45.9
10/6/2022 01:48:32	44.9
10/6/2022 01:53:32	47.3
10/6/2022 01:58:32	48.8
10/6/2022 02:03:32	44.3
10/6/2022 02:08:32	50.5
10/6/2022 02:13:32	46.6
10/6/2022 02:18:32	46.3
10/6/2022 02:23:32	47.2
10/6/2022 02:28:32	48.2
10/6/2022 02:33:32	48
10/6/2022 02:38:32	48
10/6/2022 02:43:32	47.5
10/6/2022 02:48:32	51.3
10/6/2022 02:53:32	48.8
10/6/2022 02:58:32	50.3
10/6/2022 03:03:32	50.2
10/6/2022 03:08:32	47
10/6/2022 03:13:32	50
10/6/2022 03:18:32	48.2
10/6/2022 03:23:32	51.3
10/6/2022 03:28:32	48.8
10/6/2022 03:33:32	51.2
10/6/2022 03:38:32	50.7
10/6/2022 03:43:32	50.1
10/6/2022 03:48:32	46.4
10/6/2022 03:53:32	46.7
10/6/2022 03:58:32	45.9
10/6/2022 04:03:32	46.4
10/6/2022 04:08:32	45.9
10/6/2022 04:13:32	46.2
10/6/2022 04:18:32	47.2
10/6/2022 04:23:32	46
10/6/2022 04:28:32	47.4
10/6/2022 04:33:32	47
10/6/2022 04:38:32	46.6
10/6/2022 04:43:32	46.5
10/6/2022 04:48:32	46.6
10/6/2022 04:53:32	46.8
10/6/2022 04:58:32	46.3
10/6/2022 05:03:32	46.1
10/6/2022 05:08:32	47
10/6/2022 05:13:32	46
10/6/2022 05:18:32	47.4

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
10/4/2022 08:20:01	53.1
10/4/2022 08:25:01	52.7
10/4/2022 08:30:01	53.2
10/4/2022 08:35:01	52.2
10/4/2022 08:40:01	52.4
10/4/2022 08:45:01	53.1
10/4/2022 08:50:01	52.7
10/4/2022 08:55:01	53.4
10/4/2022 09:00:01	53.6
10/4/2022 09:05:01	52.2
10/4/2022 09:10:01	51
10/4/2022 09:15:01	51.7
10/4/2022 09:20:01	52.1
10/4/2022 09:25:01	52.7
10/4/2022 09:30:01	50.9
10/4/2022 09:35:01	53.5
10/4/2022 09:40:01	52
10/4/2022 09:45:01	51.9
10/4/2022 09:50:01	52.1
10/4/2022 09:55:01	51.4
10/4/2022 10:00:01	52.7
10/4/2022 10:05:01	51.8
10/4/2022 10:10:01	51.1
10/4/2022 10:15:01	52.1
10/4/2022 10:20:01	51.7
10/4/2022 10:25:01	51.8
10/4/2022 10:30:01	53.1
10/4/2022 10:35:01	53.2
10/4/2022 10:40:01	52
10/4/2022 10:45:01	52.7
10/4/2022 10:50:01	52.6
10/4/2022 10:55:01	53.4
10/4/2022 11:00:01	53.4
10/4/2022 11:05:01	53
10/4/2022 11:10:01	53.5
10/4/2022 11:15:01	52.9
10/4/2022 11:20:01	52.9
10/4/2022 11:25:01	53.1
10/4/2022 11:30:01	52.6
10/4/2022 11:35:01	52.2
10/4/2022 11:40:01	52.9
10/4/2022 11:45:01	52.4
10/4/2022 11:50:01	51.9
10/4/2022 11:55:01	53.1
10/4/2022 12:00:01	52.2
10/4/2022 12:05:01	52.2
10/4/2022 12:10:01	51.7
10/4/2022 12:15:01	53.1
10/4/2022 12:20:01	54

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
10/6/2022 05:23:32	48.4
10/6/2022 05:28:32	47
10/6/2022 05:33:32	46.8
10/6/2022 05:38:32	46.4
10/6/2022 05:43:32	49.9
10/6/2022 05:48:32	48.6
10/6/2022 05:53:32	48.3
10/6/2022 05:58:32	49.5
10/6/2022 06:03:32	52.9
10/6/2022 06:08:32	51.2
10/6/2022 06:13:32	54.3
10/6/2022 06:18:32	51.1
10/6/2022 06:23:32	54.3
10/6/2022 06:28:32	50.3
10/6/2022 06:33:32	49.6
10/6/2022 06:38:32	50
10/6/2022 06:43:32	50.3
10/6/2022 06:48:32	50.9
10/6/2022 06:53:32	49.9
10/6/2022 06:58:32	49.7
10/6/2022 07:03:32	54.6
10/6/2022 07:08:32	50.7
10/6/2022 07:13:32	48.3
10/6/2022 07:18:32	55.5
10/6/2022 07:23:32	55.2
10/6/2022 07:28:32	49.9
10/6/2022 07:33:32	48.3
10/6/2022 07:38:32	52.1
10/6/2022 07:43:32	52.8
10/6/2022 07:48:32	53.6
10/6/2022 07:53:32	62.8
10/6/2022 07:58:32	50.6
10/6/2022 08:03:32	53
10/6/2022 08:08:32	54.6
10/6/2022 08:13:32	52
10/6/2022 08:18:32	61.1
10/6/2022 08:23:32	63.4
10/6/2022 08:28:32	59.8
10/6/2022 08:33:32	71.5
10/6/2022 08:38:32	73.6
10/6/2022 08:43:32	50.7
10/6/2022 08:48:32	54.5
10/6/2022 08:53:32	56.2
10/6/2022 08:58:32	53
10/6/2022 09:03:32	49.3
10/6/2022 09:08:32	49.8
10/6/2022 09:13:32	52.5
10/6/2022 09:18:32	47.8
10/6/2022 09:23:32	54.3

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
10/4/2022 12:25:01	53.3
10/4/2022 12:30:01	52.8
10/4/2022 12:35:01	53.6
10/4/2022 12:40:01	64.5
10/4/2022 12:45:01	54.8
10/4/2022 12:50:01	53.4
10/4/2022 12:55:01	52.9
10/4/2022 13:00:01	53.6
10/4/2022 13:05:01	52.7
10/4/2022 13:10:01	52.7
10/4/2022 13:15:01	52.9
10/4/2022 13:20:01	52.8
10/4/2022 13:25:01	53.2
10/4/2022 13:30:01	52.2
10/4/2022 13:35:01	52.9
10/4/2022 13:40:01	52.8
10/4/2022 13:45:01	53.1
10/4/2022 13:50:01	52.2
10/4/2022 13:55:01	53.8
10/4/2022 14:00:01	53.5
10/4/2022 14:05:01	52.6
10/4/2022 14:10:01	52.2
10/4/2022 14:15:01	52.8
10/4/2022 14:20:01	51.9
10/4/2022 14:25:01	52.2
10/4/2022 14:30:01	50.7
10/4/2022 14:35:01	51.8
10/4/2022 14:40:01	51.7
10/4/2022 14:45:01	50.9
10/4/2022 14:50:01	51.9
10/4/2022 14:55:01	52.6
Sun, 10/4/2022, 15:00	51.7
10/4/2022 15:05:01	54.3
10/4/2022 15:10:01	51
10/4/2022 15:15:01	52.7
10/4/2022 15:20:01	52.7
10/4/2022 15:25:01	50.8
10/4/2022 15:30:01	53.3
10/4/2022 15:35:01	51.8
10/4/2022 15:40:01	52.4
10/4/2022 15:45:01	52.1
10/4/2022 15:50:01	51.5
10/4/2022 15:55:01	52.5
10/4/2022 16:00:01	51
10/4/2022 16:05:01	51
10/4/2022 16:10:01	52.1
10/4/2022 16:15:01	51.8
10/4/2022 16:20:01	52.9
10/4/2022 16:25:01	50.8

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
10/6/2022 09:28:32	47.3
10/6/2022 09:33:32	46.9
10/6/2022 09:38:32	51.2
10/6/2022 09:43:32	49.5
10/6/2022 09:48:32	53
10/6/2022 09:53:32	52.8
10/6/2022 09:58:32	53.6
10/6/2022 10:03:32	53.5
10/6/2022 10:08:32	47.3
10/6/2022 10:13:32	48.7
10/6/2022 10:18:32	48
10/6/2022 10:23:32	48.4
10/6/2022 10:28:32	51.7
10/6/2022 10:33:32	48
10/6/2022 10:38:32	48.7
10/6/2022 10:43:32	49.4
10/6/2022 10:48:32	44.4
10/6/2022 10:53:32	46.6
10/6/2022 10:58:32	51.2
10/6/2022 11:03:32	47.4
10/6/2022 11:08:32	48
10/6/2022 11:13:32	48.4
10/6/2022 11:18:32	48.9
10/6/2022 11:23:32	52.3
10/6/2022 11:28:32	51.4
10/6/2022 11:33:32	53
10/6/2022 11:38:32	54.2
10/6/2022 11:43:32	49
10/6/2022 11:48:32	52.7
10/6/2022 11:53:32	51
10/6/2022 11:58:32	51.9
10/6/2022 12:03:32	59.5
10/6/2022 12:08:32	49.3
10/6/2022 12:13:32	50.1
10/6/2022 12:18:32	45.2
10/6/2022 12:23:32	44.6
10/6/2022 12:28:32	44
10/6/2022 12:33:32	43.7
10/6/2022 12:38:32	49.1
10/6/2022 12:43:32	46.9
10/6/2022 12:48:32	45.8
10/6/2022 12:53:32	52.1
10/6/2022 12:58:32	52.5
10/6/2022 13:03:32	49.4
10/6/2022 13:08:32	45.4
10/6/2022 13:13:32	44.7
10/6/2022 13:18:32	48.3
10/6/2022 13:23:32	48.2
10/6/2022 13:28:32	49.5

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
10/4/2022 16:30:01	52.2
10/4/2022 16:35:01	52.2
10/4/2022 16:40:01	53.5
10/4/2022 16:45:01	53
10/4/2022 16:50:01	52.7
10/4/2022 16:55:01	53.5
10/4/2022 17:00:01	53.3
10/4/2022 17:05:01	53.4
10/4/2022 17:10:01	52.3
10/4/2022 17:15:01	52.2
10/4/2022 17:20:01	52.6
10/4/2022 17:25:01	52.7
10/4/2022 17:30:01	53
10/4/2022 17:35:01	52.2
10/4/2022 17:40:01	53.5
10/4/2022 17:45:01	52
10/4/2022 17:50:01	52.7
10/4/2022 17:55:01	52.8
10/4/2022 18:00:01	53
10/4/2022 18:05:01	53
10/4/2022 18:10:01	52.8
10/4/2022 18:15:01	52.7
10/4/2022 18:20:01	53.8
10/4/2022 18:25:01	52.4
10/4/2022 18:30:01	52.1
10/4/2022 18:35:01	52.4
10/4/2022 18:40:01	53.1
10/4/2022 18:45:01	52.9
10/4/2022 18:50:01	52.3
10/4/2022 18:55:01	51.8
Sun, 10/4/2022, 19:00	52
10/4/2022 19:05:01	51.6
10/4/2022 19:10:01	51.8
10/4/2022 19:15:01	52.5
10/4/2022 19:20:01	53.1
10/4/2022 19:25:01	52.5
10/4/2022 19:30:01	52.5
10/4/2022 19:35:01	52.1
10/4/2022 19:40:01	52.8
10/4/2022 19:45:01	53.8
10/4/2022 19:50:01	53.3
10/4/2022 19:55:01	54.7
10/4/2022 20:00:01	54
10/4/2022 20:05:01	53.4
10/4/2022 20:10:01	53.3
10/4/2022 20:15:01	53.6
10/4/2022 20:20:01	53.2
10/4/2022 20:25:01	54.4
10/4/2022 20:30:01	52.8

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
10/6/2022 13:33:32	49.7
10/6/2022 13:38:32	47.5
10/6/2022 13:43:32	46.8
10/6/2022 13:48:32	49.1
10/6/2022 13:53:32	45.3
10/6/2022 13:58:32	48.1
10/6/2022 14:03:32	49.5
10/6/2022 14:08:32	48.1
10/6/2022 14:13:32	47
10/6/2022 14:18:32	69.3
10/6/2022 14:23:32	59.4
10/6/2022 14:28:32	58.4
10/6/2022 14:33:32	68.2
10/6/2022 14:38:32	51.5
10/6/2022 14:43:32	57.2
10/6/2022 14:48:32	48.1
10/6/2022 14:53:32	47.5
10/6/2022 14:58:32	45.6
10/6/2022 15:03:32	49.8
10/6/2022 15:08:32	47.8
10/6/2022 15:13:32	45.9
10/6/2022 15:18:32	57.3
10/6/2022 15:23:32	50.1
10/6/2022 15:28:32	46.8
10/6/2022 15:33:32	56.3
10/6/2022 15:38:32	49.2
10/6/2022 15:43:32	60.9
10/6/2022 15:48:32	50.5
10/6/2022 15:53:32	50.2
10/6/2022 15:58:32	47.2
10/6/2022 16:03:32	47.7
10/6/2022 16:08:32	52.7
10/6/2022 16:13:32	54.4
10/6/2022 16:18:32	47.5
10/6/2022 16:23:32	50.3
10/6/2022 16:28:32	57
10/6/2022 16:33:32	49.4
10/6/2022 16:38:32	52.5
10/6/2022 16:43:32	62.9
10/6/2022 16:48:32	53.9
10/6/2022 16:53:32	46.6
10/6/2022 16:58:32	50.6
10/6/2022 17:03:32	53
10/6/2022 17:08:32	52.6
10/6/2022 17:13:32	48.7
10/6/2022 17:18:32	50.2
10/6/2022 17:23:32	51.2
10/6/2022 17:28:32	61
10/6/2022 17:33:32	55.5

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
10/4/2022 20:35:01	54.6
10/4/2022 20:40:01	54.1
10/4/2022 20:45:01	53.5
10/4/2022 20:50:01	53.7
10/4/2022 20:55:01	53
10/4/2022 21:00:01	54.1
10/4/2022 21:05:01	53.8
10/4/2022 21:10:01	53.6
10/4/2022 21:15:01	54.5
10/4/2022 21:20:01	53.9
10/4/2022 21:25:01	54.9
10/4/2022 21:30:01	54.9
10/4/2022 21:35:01	54.2
10/4/2022 21:40:01	55.4
10/4/2022 21:45:01	55.1
10/4/2022 21:50:01	54.8
10/4/2022 21:55:01	55.1
10/4/2022 22:00:01	55.6
10/4/2022 22:05:01	55.9
10/4/2022 22:10:01	55.9
10/4/2022 22:15:01	56
10/4/2022 22:20:01	55.6
10/4/2022 22:25:01	55.3
10/4/2022 22:30:01	55.9
10/4/2022 22:35:01	56
10/4/2022 22:40:01	55.4
10/4/2022 22:45:01	55.7
10/4/2022 22:50:01	55.3
10/4/2022 22:55:01	54.9
10/4/2022 23:00:01	54.9
10/4/2022 23:05:01	55.1
10/4/2022 23:10:01	56.6
10/4/2022 23:15:01	56.1
10/4/2022 23:20:01	55.9
10/4/2022 23:25:01	55.7
10/4/2022 23:30:01	55.3
10/4/2022 23:35:01	56
10/4/2022 23:40:01	55.4
10/4/2022 23:45:01	53
10/4/2022 23:50:01	51.3
10/4/2022 23:55:01	54.4
11/4/2022 00:00:01	51.5
11/4/2022 00:05:01	52
11/4/2022 00:10:01	52.4
11/4/2022 00:15:01	52.4
11/4/2022 00:20:01	51.1
11/4/2022 00:25:01	51.4
11/4/2022 00:30:01	51
11/4/2022 00:35:01	50.9

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
10/6/2022 17:38:32	55.7
10/6/2022 17:43:32	52.8
10/6/2022 17:48:32	48
10/6/2022 17:53:32	47.3
10/6/2022 17:58:32	53.7
10/6/2022 18:03:32	49
10/6/2022 18:08:32	57.5
10/6/2022 18:13:32	53.4
10/6/2022 18:18:32	53.1
10/6/2022 18:23:32	53.6
10/6/2022 18:28:32	49.2
10/6/2022 18:33:32	51.9
10/6/2022 18:38:32	50.6
10/6/2022 18:43:32	50.2
10/6/2022 18:48:32	48.4
10/6/2022 18:53:32	49.3
10/6/2022 18:58:32	45.4
10/6/2022 19:03:32	48.8
10/6/2022 19:08:32	46.4
10/6/2022 19:13:32	46.4
10/6/2022 19:18:32	52.5
10/6/2022 19:23:32	46
10/6/2022 19:28:32	46.3
10/6/2022 19:33:32	50.9
10/6/2022 19:38:32	51.4
10/6/2022 19:43:32	53.3
10/6/2022 19:48:32	53.3
10/6/2022 19:53:32	51.4
10/6/2022 19:58:32	53.2
10/6/2022 20:03:32	47.5
10/6/2022 20:08:32	49.4
10/6/2022 20:13:32	51.8
10/6/2022 20:18:32	52.5
10/6/2022 20:23:32	50.4
10/6/2022 20:28:32	50.2
10/6/2022 20:33:32	52
10/6/2022 20:38:32	53.6
10/6/2022 20:43:32	48.5
10/6/2022 20:48:32	56.9
10/6/2022 20:53:32	47
10/6/2022 20:58:32	47.8
10/6/2022 21:03:32	49.4
10/6/2022 21:08:32	49
10/6/2022 21:13:32	49.6
10/6/2022 21:18:32	48.5
10/6/2022 21:23:32	49.1
10/6/2022 21:28:32	49.8
10/6/2022 21:33:32	50.4
10/6/2022 21:38:32	49.5

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
11/4/2022 00:40:01	50.8
11/4/2022 00:45:01	50.8
11/4/2022 00:50:01	50
11/4/2022 00:55:01	50.1
11/4/2022 01:00:01	49.6
11/4/2022 01:05:01	49.8
11/4/2022 01:10:01	50.4
11/4/2022 01:15:01	49.2
11/4/2022 01:20:01	48.9
11/4/2022 01:25:01	49.8
11/4/2022 01:30:01	49.4
11/4/2022 01:35:01	49.5
11/4/2022 01:40:01	49.4
11/4/2022 01:45:01	49.6
11/4/2022 01:50:01	49.7
11/4/2022 01:55:01	49.3
11/4/2022 02:00:01	49
11/4/2022 02:05:01	49.7
11/4/2022 02:10:01	50.2
11/4/2022 02:15:01	49.6
11/4/2022 02:20:01	49.3
11/4/2022 02:25:01	49.4
11/4/2022 02:30:01	49.5
11/4/2022 02:35:01	48.8
11/4/2022 02:40:01	48.9
11/4/2022 02:45:01	49.8
11/4/2022 02:50:01	48.7
11/4/2022 02:55:01	48.7
Mon, 11/4/2022, 03:00	49.9
11/4/2022 03:05:01	49.7
11/4/2022 03:10:01	48.9
11/4/2022 03:15:01	48.8
11/4/2022 03:20:01	48.7
11/4/2022 03:25:01	47.3
11/4/2022 03:30:01	48
11/4/2022 03:35:01	47.9
11/4/2022 03:40:01	47.9
11/4/2022 03:45:01	48.1
11/4/2022 03:50:01	48.3
11/4/2022 03:55:01	48.5
11/4/2022 04:00:01	47.5
11/4/2022 04:05:01	48.2
11/4/2022 04:10:01	51.1
11/4/2022 04:15:01	47.6
11/4/2022 04:20:01	49.4
11/4/2022 04:25:01	49.7
11/4/2022 04:30:01	48.9
11/4/2022 04:35:01	49.1
11/4/2022 04:40:01	49.2

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
10/6/2022 21:43:32	48.2
10/6/2022 21:48:32	48
10/6/2022 21:53:32	49.1
10/6/2022 21:58:32	48.2
10/6/2022 22:03:32	48.4
10/6/2022 22:08:32	49.6
10/6/2022 22:13:32	61
10/6/2022 22:18:32	70.6
10/6/2022 22:23:32	68.5
10/6/2022 22:28:32	54.6
10/6/2022 22:33:32	63.2
10/6/2022 22:38:32	63.6
10/6/2022 22:43:32	69.7
10/6/2022 22:48:32	58.9
10/6/2022 22:53:32	54.9
10/6/2022 22:58:32	58.8
10/6/2022 23:03:32	53.1
10/6/2022 23:08:32	51.1
10/6/2022 23:13:32	50.8
10/6/2022 23:18:32	55.7
10/6/2022 23:23:32	50.3
10/6/2022 23:28:32	50.7
10/6/2022 23:33:32	50.6
10/6/2022 23:38:32	50.8
10/6/2022 23:43:32	50.9
10/6/2022 23:48:32	51.2
10/6/2022 23:53:32	49.9
10/6/2022 23:58:32	51.1
11/6/2022 00:03:32	49.9
11/6/2022 00:08:32	48.3
11/6/2022 00:13:32	53.5
11/6/2022 00:18:32	49.1
11/6/2022 00:23:32	48.4
11/6/2022 00:28:32	57.3
11/6/2022 00:33:32	47.7
11/6/2022 00:38:32	48.6
11/6/2022 00:43:32	46.5
11/6/2022 00:48:32	47.1
11/6/2022 00:53:32	47
11/6/2022 00:58:32	47.4
11/6/2022 01:03:32	47.2
11/6/2022 01:08:32	47.5
11/6/2022 01:13:32	47
11/6/2022 01:18:32	46.9
11/6/2022 01:23:32	52.9
11/6/2022 01:28:32	72
11/6/2022 01:33:32	61.1
11/6/2022 01:38:32	68.8
11/6/2022 01:43:32	68.5

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
11/4/2022 04:45:01	49.1
11/4/2022 04:50:01	49.7
11/4/2022 04:55:01	49.8
11/4/2022 05:00:01	50.4
11/4/2022 05:05:01	49.8
11/4/2022 05:10:01	50
11/4/2022 05:15:01	51.5
11/4/2022 05:20:01	50.3
11/4/2022 05:25:01	50.7
11/4/2022 05:30:01	50.9
11/4/2022 05:35:01	50.2
11/4/2022 05:40:01	52.3
11/4/2022 05:45:01	50.7
11/4/2022 05:50:01	52.2
11/4/2022 05:55:01	53.1
11/4/2022 06:00:01	53.2
11/4/2022 06:05:01	53.9
11/4/2022 06:10:01	52.8
11/4/2022 06:15:01	53.6
11/4/2022 06:20:01	54.7
11/4/2022 06:25:01	54.5
11/4/2022 06:30:01	54.5
11/4/2022 06:35:01	53.8
11/4/2022 06:40:01	54.5
11/4/2022 06:45:01	55.2
11/4/2022 06:50:01	55.1
11/4/2022 06:55:01	55.7
Mon, 11/4/2022, 07:00	55.6
11/4/2022 07:05:01	55.5
11/4/2022 07:10:01	56.4
11/4/2022 07:15:01	56.2
11/4/2022 07:20:01	56.2
11/4/2022 07:25:01	56.6
11/4/2022 07:30:01	55.4
11/4/2022 07:35:01	56.5
11/4/2022 07:40:01	56.1
11/4/2022 07:45:01	55.7
11/4/2022 07:50:01	55.5
11/4/2022 07:55:01	57.2
11/4/2022 08:00:01	55.8
11/4/2022 08:05:01	56.1
11/4/2022 08:10:01	55.8
11/4/2022 08:15:01	54.8
11/4/2022 08:20:01	55.6
11/4/2022 08:25:01	55.4
11/4/2022 08:30:01	55.3
11/4/2022 08:35:01	56.6
11/4/2022 08:40:01	55
11/4/2022 08:45:01	55.6

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
11/6/2022 01:48:32	68.5
11/6/2022 01:53:32	73.7
11/6/2022 01:58:32	71.2
11/6/2022 02:03:32	70.4
11/6/2022 02:08:32	71.3
11/6/2022 02:13:32	63.4
11/6/2022 02:18:32	63.3
11/6/2022 02:23:32	62.4
11/6/2022 02:28:32	65.7
11/6/2022 02:33:32	57.4
11/6/2022 02:38:32	65.4
11/6/2022 02:43:32	58.9
11/6/2022 02:48:32	62.3
11/6/2022 02:53:32	56
11/6/2022 02:58:32	61.1
11/6/2022 03:03:32	55.6
11/6/2022 03:08:32	57.8
11/6/2022 03:13:32	53.8
11/6/2022 03:18:32	54.7
11/6/2022 03:23:32	53.2
11/6/2022 03:28:32	59.2
11/6/2022 03:33:32	53
11/6/2022 03:38:32	52.4
11/6/2022 03:43:32	52
11/6/2022 03:48:32	52.6
11/6/2022 03:53:32	52.5
11/6/2022 03:58:32	51.9
11/6/2022 04:03:32	52.1
11/6/2022 04:08:32	52.1
11/6/2022 04:13:32	52.7
11/6/2022 04:18:32	52
11/6/2022 04:23:32	57.8
11/6/2022 04:28:32	53.8
11/6/2022 04:33:32	52.2
11/6/2022 04:38:32	52.4
11/6/2022 04:43:32	51.3
11/6/2022 04:48:32	47.1
11/6/2022 04:53:32	47.5
11/6/2022 04:58:32	47.2
11/6/2022 05:03:32	46.2
11/6/2022 05:08:32	46.4
11/6/2022 05:13:32	50
11/6/2022 05:18:32	47.7
11/6/2022 05:23:32	46.9
11/6/2022 05:28:32	48.2
11/6/2022 05:33:32	50.4
11/6/2022 05:38:32	48.1
11/6/2022 05:43:32	48.5
11/6/2022 05:48:32	48.1

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
11/4/2022 08:50:01	54.8
11/4/2022 08:55:01	54.7
11/4/2022 09:00:01	55.8
11/4/2022 09:05:01	58.7
11/4/2022 09:10:01	57.1
11/4/2022 09:15:01	55
11/4/2022 09:20:01	53.9
11/4/2022 09:25:01	55.2
11/4/2022 09:30:01	55.8
11/4/2022 09:35:01	53
11/4/2022 09:40:01	53.2
11/4/2022 09:45:01	53.7
11/4/2022 09:50:01	52.8
11/4/2022 09:55:01	52.3
11/4/2022 10:00:01	67.9
11/4/2022 10:05:01	55.3
11/4/2022 10:10:01	54.7
11/4/2022 10:15:01	53.3
11/4/2022 10:20:01	53.9
11/4/2022 10:25:01	54.4
11/4/2022 10:30:01	56.8
11/4/2022 10:35:01	57.9
11/4/2022 10:40:01	61.2
11/4/2022 10:45:01	60.8
11/4/2022 10:50:01	58.5
11/4/2022 10:55:01	66.5
11/4/2022 11:00:01	67.1
11/4/2022 11:05:01	69.8
11/4/2022 11:10:01	67.4
11/4/2022 11:15:01	66.4
11/4/2022 11:20:01	69.6
11/4/2022 11:25:01	82.8
11/4/2022 11:30:01	75.2
11/4/2022 11:35:01	80.8
11/4/2022 11:40:01	80.4
11/4/2022 11:45:01	76.8
11/4/2022 11:50:01	65.9
11/4/2022 11:55:01	67.8
11/4/2022 12:00:01	59.8
11/4/2022 12:05:01	56.3
11/4/2022 12:10:01	57.9
11/4/2022 12:15:01	57.3
11/4/2022 12:20:01	62.1
11/4/2022 12:25:01	57.4
11/4/2022 12:30:01	55.7
11/4/2022 12:35:01	56.2
11/4/2022 12:40:01	55.9
11/4/2022 12:45:01	56.3
11/4/2022 12:50:01	55

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
11/6/2022 05:53:32	48.3
11/6/2022 05:58:32	49.8
11/6/2022 06:03:32	49.6
11/6/2022 06:08:32	50.1
11/6/2022 06:13:32	51.7
11/6/2022 06:18:32	49.6
11/6/2022 06:23:32	50.5
11/6/2022 06:28:32	49.8
11/6/2022 06:33:32	49.5
11/6/2022 06:38:32	51.6
11/6/2022 06:43:32	56.5
11/6/2022 06:48:32	52.5
11/6/2022 06:53:32	51
11/6/2022 06:58:32	54.9
11/6/2022 07:03:32	52.9
11/6/2022 07:08:32	53.7
11/6/2022 07:13:32	62.2
11/6/2022 07:18:32	53.1
11/6/2022 07:23:32	51.7
11/6/2022 07:28:32	49.7
11/6/2022 07:33:32	49.4
11/6/2022 07:38:32	49.9
11/6/2022 07:43:32	51
11/6/2022 07:48:32	48.4
11/6/2022 07:53:32	50.5
11/6/2022 07:58:32	52.1
11/6/2022 08:03:32	52.5
11/6/2022 08:08:32	50.4
11/6/2022 08:13:32	50.9
11/6/2022 08:18:32	50.4
11/6/2022 08:23:32	54.5
11/6/2022 08:28:32	51.2
11/6/2022 08:33:32	52.7
11/6/2022 08:38:32	51.8
11/6/2022 08:43:32	51.3
11/6/2022 08:48:32	52.1
11/6/2022 08:53:32	50.7
11/6/2022 08:58:32	55.7
11/6/2022 09:03:32	58.6
11/6/2022 09:08:32	59.6
11/6/2022 09:13:32	51.8
11/6/2022 09:18:32	51
11/6/2022 09:23:32	52
11/6/2022 09:28:32	52.2
11/6/2022 09:33:32	51.3
11/6/2022 09:38:32	51
11/6/2022 09:43:32	52.7
11/6/2022 09:48:32	50.3
11/6/2022 09:53:32	50.3

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
11/4/2022 12:55:01	55.2
11/4/2022 13:00:01	56.7
11/4/2022 13:05:01	56.1
11/4/2022 13:10:01	55.4
11/4/2022 13:15:01	56.4
11/4/2022 13:20:01	56.8
11/4/2022 13:25:01	56.1
11/4/2022 13:30:01	54.7
11/4/2022 13:35:01	56.1
11/4/2022 13:40:01	55
11/4/2022 13:45:01	64.1
11/4/2022 13:50:01	66
11/4/2022 13:55:01	55.7
11/4/2022 14:00:01	55.2
11/4/2022 14:05:01	55.9
11/4/2022 14:10:01	55.7
11/4/2022 14:15:01	54.4
11/4/2022 14:20:01	55.6
11/4/2022 14:25:01	54
11/4/2022 14:30:01	55.5
11/4/2022 14:35:01	53.9
11/4/2022 14:40:01	59.9
11/4/2022 14:45:01	67.1
11/4/2022 14:50:01	59.1
11/4/2022 14:55:01	55.8
Mon, 11/4/2022, 15:00	58.9
11/4/2022 15:05:01	54.3
11/4/2022 15:10:01	54.5
11/4/2022 15:15:01	53.3
11/4/2022 15:20:01	52.9
11/4/2022 15:25:01	53.2
11/4/2022 15:30:01	53.9
11/4/2022 15:35:01	56.2
11/4/2022 15:40:01	55.2
11/4/2022 15:45:01	55.7
11/4/2022 15:50:01	60.3
11/4/2022 15:55:01	55.6
11/4/2022 16:00:01	57.9
11/4/2022 16:05:01	57.4
11/4/2022 16:10:01	54.4
11/4/2022 16:15:01	55.2
11/4/2022 16:20:01	54.4
11/4/2022 16:25:01	56
11/4/2022 16:30:01	63.9
11/4/2022 16:35:01	56.3
11/4/2022 16:40:01	55.6
11/4/2022 16:45:01	55.8
11/4/2022 16:50:01	56.9
11/4/2022 16:55:01	57.7

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
11/6/2022 09:58:32	50.3
11/6/2022 10:03:32	56.4
11/6/2022 10:08:32	52.3
11/6/2022 10:13:32	48.6
11/6/2022 10:18:32	49.1
11/6/2022 10:23:32	51.6
11/6/2022 10:28:32	49
11/6/2022 10:33:32	50.9
11/6/2022 10:38:32	49.9
11/6/2022 10:43:32	49.2
11/6/2022 10:48:32	50
11/6/2022 10:53:32	49.9
11/6/2022 10:58:32	54.2
11/6/2022 11:03:32	49.7
11/6/2022 11:08:32	49.2
11/6/2022 11:13:32	49.3
11/6/2022 11:18:32	50.3
11/6/2022 11:23:32	50.8
11/6/2022 11:28:32	46.3
11/6/2022 11:33:32	53.8
11/6/2022 11:38:32	47.5
11/6/2022 11:43:32	46
11/6/2022 11:48:32	52.7
11/6/2022 11:53:32	46
11/6/2022 11:58:32	45.5
11/6/2022 12:03:32	48.7
11/6/2022 12:08:32	46
11/6/2022 12:13:32	47.9
11/6/2022 12:18:32	46.8
11/6/2022 12:23:32	46.4
11/6/2022 12:28:32	49.5
11/6/2022 12:33:32	47.2
11/6/2022 12:38:32	47.9
11/6/2022 12:43:32	52.3
11/6/2022 12:48:32	47.6
11/6/2022 12:53:32	52.1
11/6/2022 12:58:32	48
11/6/2022 13:03:32	49.7
11/6/2022 13:08:32	47.8
11/6/2022 13:13:32	47.4
11/6/2022 13:18:32	47.8
11/6/2022 13:23:32	46.4
11/6/2022 13:28:32	48.3
11/6/2022 13:33:32	47.1
11/6/2022 13:38:32	49
11/6/2022 13:43:32	47.1
11/6/2022 13:48:32	51.1
11/6/2022 13:53:32	54.1
11/6/2022 13:58:32	46.9

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
11/4/2022 17:00:01	54.7
11/4/2022 17:05:01	54.1
11/4/2022 17:10:01	54
11/4/2022 17:15:01	54.8
11/4/2022 17:20:01	56.4
11/4/2022 17:25:01	55.3
11/4/2022 17:30:01	54.9
11/4/2022 17:35:01	55.6
11/4/2022 17:40:01	55.3
11/4/2022 17:45:01	55.1
11/4/2022 17:50:01	55.5
11/4/2022 17:55:01	55.3
11/4/2022 18:00:01	55.8
11/4/2022 18:05:01	55.3
11/4/2022 18:10:01	55.4
11/4/2022 18:15:01	55.1
11/4/2022 18:20:01	59.8
11/4/2022 18:25:01	55.8
11/4/2022 18:30:01	56.2
11/4/2022 18:35:01	55.2
11/4/2022 18:40:01	56.4
11/4/2022 18:45:01	55.8
11/4/2022 18:50:01	55.7
11/4/2022 18:55:01	56.3
Mon, 11/4/2022, 19:00	56.1
11/4/2022 19:05:01	56
11/4/2022 19:10:01	54.8
11/4/2022 19:15:01	55.7
11/4/2022 19:20:01	60.8
11/4/2022 19:25:01	64.1
11/4/2022 19:30:01	62.1
11/4/2022 19:35:01	54.4
11/4/2022 19:40:01	54.9
11/4/2022 19:45:01	55.7
11/4/2022 19:50:01	56.3
11/4/2022 19:55:01	57.3
11/4/2022 20:00:01	54.1
11/4/2022 20:05:01	59
11/4/2022 20:10:01	56.5
11/4/2022 20:15:01	54.8
11/4/2022 20:20:01	55.5
11/4/2022 20:25:01	55.4
11/4/2022 20:30:01	55.8
11/4/2022 20:35:01	57.6
11/4/2022 20:40:01	56.9
11/4/2022 20:45:01	56.7
11/4/2022 20:50:01	54.6
11/4/2022 20:55:01	55.1
11/4/2022 21:00:01	55.9

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
11/6/2022 14:03:32	58.3
11/6/2022 14:08:32	45.9
11/6/2022 14:13:32	46.1
11/6/2022 14:18:32	53.7
11/6/2022 14:23:32	45.3
11/6/2022 14:28:32	50
11/6/2022 14:33:32	46
11/6/2022 14:38:32	46.9
11/6/2022 14:43:32	47
11/6/2022 14:48:32	47.8
11/6/2022 14:53:32	51.6
11/6/2022 14:58:32	49
11/6/2022 15:03:32	46.2
11/6/2022 15:08:32	47
11/6/2022 15:13:32	47.1
11/6/2022 15:18:32	50.4
11/6/2022 15:23:32	48.3
11/6/2022 15:28:32	44.5
11/6/2022 15:33:32	48.6
11/6/2022 15:38:32	56.7
11/6/2022 15:43:32	47.5
11/6/2022 15:48:32	51.2
11/6/2022 15:53:32	46.6
11/6/2022 15:58:32	49.2
11/6/2022 16:03:32	46.8
11/6/2022 16:08:32	47.1
11/6/2022 16:13:32	46.6
11/6/2022 16:18:32	47.1
11/6/2022 16:23:32	49.3
11/6/2022 16:28:32	46.6
11/6/2022 16:33:32	45.9
11/6/2022 16:38:32	46
11/6/2022 16:43:32	47.4
11/6/2022 16:48:32	48.7
11/6/2022 16:53:32	49.7
11/6/2022 16:58:32	50
11/6/2022 17:03:32	52.4
11/6/2022 17:08:32	51.2
11/6/2022 17:13:32	53.6
11/6/2022 17:18:32	47.2
11/6/2022 17:23:32	51.4
11/6/2022 17:28:32	51.2
11/6/2022 17:33:32	52.7
11/6/2022 17:38:32	48.2
11/6/2022 17:43:32	49
11/6/2022 17:48:32	47.1
11/6/2022 17:53:32	46.4
11/6/2022 17:58:32	51.3
11/6/2022 18:03:32	45.8

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
11/4/2022 21:05:01	56.1
11/4/2022 21:10:01	56.1
11/4/2022 21:15:01	55.4
11/4/2022 21:20:01	56.3
11/4/2022 21:25:01	57.4
11/4/2022 21:30:01	57.5
11/4/2022 21:35:01	58.1
11/4/2022 21:40:01	58.8
11/4/2022 21:45:01	59.2
11/4/2022 21:50:01	59
11/4/2022 21:55:01	59
11/4/2022 22:00:01	59.3
11/4/2022 22:05:01	58.7
11/4/2022 22:10:01	58.9
11/4/2022 22:15:01	59.5
11/4/2022 22:20:01	59.4
11/4/2022 22:25:01	58.7
11/4/2022 22:30:01	58.8
11/4/2022 22:35:01	57.7
11/4/2022 22:40:01	58.3
11/4/2022 22:45:01	57.5
11/4/2022 22:50:01	57.1
11/4/2022 22:55:01	56.9
11/4/2022 23:00:01	56.6
11/4/2022 23:05:01	57.4
11/4/2022 23:10:01	56.1
11/4/2022 23:15:01	57.1
11/4/2022 23:20:01	56.4
11/4/2022 23:25:01	55.2
11/4/2022 23:30:01	56
11/4/2022 23:35:01	55.5
11/4/2022 23:40:01	55.1
11/4/2022 23:45:01	54.2
11/4/2022 23:50:01	54.9
11/4/2022 23:55:01	54
12/4/2022 00:00:01	55.6
12/4/2022 00:05:01	52.9
12/4/2022 00:10:01	53.1
12/4/2022 00:15:01	52.6
12/4/2022 00:20:01	52.9
12/4/2022 00:25:01	52.7
12/4/2022 00:30:01	52.6
12/4/2022 00:35:01	51.8
12/4/2022 00:40:01	52.2
12/4/2022 00:45:01	52.5
12/4/2022 00:50:01	52.4
12/4/2022 00:55:01	51.3
12/4/2022 01:00:01	51.6
12/4/2022 01:05:01	51.3

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
11/6/2022 18:08:32	48.8
11/6/2022 18:13:32	54.6
11/6/2022 18:18:32	46.6
11/6/2022 18:23:32	53.5
11/6/2022 18:28:32	48.9
11/6/2022 18:33:32	50.9
11/6/2022 18:38:32	44.8
11/6/2022 18:43:32	44.3
11/6/2022 18:48:32	47.3
11/6/2022 18:53:32	45.2
11/6/2022 18:58:32	47.1
11/6/2022 19:03:32	52.8
11/6/2022 19:08:32	47.4
11/6/2022 19:13:32	47.2
11/6/2022 19:18:32	46.6
11/6/2022 19:23:32	47.4
11/6/2022 19:28:32	46.9
11/6/2022 19:33:32	47.8
11/6/2022 19:38:32	47.3
11/6/2022 19:43:32	48.9
11/6/2022 19:48:32	49.6
11/6/2022 19:53:32	48.9
11/6/2022 19:58:32	50
11/6/2022 20:03:32	53.1
11/6/2022 20:08:32	50.6
11/6/2022 20:13:32	49.1
11/6/2022 20:18:32	48.8
11/6/2022 20:23:32	63.7
11/6/2022 20:28:32	54.2
11/6/2022 20:33:32	53.9
11/6/2022 20:38:32	54
11/6/2022 20:43:32	53.5
11/6/2022 20:48:32	53.5
11/6/2022 20:53:32	54.1
11/6/2022 20:58:32	53.6
11/6/2022 21:03:32	54.6
11/6/2022 21:08:32	53.6
11/6/2022 21:13:32	53.6
11/6/2022 21:18:32	52.8
11/6/2022 21:23:32	55.1
11/6/2022 21:28:32	53.8
11/6/2022 21:33:32	52.9
11/6/2022 21:38:32	53
11/6/2022 21:43:32	53.7
11/6/2022 21:48:32	53.1
11/6/2022 21:53:32	53.1
11/6/2022 21:58:32	53
11/6/2022 22:03:32	53.4
11/6/2022 22:08:32	52.5

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
12/4/2022 01:10:01	51
12/4/2022 01:15:01	51.3
12/4/2022 01:20:01	51.1
12/4/2022 01:25:01	50.4
12/4/2022 01:30:01	50.3
12/4/2022 01:35:01	50.4
12/4/2022 01:40:01	51.2
12/4/2022 01:45:01	50
12/4/2022 01:50:01	50
12/4/2022 01:55:01	50.9
12/4/2022 02:00:01	50.3
12/4/2022 02:05:01	50.2
12/4/2022 02:10:01	50.5
12/4/2022 02:15:01	50.6
12/4/2022 02:20:01	51.2
12/4/2022 02:25:01	51.4
12/4/2022 02:30:01	51.3
12/4/2022 02:35:01	51.1
12/4/2022 02:40:01	50.3
12/4/2022 02:45:01	50.4
12/4/2022 02:50:01	50.1
12/4/2022 02:55:01	50
Tue, 12/4/2022, 03:00	50.3
12/4/2022 03:05:01	50.6
12/4/2022 03:10:01	50.7
12/4/2022 03:15:01	51.2
12/4/2022 03:20:01	50.5
12/4/2022 03:25:01	51.8
12/4/2022 03:30:01	51.4
12/4/2022 03:35:01	51.8
12/4/2022 03:40:01	51.4
12/4/2022 03:45:01	50.8
12/4/2022 03:50:01	50.2
12/4/2022 03:55:01	50.7
12/4/2022 04:00:01	51.1
12/4/2022 04:05:01	50.6
12/4/2022 04:10:01	50
12/4/2022 04:15:01	50.4
12/4/2022 04:20:01	50.6
12/4/2022 04:25:01	50.3
12/4/2022 04:30:01	54.3
12/4/2022 04:35:01	52.9
12/4/2022 04:40:01	50.6
12/4/2022 04:45:01	51.6
12/4/2022 04:50:01	51.3
12/4/2022 04:55:01	50.6
12/4/2022 05:00:01	50.4
12/4/2022 05:05:01	50.7
12/4/2022 05:10:01	50.8

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
11/6/2022 22:13:32	49.2
11/6/2022 22:18:32	55.7
11/6/2022 22:23:32	48.6
11/6/2022 22:28:32	48.2
11/6/2022 22:33:32	47.7
11/6/2022 22:38:32	47.9
11/6/2022 22:43:32	46.5
11/6/2022 22:48:32	47.8
11/6/2022 22:53:32	48.3
11/6/2022 22:58:32	50.2
11/6/2022 23:03:32	48.6
11/6/2022 23:08:32	47.8
11/6/2022 23:13:32	47
11/6/2022 23:18:32	50.3
11/6/2022 23:23:32	46.5
11/6/2022 23:28:32	46
11/6/2022 23:33:32	59
11/6/2022 23:38:32	47.6
11/6/2022 23:43:32	46.5
11/6/2022 23:48:32	46.8
11/6/2022 23:53:32	47.2
11/6/2022 23:58:32	45.7
12/6/2022 00:03:32	46.4
12/6/2022 00:08:32	46.8
12/6/2022 00:13:32	47.9
12/6/2022 00:18:32	47.5
12/6/2022 00:23:32	47.5
12/6/2022 00:28:32	47.8
12/6/2022 00:33:32	48.8
12/6/2022 00:38:32	47.4
12/6/2022 00:43:32	48.2
12/6/2022 00:48:32	47.4
12/6/2022 00:53:32	48.4
12/6/2022 00:58:32	49.6
12/6/2022 01:03:32	48.1
12/6/2022 01:08:32	48.9
12/6/2022 01:13:32	48.2
12/6/2022 01:18:32	48.1
12/6/2022 01:23:32	48.6
12/6/2022 01:28:32	48.5
12/6/2022 01:33:32	48.5
12/6/2022 01:38:32	49.2
12/6/2022 01:43:32	48.3
12/6/2022 01:48:32	48.6
12/6/2022 01:53:32	58.9
12/6/2022 01:58:32	47.6
12/6/2022 02:03:32	45.6
12/6/2022 02:08:32	46.4
12/6/2022 02:13:32	48.3

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
12/4/2022 05:15:01	53
12/4/2022 05:20:01	51.8
12/4/2022 05:25:01	52.9
12/4/2022 05:30:01	51.8
12/4/2022 05:35:01	51.8
12/4/2022 05:40:01	52.3
12/4/2022 05:45:01	52.6
12/4/2022 05:50:01	53.8
12/4/2022 05:55:01	53.2
12/4/2022 06:00:01	53.7
12/4/2022 06:05:01	53.8
12/4/2022 06:10:01	53.7
12/4/2022 06:15:01	54.5
12/4/2022 06:20:01	53.9
12/4/2022 06:25:01	54.6
12/4/2022 06:30:01	54.9
12/4/2022 06:35:01	54.9
12/4/2022 06:40:01	55.2
12/4/2022 06:45:01	56
12/4/2022 06:50:01	56.1
12/4/2022 06:55:01	56.6
Tue, 12/4/2022, 07:00	57.4
12/4/2022 07:05:01	56.5
12/4/2022 07:10:01	56.8
12/4/2022 07:15:01	56.9
12/4/2022 07:20:01	57.1
12/4/2022 07:25:01	57.4
12/4/2022 07:30:01	56.7
12/4/2022 07:35:01	57.9
12/4/2022 07:40:01	57
12/4/2022 07:45:01	56.5
12/4/2022 07:50:01	56.5
12/4/2022 07:55:01	56.3
12/4/2022 08:00:01	55.1
12/4/2022 08:05:01	55.8
12/4/2022 08:10:01	55.9
12/4/2022 08:15:01	54.6
12/4/2022 08:20:01	55.5
12/4/2022 08:25:01	56.1
12/4/2022 08:30:01	55.7
12/4/2022 08:35:01	56.5
12/4/2022 08:40:01	56.7
12/4/2022 08:45:01	55.1
12/4/2022 08:50:01	56.1
12/4/2022 08:55:01	56.1
12/4/2022 09:00:01	55.6
12/4/2022 09:05:01	54.9
12/4/2022 09:10:01	54.9
12/4/2022 09:15:01	56.1

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
12/6/2022 02:18:32	46.9
12/6/2022 02:23:32	48
12/6/2022 02:28:32	46.3
12/6/2022 02:33:32	47.4
12/6/2022 02:38:32	48.2
12/6/2022 02:43:32	47.5
12/6/2022 02:48:32	47.7
12/6/2022 02:53:32	50.6
12/6/2022 02:58:32	50.4
12/6/2022 03:03:32	53.1
12/6/2022 03:08:32	46.1
12/6/2022 03:13:32	46.7
12/6/2022 03:18:32	45.4
12/6/2022 03:23:32	45.7
12/6/2022 03:28:32	46.2
12/6/2022 03:33:32	46.6
12/6/2022 03:38:32	45.9
12/6/2022 03:43:32	45.3
12/6/2022 03:48:32	46
12/6/2022 03:53:32	46.5
12/6/2022 03:58:32	46.7
12/6/2022 04:03:32	46.6
12/6/2022 04:08:32	46.6
12/6/2022 04:13:32	47.5
12/6/2022 04:18:32	46.7
12/6/2022 04:23:32	46.2
12/6/2022 04:28:32	45.9
12/6/2022 04:33:32	46.1
12/6/2022 04:38:32	46.6
12/6/2022 04:43:32	46.2
12/6/2022 04:48:32	45.9
12/6/2022 04:53:32	48.2
12/6/2022 04:58:32	45.8
12/6/2022 05:03:32	46.2
12/6/2022 05:08:32	45.9
12/6/2022 05:13:32	46.6
12/6/2022 05:18:32	56
12/6/2022 05:23:32	61.4
12/6/2022 05:28:32	50.3
12/6/2022 05:33:32	47
12/6/2022 05:38:32	47.1
12/6/2022 05:43:32	47.3
12/6/2022 05:48:32	48.6
12/6/2022 05:53:32	47.8
12/6/2022 05:58:32	47.9
12/6/2022 06:03:32	47.6
12/6/2022 06:08:32	50.1
12/6/2022 06:13:32	50.1
12/6/2022 06:18:32	55.6

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
12/4/2022 09:20:01	54.2
12/4/2022 09:25:01	56.1
12/4/2022 09:30:01	61.6
12/4/2022 09:35:01	57.9
12/4/2022 09:40:01	55.3
12/4/2022 09:45:01	55
12/4/2022 09:50:01	54.6
12/4/2022 09:55:01	56.6
12/4/2022 10:00:01	63.4
12/4/2022 10:05:01	54.6
12/4/2022 10:10:01	55.6
12/4/2022 10:15:01	55.4
12/4/2022 10:20:01	55.6
12/4/2022 10:25:01	54.9
12/4/2022 10:30:01	54.6
12/4/2022 10:35:01	57.1
12/4/2022 10:40:01	56.8
12/4/2022 10:45:01	54.8
12/4/2022 10:50:01	53.5
12/4/2022 10:55:01	53.5
12/4/2022 11:00:01	54.8
12/4/2022 11:05:01	54.1
12/4/2022 11:10:01	53.7
12/4/2022 11:15:01	54.4
12/4/2022 11:20:01	54.4
12/4/2022 11:25:01	56.1
12/4/2022 11:30:01	54.9
12/4/2022 11:35:01	52.8
12/4/2022 11:40:01	53.3
12/4/2022 11:45:01	54.7
12/4/2022 11:50:01	53.1
12/4/2022 11:55:01	55.9
12/4/2022 12:00:01	53.6
12/4/2022 12:05:01	56.4
12/4/2022 12:10:01	55.5
12/4/2022 12:15:01	53.5
12/4/2022 12:20:01	56.9
12/4/2022 12:25:01	52.8
12/4/2022 12:30:01	52.2
12/4/2022 12:35:01	52.3
12/4/2022 12:40:01	54.3
12/4/2022 12:45:01	56.1
12/4/2022 12:50:01	52.4
12/4/2022 12:55:01	52.6
12/4/2022 13:00:01	59.1
12/4/2022 13:05:01	53.7
12/4/2022 13:10:01	53.9
12/4/2022 13:15:01	52.8
12/4/2022 13:20:01	53.6

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
12/6/2022 06:23:32	51.4
12/6/2022 06:28:32	52.6
12/6/2022 06:33:32	49.7
12/6/2022 06:38:32	55.4
12/6/2022 06:43:32	61.2
12/6/2022 06:48:32	56.2
12/6/2022 06:53:32	50.9
12/6/2022 06:58:32	50.6
12/6/2022 07:03:32	52.1
12/6/2022 07:08:32	51.4
12/6/2022 07:13:32	48.8
12/6/2022 07:18:32	50.3
12/6/2022 07:23:32	48.8
12/6/2022 07:28:32	52.1
12/6/2022 07:33:32	50.9
12/6/2022 07:38:32	50.1
12/6/2022 07:43:32	49.5
12/6/2022 07:48:32	49.2
12/6/2022 07:53:32	52.3
12/6/2022 07:58:32	52.7
12/6/2022 08:03:32	51.3
12/6/2022 08:08:32	51.3
12/6/2022 08:13:32	50.5
12/6/2022 08:18:32	50.7
12/6/2022 08:23:32	48.1
12/6/2022 08:28:32	53.1
12/6/2022 08:33:32	52.6
12/6/2022 08:38:32	52.7
12/6/2022 08:43:32	57
12/6/2022 08:48:32	62.5
12/6/2022 08:53:32	57
12/6/2022 08:58:32	54.5
12/6/2022 09:03:32	52.9
12/6/2022 09:08:32	58.5
12/6/2022 09:13:32	61.7
12/6/2022 09:18:32	60.5
12/6/2022 09:23:32	66.6
12/6/2022 09:28:32	55.4
12/6/2022 09:33:32	58.4
12/6/2022 09:38:32	52.8
12/6/2022 09:43:32	53.5
12/6/2022 09:48:32	50.5
12/6/2022 09:53:32	51.5
12/6/2022 09:58:32	52.2
12/6/2022 10:03:32	51.4
12/6/2022 10:08:32	50.1
12/6/2022 10:13:32	52.4
12/6/2022 10:18:32	53.6
12/6/2022 10:23:32	51.3

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
12/4/2022 13:25:01	53.4
12/4/2022 13:30:01	54
12/4/2022 13:35:01	53.9
12/4/2022 13:40:01	53.8
12/4/2022 13:45:01	53.8
12/4/2022 13:50:01	66.1
12/4/2022 13:55:01	53.1
12/4/2022 14:00:01	53.3
12/4/2022 14:05:01	52.1
12/4/2022 14:10:01	53.3
12/4/2022 14:15:01	52.7
12/4/2022 14:20:01	52.8
12/4/2022 14:25:01	53.6
12/4/2022 14:30:01	53.9
12/4/2022 14:35:01	52.9
12/4/2022 14:40:01	53.5
12/4/2022 14:45:01	65.9
12/4/2022 14:50:01	52.5
12/4/2022 14:55:01	54.2
Tue, 12/4/2022, 15:00	63.9
12/4/2022 15:05:01	55.5
12/4/2022 15:10:01	55.2
12/4/2022 15:15:01	57
12/4/2022 15:20:01	60.4
12/4/2022 15:25:01	56.2
12/4/2022 15:30:01	54.6
12/4/2022 15:35:01	55.5
12/4/2022 15:40:01	59.1
12/4/2022 15:45:01	53.9
12/4/2022 15:50:01	55.7
12/4/2022 15:55:01	53.9
12/4/2022 16:00:01	53.2
12/4/2022 16:05:01	54.6
12/4/2022 16:10:01	55
12/4/2022 16:15:01	54
12/4/2022 16:20:01	55.1
12/4/2022 16:25:01	55
12/4/2022 16:30:01	56.1
12/4/2022 16:35:01	53.7
12/4/2022 16:40:01	55.3
12/4/2022 16:45:01	53.4
12/4/2022 16:50:01	54.6
12/4/2022 16:55:01	54.3
12/4/2022 17:00:01	57
12/4/2022 17:05:01	60.4
12/4/2022 17:10:01	61.9
12/4/2022 17:15:01	53.5
12/4/2022 17:20:01	53.8
12/4/2022 17:25:01	54.2

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
12/6/2022 10:28:32	48.5
12/6/2022 10:33:32	49.8
12/6/2022 10:38:32	49.4
12/6/2022 10:43:32	51.2
12/6/2022 10:48:32	49.9
12/6/2022 10:53:32	49.7
12/6/2022 10:58:32	47.9
12/6/2022 11:03:32	51.3
12/6/2022 11:08:32	50.6
12/6/2022 11:13:32	54.1
12/6/2022 11:18:32	52
12/6/2022 11:23:32	48.5
12/6/2022 11:28:32	47.4
12/6/2022 11:33:32	52.8
12/6/2022 11:38:32	53.2
12/6/2022 11:43:32	51.1
12/6/2022 11:48:32	47.1
12/6/2022 11:53:32	52.3
12/6/2022 11:58:32	46.4
12/6/2022 12:03:32	45.3
12/6/2022 12:08:32	49.7
12/6/2022 12:13:32	44.5
12/6/2022 12:18:32	47.4
12/6/2022 12:23:32	51.2
12/6/2022 12:28:32	51.8
12/6/2022 12:33:32	46.2
12/6/2022 12:38:32	44.1
12/6/2022 12:43:32	47.4
12/6/2022 12:48:32	46.7
12/6/2022 12:53:32	48
12/6/2022 12:58:32	45.6
12/6/2022 13:03:32	45.1
12/6/2022 13:08:32	47.2
12/6/2022 13:13:32	45.3
12/6/2022 13:18:32	44.5
12/6/2022 13:23:32	44.6
12/6/2022 13:28:32	51.8
12/6/2022 13:33:32	43.2
12/6/2022 13:38:32	48.1
12/6/2022 13:43:32	61.2
12/6/2022 13:48:32	47.3
12/6/2022 13:53:32	43.8
12/6/2022 13:58:32	45.3
12/6/2022 14:03:32	44.9
12/6/2022 14:08:32	43.9
12/6/2022 14:13:32	46
12/6/2022 14:18:32	42.5
12/6/2022 14:23:32	48
12/6/2022 14:28:32	44.8

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
12/4/2022 17:30:01	55.4
12/4/2022 17:35:01	54.4
12/4/2022 17:40:01	53.5
12/4/2022 17:45:01	55.4
12/4/2022 17:50:01	54.3
12/4/2022 17:55:01	54.9
12/4/2022 18:00:01	54.5
12/4/2022 18:05:01	53.9
12/4/2022 18:10:01	54.2
12/4/2022 18:15:01	55.4
12/4/2022 18:20:01	54.3
12/4/2022 18:25:01	54.4
12/4/2022 18:30:01	55.9
12/4/2022 18:35:01	55.1
12/4/2022 18:40:01	56.2
12/4/2022 18:45:01	54.4
12/4/2022 18:50:01	55
12/4/2022 18:55:01	55
Tue, 12/4/2022, 19:00	54.3
12/4/2022 19:05:01	54.3
12/4/2022 19:10:01	53.9
12/4/2022 19:15:01	54.5
12/4/2022 19:20:01	67.1
12/4/2022 19:25:01	63.3
12/4/2022 19:30:01	68
12/4/2022 19:35:01	54.1
12/4/2022 19:40:01	55.3
12/4/2022 19:45:01	60.4
12/4/2022 19:50:01	57.1
12/4/2022 19:55:01	57
12/4/2022 20:00:01	59.7
12/4/2022 20:05:01	59.5
12/4/2022 20:10:01	61.3
12/4/2022 20:15:01	59.8
12/4/2022 20:20:01	58.7
12/4/2022 20:25:01	57.7
12/4/2022 20:30:01	60.3
12/4/2022 20:35:01	61
12/4/2022 20:40:01	58.8
12/4/2022 20:45:01	59.2
12/4/2022 20:50:01	59
12/4/2022 20:55:01	58.5
12/4/2022 21:00:01	57
12/4/2022 21:05:01	56.7
12/4/2022 21:10:01	57.1
12/4/2022 21:15:01	57
12/4/2022 21:20:01	57.6
12/4/2022 21:25:01	57.4
12/4/2022 21:30:01	58.1

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
12/6/2022 14:33:32	42.7
12/6/2022 14:38:32	43.5
12/6/2022 14:43:32	56.5
12/6/2022 14:48:32	44.3
12/6/2022 14:53:32	46
12/6/2022 14:58:32	44.9
12/6/2022 15:03:32	43
12/6/2022 15:08:32	47.3
12/6/2022 15:13:32	44.1
12/6/2022 15:18:32	50.1
12/6/2022 15:23:32	46.9
12/6/2022 15:28:32	47
12/6/2022 15:33:32	45.3
12/6/2022 15:38:32	49.1
12/6/2022 15:43:32	45.5
12/6/2022 15:48:32	43
12/6/2022 15:53:32	51.9
12/6/2022 15:58:32	52.4
12/6/2022 16:03:32	44.7
12/6/2022 16:08:32	47.1
12/6/2022 16:13:32	51.8
12/6/2022 16:18:32	47.2
12/6/2022 16:23:32	48.9
12/6/2022 16:28:32	54.5
12/6/2022 16:33:32	47
12/6/2022 16:38:32	48.9
12/6/2022 16:43:32	47.2
12/6/2022 16:48:32	45.6
12/6/2022 16:53:32	47
12/6/2022 16:58:32	47.4
12/6/2022 17:03:32	50.6
12/6/2022 17:08:32	46.2
12/6/2022 17:13:32	44.5
12/6/2022 17:18:32	46.7
12/6/2022 17:23:32	49.1
12/6/2022 17:28:32	47.9
12/6/2022 17:33:32	46.8
12/6/2022 17:38:32	50.6
12/6/2022 17:43:32	48.5
12/6/2022 17:48:32	48.2
12/6/2022 17:53:32	46.7
12/6/2022 17:58:32	46.7
12/6/2022 18:03:32	50.6
12/6/2022 18:08:32	58.9
12/6/2022 18:13:32	49.1
12/6/2022 18:18:32	49.3
12/6/2022 18:23:32	47.5
12/6/2022 18:28:32	53.9
12/6/2022 18:33:32	47.4

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
12/4/2022 21:35:01	58.1
12/4/2022 21:40:01	58.8
12/4/2022 21:45:01	59.3
12/4/2022 21:50:01	59.3
12/4/2022 21:55:01	59.2
12/4/2022 22:00:01	59
12/4/2022 22:05:01	59
12/4/2022 22:10:01	58.9
12/4/2022 22:15:01	58.9
12/4/2022 22:20:01	57.9
12/4/2022 22:25:01	57.7
12/4/2022 22:30:01	58.3
12/4/2022 22:35:01	58
12/4/2022 22:40:01	58.3
12/4/2022 22:45:01	58.1
12/4/2022 22:50:01	57.4
12/4/2022 22:55:01	57.4
12/4/2022 23:00:01	57.5
12/4/2022 23:05:01	56.9
12/4/2022 23:10:01	56.6
12/4/2022 23:15:01	57
12/4/2022 23:20:01	56.2
12/4/2022 23:25:01	56
12/4/2022 23:30:01	56.4
12/4/2022 23:35:01	55.3
12/4/2022 23:40:01	55.8
12/4/2022 23:45:01	55.1
12/4/2022 23:50:01	55.6
12/4/2022 23:55:01	53.9
13/4/2022 00:00:01	53.7
13/4/2022 00:05:01	54
13/4/2022 00:10:01	54
13/4/2022 00:15:01	53.2
13/4/2022 00:20:01	54.2
13/4/2022 00:25:01	52.2
13/4/2022 00:30:01	51.8
13/4/2022 00:35:01	51.7
13/4/2022 00:40:01	52.3
13/4/2022 00:45:01	51.4
13/4/2022 00:50:01	51.1
13/4/2022 00:55:01	51.4
13/4/2022 01:00:01	51
13/4/2022 01:05:01	50.9
13/4/2022 01:10:01	49.9
13/4/2022 01:15:01	50.6
13/4/2022 01:20:01	50.3
13/4/2022 01:25:01	50.3
13/4/2022 01:30:01	50.8
13/4/2022 01:35:01	51.5

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
12/6/2022 18:38:32	50.8
12/6/2022 18:43:32	49.7
12/6/2022 18:48:32	52.6
12/6/2022 18:53:32	45.8
12/6/2022 18:58:32	47.1
12/6/2022 19:03:32	51
12/6/2022 19:08:32	45.5
12/6/2022 19:13:32	62.1
12/6/2022 19:18:32	47.1
12/6/2022 19:23:32	52.2
12/6/2022 19:28:32	52.3
12/6/2022 19:33:32	48.1
12/6/2022 19:38:32	50.2
12/6/2022 19:43:32	46.9
12/6/2022 19:48:32	48.7
12/6/2022 19:53:32	46.8
12/6/2022 19:58:32	46.2
12/6/2022 20:03:32	54.5
12/6/2022 20:08:32	44.5
12/6/2022 20:13:32	46.2
12/6/2022 20:18:32	44.1
12/6/2022 20:23:32	47.3
12/6/2022 20:28:32	45.7
12/6/2022 20:33:32	44.6
12/6/2022 20:38:32	45.1
12/6/2022 20:43:32	46.6
12/6/2022 20:48:32	46.2
12/6/2022 20:53:32	40.1
12/6/2022 20:58:32	40.2
12/6/2022 21:03:32	43.8
12/6/2022 21:08:32	44.4
12/6/2022 21:13:32	44.5
12/6/2022 21:18:32	43.9
12/6/2022 21:23:32	46.4
12/6/2022 21:28:32	45.4
12/6/2022 21:33:32	46.8
12/6/2022 21:38:32	44.9
12/6/2022 21:43:32	47.8
12/6/2022 21:48:32	44.9
12/6/2022 21:53:32	53.7
12/6/2022 21:58:32	45.1
12/6/2022 22:03:32	46.6
12/6/2022 22:08:32	45.7
12/6/2022 22:13:32	46.9
12/6/2022 22:18:32	45
12/6/2022 22:23:32	52
12/6/2022 22:28:32	51.9
12/6/2022 22:33:32	58.5
12/6/2022 22:38:32	46

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
13/4/2022 01:40:01	50.8
13/4/2022 01:45:01	50.2
13/4/2022 01:50:01	49.9
13/4/2022 01:55:01	50.4
13/4/2022 02:00:01	49.6
13/4/2022 02:05:01	49.6
13/4/2022 02:10:01	49.7
13/4/2022 02:15:01	49.3
13/4/2022 02:20:01	50.1
13/4/2022 02:25:01	49.9
13/4/2022 02:30:01	50
13/4/2022 02:35:01	49.7
13/4/2022 02:40:01	50.5
13/4/2022 02:45:01	50.7
13/4/2022 02:50:01	51
13/4/2022 02:55:01	50.5
Wed, 13/4/2022, 03:00	49.9
13/4/2022 03:05:01	50.3
13/4/2022 03:10:01	50.5
13/4/2022 03:15:01	50.5
13/4/2022 03:20:01	50.7
13/4/2022 03:25:01	50.1
13/4/2022 03:30:01	50.8
13/4/2022 03:35:01	49.9
13/4/2022 03:40:01	49.6
13/4/2022 03:45:01	49.6
13/4/2022 03:50:01	49.5
13/4/2022 03:55:01	49.9
13/4/2022 04:00:01	50
13/4/2022 04:05:01	49.9
13/4/2022 04:10:01	50.5
13/4/2022 04:15:01	49.8
13/4/2022 04:20:01	50
13/4/2022 04:25:01	50.9
13/4/2022 04:30:01	51
13/4/2022 04:35:01	51.2
13/4/2022 04:40:01	50.9
13/4/2022 04:45:01	51.4
13/4/2022 04:50:01	51.3
13/4/2022 04:55:01	51.5
13/4/2022 05:00:01	51
13/4/2022 05:05:01	50.7
13/4/2022 05:10:01	50.5
13/4/2022 05:15:01	50.6
13/4/2022 05:20:01	50.3
13/4/2022 05:25:01	50.6
13/4/2022 05:30:01	52.8
13/4/2022 05:35:01	51.6
13/4/2022 05:40:01	52.9

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
12/6/2022 22:43:32	46.7
12/6/2022 22:48:32	46.2
12/6/2022 22:53:32	46.2
12/6/2022 22:58:32	48.2
12/6/2022 23:03:32	46.9
12/6/2022 23:08:32	44.3
12/6/2022 23:13:32	46.5
12/6/2022 23:18:32	48.1
12/6/2022 23:23:32	46.1
12/6/2022 23:28:32	48.2
12/6/2022 23:33:32	48.8
12/6/2022 23:38:32	50
12/6/2022 23:43:32	51.3
12/6/2022 23:48:32	52
12/6/2022 23:53:32	53.8
12/6/2022 23:58:32	44.9
13/6/2022 00:03:32	47.1
13/6/2022 00:08:32	44.5
13/6/2022 00:13:32	44.3
13/6/2022 00:18:32	46
13/6/2022 00:23:32	45
13/6/2022 00:28:32	44.7
13/6/2022 00:33:32	43.7
13/6/2022 00:38:32	44
13/6/2022 00:43:32	44.1
13/6/2022 00:48:32	45.1
13/6/2022 00:53:32	43.8
13/6/2022 00:58:32	43.9
13/6/2022 01:03:32	43.9
13/6/2022 01:08:32	44.2
13/6/2022 01:13:32	43.4
13/6/2022 01:18:32	44.3
13/6/2022 01:23:32	43.7
13/6/2022 01:28:32	43.9
13/6/2022 01:33:32	43.2
13/6/2022 01:38:32	43.5
13/6/2022 01:43:32	45.1
13/6/2022 01:48:32	44.3
13/6/2022 01:53:32	42.2
13/6/2022 01:58:32	46.2
13/6/2022 02:03:32	44.7
13/6/2022 02:08:32	45
13/6/2022 02:13:32	45.4
13/6/2022 02:18:32	45.1
13/6/2022 02:23:32	45.5
13/6/2022 02:28:32	45.6
13/6/2022 02:33:32	45
13/6/2022 02:38:32	44.6
13/6/2022 02:43:32	44.2

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
13/4/2022 05:45:01	52.6
13/4/2022 05:50:01	53.1
13/4/2022 05:55:01	52.6
13/4/2022 06:00:01	53.2
13/4/2022 06:05:01	53.8
13/4/2022 06:10:01	53.8
13/4/2022 06:15:01	54
13/4/2022 06:20:01	54.7
13/4/2022 06:25:01	53.9
13/4/2022 06:30:01	53.5
13/4/2022 06:35:01	56.8
13/4/2022 06:40:01	54.8
13/4/2022 06:45:01	54.4
13/4/2022 06:50:01	55.8
13/4/2022 06:55:01	55.4
Wed, 13/4/2022, 07:00	56.3
13/4/2022 07:05:01	56.1
13/4/2022 07:10:01	56.3
13/4/2022 07:15:01	55.6
13/4/2022 07:20:01	55.6
13/4/2022 07:25:01	55
13/4/2022 07:30:01	55.9
13/4/2022 07:35:01	56
13/4/2022 07:40:01	56.7
13/4/2022 07:45:01	56.5
13/4/2022 07:50:01	58.9
13/4/2022 07:55:01	59.1
13/4/2022 08:00:01	56.2
13/4/2022 08:05:01	55.6
13/4/2022 08:10:01	56.2
13/4/2022 08:15:01	55.5
13/4/2022 08:20:01	56.1
13/4/2022 08:25:01	55.8
13/4/2022 08:30:01	55.2
13/4/2022 08:35:01	55.6
13/4/2022 08:40:01	56.8
13/4/2022 08:45:01	55.2
13/4/2022 08:50:01	56.5
13/4/2022 08:55:01	55.8
13/4/2022 09:00:01	55.5
13/4/2022 09:05:01	56.2
13/4/2022 09:10:01	56.1
13/4/2022 09:15:01	54.6
13/4/2022 09:20:01	55.3
13/4/2022 09:25:01	55.6
13/4/2022 09:30:01	55.2
13/4/2022 09:35:01	54.5
13/4/2022 09:40:01	54.1
13/4/2022 09:45:01	55.3

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
13/6/2022 02:48:32	45.8
13/6/2022 02:53:32	45.9
13/6/2022 02:58:32	47
13/6/2022 03:03:32	48
13/6/2022 03:08:32	47.4
13/6/2022 03:13:32	48
13/6/2022 03:18:32	48.7
13/6/2022 03:23:32	46.6
13/6/2022 03:28:32	46.5
13/6/2022 03:33:32	46.2
13/6/2022 03:38:32	46.7
13/6/2022 03:43:32	46.2
13/6/2022 03:48:32	44.8
13/6/2022 03:53:32	46.8
13/6/2022 03:58:32	45.6
13/6/2022 04:03:32	47.4
13/6/2022 04:08:32	45
13/6/2022 04:13:32	45
13/6/2022 04:18:32	45.5
13/6/2022 04:23:32	45.9
13/6/2022 04:28:32	44.8
13/6/2022 04:33:32	45
13/6/2022 04:38:32	44.9
13/6/2022 04:43:32	45.1
13/6/2022 04:48:32	44.9
13/6/2022 04:53:32	45.3
13/6/2022 04:58:32	45.3
13/6/2022 05:03:32	45.5
13/6/2022 05:08:32	46
13/6/2022 05:13:32	45.4
13/6/2022 05:18:32	46
13/6/2022 05:23:32	44.4
13/6/2022 05:28:32	44.6
13/6/2022 05:33:32	51.7
13/6/2022 05:38:32	65.7
13/6/2022 05:43:32	60.2
13/6/2022 05:48:32	73.2
13/6/2022 05:53:32	70.8
13/6/2022 05:58:32	77.8
13/6/2022 06:03:32	74.4
13/6/2022 06:08:32	71
13/6/2022 06:13:32	72.2
13/6/2022 06:18:32	69.2
13/6/2022 06:23:32	58.9
13/6/2022 06:28:32	56.5
13/6/2022 06:33:32	64.8
13/6/2022 06:38:32	68.1
13/6/2022 06:43:32	68.6
13/6/2022 06:48:32	70.8

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
13/4/2022 09:50:01	59.4
13/4/2022 09:55:01	54.6
13/4/2022 10:00:01	65.7
13/4/2022 10:05:01	53.6
13/4/2022 10:10:01	54.3
13/4/2022 10:15:01	53.7
13/4/2022 10:20:01	53.8
13/4/2022 10:25:01	55.1
13/4/2022 10:30:01	54.7
13/4/2022 10:35:01	53
13/4/2022 10:40:01	53
13/4/2022 10:45:01	54.2
13/4/2022 10:50:01	57
13/4/2022 10:55:01	53.2
13/4/2022 11:00:01	57.4
13/4/2022 11:05:01	53
13/4/2022 11:10:01	53.5
13/4/2022 11:15:01	54.1
13/4/2022 11:20:01	54.5
13/4/2022 11:25:01	52.2
13/4/2022 11:30:01	53.8
13/4/2022 11:35:01	51.7
13/4/2022 11:40:01	54.3
13/4/2022 11:45:01	53.6
13/4/2022 11:50:01	52.2
13/4/2022 11:55:01	53.7
13/4/2022 12:00:01	53.4
13/4/2022 12:05:01	55.9
13/4/2022 12:10:01	56.4
13/4/2022 12:15:01	57.9
13/4/2022 12:20:01	53.8
13/4/2022 12:25:01	55.4
13/4/2022 12:30:01	53.5
13/4/2022 12:35:01	53.7
13/4/2022 12:40:01	53
13/4/2022 12:45:01	53.4
13/4/2022 12:50:01	52.9
13/4/2022 12:55:01	52.8
13/4/2022 13:00:01	52.9
13/4/2022 13:05:01	54.5
13/4/2022 13:10:01	54
13/4/2022 13:15:01	53.5
13/4/2022 13:20:01	54.4
13/4/2022 13:25:01	54.4
13/4/2022 13:30:01	53.3
13/4/2022 13:35:01	56.5
13/4/2022 13:40:01	56.2
13/4/2022 13:45:01	53.2
13/4/2022 13:50:01	55.2

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
13/6/2022 06:53:32	70.7
13/6/2022 06:58:32	62.2
13/6/2022 07:03:32	64.6
13/6/2022 07:08:32	61.8
13/6/2022 07:13:32	56.7
13/6/2022 07:18:32	55.6
13/6/2022 07:23:32	56
13/6/2022 07:28:32	56.4
13/6/2022 07:33:32	55.3
13/6/2022 07:38:32	56.3
13/6/2022 07:43:32	53.9
13/6/2022 07:48:32	54.9
13/6/2022 07:53:32	53.6
13/6/2022 07:58:32	54.2
13/6/2022 08:03:32	52.8
13/6/2022 08:08:32	50.6
13/6/2022 08:13:32	50.8
13/6/2022 08:18:32	54.4
13/6/2022 08:23:32	48.1
13/6/2022 08:28:32	50.6
13/6/2022 08:33:32	50.2
13/6/2022 08:38:32	48.5
13/6/2022 08:43:32	49.1
13/6/2022 08:48:32	53.1
13/6/2022 08:53:32	47.3
13/6/2022 08:58:32	49.2
13/6/2022 09:03:32	47.3
13/6/2022 09:08:32	49.7
13/6/2022 09:13:32	47.7
13/6/2022 09:18:32	48.4
13/6/2022 09:23:32	47.7
13/6/2022 09:28:32	47
13/6/2022 09:33:32	47.5
13/6/2022 09:38:32	56.9
13/6/2022 09:43:32	48.7
13/6/2022 09:48:32	47.6
13/6/2022 09:53:32	58.2
13/6/2022 09:58:32	70.4
13/6/2022 10:03:32	47.7
13/6/2022 10:08:32	56.6
13/6/2022 10:13:32	49.6
13/6/2022 10:18:32	48.1
13/6/2022 10:23:32	46.1
13/6/2022 10:28:32	49.7
13/6/2022 10:33:32	46.8
13/6/2022 10:38:32	47.1
13/6/2022 10:43:32	49.2
13/6/2022 10:48:32	51.5
13/6/2022 10:53:32	55.8

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
13/4/2022 13:55:01	54.2
13/4/2022 14:00:01	54.2
13/4/2022 14:05:01	53.4
13/4/2022 14:10:01	52.8
13/4/2022 14:15:01	54
13/4/2022 14:20:01	53.2
13/4/2022 14:25:01	53.9
13/4/2022 14:30:01	52.3
13/4/2022 14:35:01	52
13/4/2022 14:40:01	53.6
13/4/2022 14:45:01	54.1
13/4/2022 14:50:01	63.9
13/4/2022 14:55:01	68.6
Wed, 13/4/2022, 15:00	53.7
13/4/2022 15:05:01	54.9
13/4/2022 15:10:01	56.1
13/4/2022 15:15:01	55.6
13/4/2022 15:20:01	58.7
13/4/2022 15:25:01	61.5
13/4/2022 15:30:01	55.5
13/4/2022 15:35:01	57.6
13/4/2022 15:40:01	60.2
13/4/2022 15:45:01	59.9
13/4/2022 15:50:01	57
13/4/2022 15:55:01	55.9
13/4/2022 16:00:01	53.7
13/4/2022 16:05:01	59.4
13/4/2022 16:10:01	56.2
13/4/2022 16:15:01	56.3
13/4/2022 16:20:01	53.6
13/4/2022 16:25:01	53.4
13/4/2022 16:30:01	55.2
13/4/2022 16:35:01	55.6
13/4/2022 16:40:01	52.9
13/4/2022 16:45:01	55.4
13/4/2022 16:50:01	53.2
13/4/2022 16:55:01	54.6
13/4/2022 17:00:01	53.8
13/4/2022 17:05:01	53.9
13/4/2022 17:10:01	53.8
13/4/2022 17:15:01	54.3
13/4/2022 17:20:01	54.1
13/4/2022 17:25:01	54.8
13/4/2022 17:30:01	55.4
13/4/2022 17:35:01	54.4
13/4/2022 17:40:01	55.4
13/4/2022 17:45:01	55.4
13/4/2022 17:50:01	55.9
13/4/2022 17:55:01	54.4

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
13/6/2022 10:58:32	46.4
13/6/2022 11:03:32	45.3
13/6/2022 11:08:32	50.7
13/6/2022 11:13:32	44.4
13/6/2022 11:18:32	51.6
13/6/2022 11:23:32	46.1
13/6/2022 11:28:32	47.4
13/6/2022 11:33:32	50.6
13/6/2022 11:38:32	60.2
13/6/2022 11:43:32	52.3
13/6/2022 11:48:32	48.3
13/6/2022 11:53:32	48.5
13/6/2022 11:58:32	45.6
13/6/2022 12:03:32	45.9
13/6/2022 12:08:32	46.1
13/6/2022 12:13:32	44.9
13/6/2022 12:18:32	57.2
13/6/2022 12:23:32	65.7
13/6/2022 12:28:32	50.6
13/6/2022 12:33:32	48.6
13/6/2022 12:38:32	52.7
13/6/2022 12:43:32	47.6
13/6/2022 12:48:32	51.9
13/6/2022 12:53:32	49.2
13/6/2022 12:58:32	47.9
13/6/2022 13:03:32	48.9
13/6/2022 13:08:32	47.9
13/6/2022 13:13:32	51.1
13/6/2022 13:18:32	52.8
13/6/2022 13:23:32	49
13/6/2022 13:28:32	49
13/6/2022 13:33:32	50.1
13/6/2022 13:38:32	52.5
13/6/2022 13:43:32	49.5
13/6/2022 13:48:32	57
13/6/2022 13:53:32	51
13/6/2022 13:58:32	67.2
13/6/2022 14:03:32	50.8
13/6/2022 14:08:32	50.3
13/6/2022 14:13:32	48.9
13/6/2022 14:18:32	52.4
13/6/2022 14:23:32	52
13/6/2022 14:28:32	55.9
13/6/2022 14:33:32	55.1
13/6/2022 14:38:32	46.5
13/6/2022 14:43:32	48.8
13/6/2022 14:48:32	60.5
13/6/2022 14:53:32	54.4
13/6/2022 14:58:32	58.5

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
13/4/2022 18:00:01	55
13/4/2022 18:05:01	55.9
13/4/2022 18:10:01	55.8
13/4/2022 18:15:01	55.8
13/4/2022 18:20:01	56.7
13/4/2022 18:25:01	55.6
13/4/2022 18:30:01	55.2
13/4/2022 18:35:01	55.3
13/4/2022 18:40:01	55.4
13/4/2022 18:45:01	54.9
13/4/2022 18:50:01	55.5
13/4/2022 18:55:01	55.5
Wed, 13/4/2022, 19:00	55.6
13/4/2022 19:05:01	55.1
13/4/2022 19:10:01	54.7
13/4/2022 19:15:01	54.8
13/4/2022 19:20:01	63
13/4/2022 19:25:01	68.3
13/4/2022 19:30:01	54.1
13/4/2022 19:35:01	69.3
13/4/2022 19:40:01	56.3
13/4/2022 19:45:01	55.3
13/4/2022 19:50:01	56.6
13/4/2022 19:55:01	61.9
13/4/2022 20:00:01	57.8
13/4/2022 20:05:01	61.2
13/4/2022 20:10:01	60.7
13/4/2022 20:15:01	57.6
13/4/2022 20:20:01	58.2
13/4/2022 20:25:01	60.5
13/4/2022 20:30:01	58
13/4/2022 20:35:01	56.3
13/4/2022 20:40:01	56.1
13/4/2022 20:45:01	58
13/4/2022 20:50:01	55.8
13/4/2022 20:55:01	57.3
13/4/2022 21:00:01	55.1
13/4/2022 21:05:01	55.4
13/4/2022 21:10:01	56.2
13/4/2022 21:15:01	55.3
13/4/2022 21:20:01	55.9
13/4/2022 21:25:01	55.8
13/4/2022 21:30:01	56.2
13/4/2022 21:35:01	56.4
13/4/2022 21:40:01	56.4
13/4/2022 21:45:01	56.9
13/4/2022 21:50:01	57.4
13/4/2022 21:55:01	57.2
13/4/2022 22:00:01	57.7

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
13/6/2022 15:03:32	48.5
13/6/2022 15:08:32	53.2
13/6/2022 15:13:32	56.7
13/6/2022 15:18:32	54.9
13/6/2022 15:23:32	50
13/6/2022 15:28:32	47.1
13/6/2022 15:33:32	48.3
13/6/2022 15:38:32	50.4
13/6/2022 15:43:32	55.6
13/6/2022 15:48:32	60.5
13/6/2022 15:53:32	46.2
13/6/2022 15:58:32	49.2
13/6/2022 16:03:32	46.6
13/6/2022 16:08:32	49.4
13/6/2022 16:13:32	47.1
13/6/2022 16:18:32	47.4
13/6/2022 16:23:32	48.4
13/6/2022 16:28:32	55.1
13/6/2022 16:33:32	46
13/6/2022 16:38:32	49.7
13/6/2022 16:43:32	60.8
13/6/2022 16:48:32	49.2
13/6/2022 16:53:32	57.1
13/6/2022 16:58:32	64.6
13/6/2022 17:03:32	67.5
13/6/2022 17:08:32	62.2
13/6/2022 17:13:32	65.6
13/6/2022 17:18:32	61.9
13/6/2022 17:23:32	72.5
13/6/2022 17:28:32	58.2
13/6/2022 17:33:32	64.5
13/6/2022 17:38:32	58.4
13/6/2022 17:43:32	56.7
13/6/2022 17:48:32	50.5
13/6/2022 17:53:32	51.6
13/6/2022 17:58:32	52.5
13/6/2022 18:03:32	47.9
13/6/2022 18:08:32	48.8
13/6/2022 18:13:32	58.7
13/6/2022 18:18:32	47.7
13/6/2022 18:23:32	50.9
13/6/2022 18:28:32	47.7
13/6/2022 18:33:32	49.6
13/6/2022 18:38:32	49.5
13/6/2022 18:43:32	49.9
13/6/2022 18:48:32	49.9
13/6/2022 18:53:32	49.9
13/6/2022 18:58:32	49
13/6/2022 19:03:32	51.1

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
13/4/2022 22:05:01	57.3
13/4/2022 22:10:01	57.7
13/4/2022 22:15:01	57.3
13/4/2022 22:20:01	56.9
13/4/2022 22:25:01	55.5
13/4/2022 22:30:01	56.2
13/4/2022 22:35:01	55.6
13/4/2022 22:40:01	55.5
13/4/2022 22:45:01	55
13/4/2022 22:50:01	54.9
13/4/2022 22:55:01	54.4
13/4/2022 23:00:01	54.3
13/4/2022 23:05:01	58.4
13/4/2022 23:10:01	54.9
13/4/2022 23:15:01	54.3
13/4/2022 23:20:01	54.5
13/4/2022 23:25:01	54.1
13/4/2022 23:30:01	54.3
13/4/2022 23:35:01	53.4
13/4/2022 23:40:01	54
13/4/2022 23:45:01	54.2
13/4/2022 23:50:01	53.5
13/4/2022 23:55:01	52.7
14/4/2022 00:00:01	52.6
14/4/2022 00:05:01	54.8
14/4/2022 00:10:01	51.8
14/4/2022 00:15:01	51.5
14/4/2022 00:20:01	51.7
14/4/2022 00:25:01	51.2
14/4/2022 00:30:01	50.5
14/4/2022 00:35:01	50.7
14/4/2022 00:40:01	50.7
14/4/2022 00:45:01	50
14/4/2022 00:50:01	50.2
14/4/2022 00:55:01	50.4
14/4/2022 01:00:01	50
14/4/2022 01:05:01	49.8
14/4/2022 01:10:01	49.5
14/4/2022 01:15:01	49.7
14/4/2022 01:20:01	49.6
14/4/2022 01:25:01	51.1
14/4/2022 01:30:01	49.9
14/4/2022 01:35:01	50.2
14/4/2022 01:40:01	50.5
14/4/2022 01:45:01	49.9
14/4/2022 01:50:01	51.6
14/4/2022 01:55:01	51.7
14/4/2022 02:00:01	50.1
14/4/2022 02:05:01	47.6

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
13/6/2022 19:08:32	52.4
13/6/2022 19:13:32	53.1
13/6/2022 19:18:32	53.8
13/6/2022 19:23:32	53.9
13/6/2022 19:28:32	55.1
13/6/2022 19:33:32	54
13/6/2022 19:38:32	55.2
13/6/2022 19:43:32	53.4
13/6/2022 19:48:32	52.9
13/6/2022 19:53:32	52.9
13/6/2022 19:58:32	52.7
13/6/2022 20:03:32	52.1
13/6/2022 20:08:32	52.3
13/6/2022 20:13:32	53.5
13/6/2022 20:18:32	51
13/6/2022 20:23:32	50.9
13/6/2022 20:28:32	51.6
13/6/2022 20:33:32	52.6
13/6/2022 20:38:32	51.4
13/6/2022 20:43:32	51.5
13/6/2022 20:48:32	51.1
13/6/2022 20:53:32	55.1
13/6/2022 20:58:32	50.6
13/6/2022 21:03:32	51.3
13/6/2022 21:08:32	49.9
13/6/2022 21:13:32	50.5
13/6/2022 21:18:32	50.1
13/6/2022 21:23:32	49.5
13/6/2022 21:28:32	49.6
13/6/2022 21:33:32	51.6
13/6/2022 21:38:32	49.7
13/6/2022 21:43:32	49.4
13/6/2022 21:48:32	49.2
13/6/2022 21:53:32	48.5
13/6/2022 21:58:32	48.1
13/6/2022 22:03:32	48.7
13/6/2022 22:08:32	49.1
13/6/2022 22:13:32	48.3
13/6/2022 22:18:32	49.4
13/6/2022 22:23:32	48.7
13/6/2022 22:28:32	47.9
13/6/2022 22:33:32	47.5
13/6/2022 22:38:32	47
13/6/2022 22:43:32	48.1
13/6/2022 22:48:32	47.7
13/6/2022 22:53:32	48.2
13/6/2022 22:58:32	47.9
13/6/2022 23:03:32	48.9
13/6/2022 23:08:32	48.5

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
14/4/2022 02:10:01	48.8
14/4/2022 02:15:01	50.4
14/4/2022 02:20:01	48.9
14/4/2022 02:25:01	48.8
14/4/2022 02:30:01	49.5
14/4/2022 02:35:01	47.9
14/4/2022 02:40:01	48.2
14/4/2022 02:45:01	48.5
14/4/2022 02:50:01	48
14/4/2022 02:55:01	48
Thu, 14/4/2022, 03:00	48.8
14/4/2022 03:05:01	49.2
14/4/2022 03:10:01	50.3
14/4/2022 03:15:01	49.1
14/4/2022 03:20:01	49.2
14/4/2022 03:25:01	50.5
14/4/2022 03:30:01	49.4
14/4/2022 03:35:01	50.2
14/4/2022 03:40:01	50.2
14/4/2022 03:45:01	49.9
14/4/2022 03:50:01	49.7
14/4/2022 03:55:01	49.9
14/4/2022 04:00:01	49.7
14/4/2022 04:05:01	48.8
14/4/2022 04:10:01	49.3
14/4/2022 04:15:01	48.6
14/4/2022 04:20:01	48.4
14/4/2022 04:25:01	48.8
14/4/2022 04:30:01	49
14/4/2022 04:35:01	50.7
14/4/2022 04:40:01	51.7
14/4/2022 04:45:01	50.9
14/4/2022 04:50:01	50.6
14/4/2022 04:55:01	50.2
14/4/2022 05:00:01	51.4
14/4/2022 05:05:01	51.6
14/4/2022 05:10:01	53.4
14/4/2022 05:15:01	52
14/4/2022 05:20:01	52.3
14/4/2022 05:25:01	52.2
14/4/2022 05:30:01	52.4
14/4/2022 05:35:01	52
14/4/2022 05:40:01	53.2
14/4/2022 05:45:01	53
14/4/2022 05:50:01	53.7
14/4/2022 05:55:01	53.8
14/4/2022 06:00:01	54.7
14/4/2022 06:05:01	54.1
14/4/2022 06:10:01	53.9

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
13/6/2022 23:13:32	47.7
13/6/2022 23:18:32	47.3
13/6/2022 23:23:32	48.9
13/6/2022 23:28:32	50.2
13/6/2022 23:33:32	46.9
13/6/2022 23:38:32	47.3
13/6/2022 23:43:32	46.3
13/6/2022 23:48:32	46.9
13/6/2022 23:53:32	47.5
13/6/2022 23:58:32	47.1
14/6/2022 00:03:32	47.6
14/6/2022 00:08:32	47.5
14/6/2022 00:13:32	46.5
14/6/2022 00:18:32	46.8
14/6/2022 00:23:32	45.2
14/6/2022 00:28:32	47.1
14/6/2022 00:33:32	45.8
14/6/2022 00:38:32	46
14/6/2022 00:43:32	45.8
14/6/2022 00:48:32	45.9
14/6/2022 00:53:32	45.7
14/6/2022 00:58:32	45.6
14/6/2022 01:03:32	47.4
14/6/2022 01:08:32	48.7
14/6/2022 01:13:32	46.1
14/6/2022 01:18:32	46.7
14/6/2022 01:23:32	46.8
14/6/2022 01:28:32	46.6
14/6/2022 01:33:32	46.1
14/6/2022 01:38:32	46.1
14/6/2022 01:43:32	47.1
14/6/2022 01:48:32	47.3
14/6/2022 01:53:32	44.5
14/6/2022 01:58:32	46.9
14/6/2022 02:03:32	46.2
14/6/2022 02:08:32	46.6
14/6/2022 02:13:32	46
14/6/2022 02:18:32	46
14/6/2022 02:23:32	46.5
14/6/2022 02:28:32	45.5
14/6/2022 02:33:32	44
14/6/2022 02:38:32	45.2
14/6/2022 02:43:32	44.6
14/6/2022 02:48:32	45.4
14/6/2022 02:53:32	44.3
14/6/2022 02:58:32	44.3
14/6/2022 03:03:32	46.5
14/6/2022 03:08:32	44.8
14/6/2022 03:13:32	44

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
14/4/2022 06:15:01	54.8
14/4/2022 06:20:01	54.9
14/4/2022 06:25:01	54.3
14/4/2022 06:30:01	54.3
14/4/2022 06:35:01	54.9
14/4/2022 06:40:01	54.8
14/4/2022 06:45:01	56.2
14/4/2022 06:50:01	56.5
14/4/2022 06:55:01	56.2
Thu, 14/4/2022, 07:00	56.6
14/4/2022 07:05:01	56.3
14/4/2022 07:10:01	56.6
14/4/2022 07:15:01	56.7
14/4/2022 07:20:01	57.1
14/4/2022 07:25:01	57.2
14/4/2022 07:30:01	55.8
14/4/2022 07:35:01	56.7
14/4/2022 07:40:01	55.7
14/4/2022 07:45:01	57.1
14/4/2022 07:50:01	55.8
14/4/2022 07:55:01	56.1
14/4/2022 08:00:01	59
14/4/2022 08:05:01	58.8
14/4/2022 08:10:01	56.7
14/4/2022 08:15:01	56
14/4/2022 08:20:01	55.3
14/4/2022 08:25:01	55.3
14/4/2022 08:30:01	54.9
14/4/2022 08:35:01	56.3
14/4/2022 08:40:01	55.3
14/4/2022 08:45:01	55
14/4/2022 08:50:01	56.4
14/4/2022 08:55:01	56.1
14/4/2022 09:00:01	57.8
14/4/2022 09:05:01	54.2
14/4/2022 09:10:01	55.9
14/4/2022 09:15:01	57
14/4/2022 09:20:01	55.5
14/4/2022 09:25:01	56
14/4/2022 09:30:01	54.4
14/4/2022 09:35:01	56.5
14/4/2022 09:40:01	55.5
14/4/2022 09:45:01	54.8
14/4/2022 09:50:01	58.9
14/4/2022 09:55:01	55.2
14/4/2022 10:00:01	58.7
14/4/2022 10:05:01	54.6
14/4/2022 10:10:01	53.4
14/4/2022 10:15:01	55.1

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
14/6/2022 03:18:32	45.1
14/6/2022 03:23:32	44.8
14/6/2022 03:28:32	45.3
14/6/2022 03:33:32	44.8
14/6/2022 03:38:32	46.2
14/6/2022 03:43:32	45.9
14/6/2022 03:48:32	44.5
14/6/2022 03:53:32	46.3
14/6/2022 03:58:32	44.9
14/6/2022 04:03:32	44.9
14/6/2022 04:08:32	48.5
14/6/2022 04:13:32	44.9
14/6/2022 04:18:32	44.3
14/6/2022 04:23:32	44.2
14/6/2022 04:28:32	45.1
14/6/2022 04:33:32	45.3
14/6/2022 04:38:32	44.1
14/6/2022 04:43:32	44.2
14/6/2022 04:48:32	44.5
14/6/2022 04:53:32	45.5
14/6/2022 04:58:32	45.2
14/6/2022 05:03:32	45.6
14/6/2022 05:08:32	45.8
14/6/2022 05:13:32	46
14/6/2022 05:18:32	47.6
14/6/2022 05:23:32	46.9
14/6/2022 05:28:32	45.9
14/6/2022 05:33:32	46.1
14/6/2022 05:38:32	47.7
14/6/2022 05:43:32	47.6
14/6/2022 05:48:32	49.2
14/6/2022 05:53:32	50.3
14/6/2022 05:58:32	50.9
14/6/2022 06:03:32	52.7
14/6/2022 06:08:32	54.2
14/6/2022 06:13:32	53.5
14/6/2022 06:18:32	53.1
14/6/2022 06:23:32	53
14/6/2022 06:28:32	53.4
14/6/2022 06:33:32	54.1
14/6/2022 06:38:32	53.7
14/6/2022 06:43:32	53.8
14/6/2022 06:48:32	52.8
14/6/2022 06:53:32	57.6
14/6/2022 06:58:32	52.9
14/6/2022 07:03:32	57.4
14/6/2022 07:08:32	53.9
14/6/2022 07:13:32	56.3
14/6/2022 07:18:32	56.3

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
14/4/2022 10:20:01	54.1
14/4/2022 10:25:01	53.8
14/4/2022 10:30:01	55.5
14/4/2022 10:35:01	59.4
14/4/2022 10:40:01	53.9
14/4/2022 10:45:01	59.4
14/4/2022 10:50:01	53.4
14/4/2022 10:55:01	57.1
14/4/2022 11:00:01	54.7
14/4/2022 11:05:01	54.4
14/4/2022 11:10:01	54.2
14/4/2022 11:15:01	53.2
14/4/2022 11:20:01	57.3
14/4/2022 11:25:01	54.3
14/4/2022 11:30:01	53.6
14/4/2022 11:35:01	55.5
14/4/2022 11:40:01	53
14/4/2022 11:45:01	53.9
14/4/2022 11:50:01	53.3
14/4/2022 11:55:01	66.1
14/4/2022 12:00:01	55.9
14/4/2022 12:05:01	53.5
14/4/2022 12:10:01	54.3
14/4/2022 12:15:01	55.4
14/4/2022 12:20:01	56.2
14/4/2022 12:25:01	58.3
14/4/2022 12:30:01	53.8
14/4/2022 12:35:01	57.5
14/4/2022 12:40:01	57.5
14/4/2022 12:45:01	58.6
14/4/2022 12:50:01	56.8
14/4/2022 12:55:01	57.9
14/4/2022 13:00:01	55.6
14/4/2022 13:05:01	54.6
14/4/2022 13:10:01	52.3
14/4/2022 13:15:01	52.7
14/4/2022 13:20:01	52.7
14/4/2022 13:25:01	53.3
14/4/2022 13:30:01	52.3
14/4/2022 13:35:01	52.4
14/4/2022 13:40:01	52.2
14/4/2022 13:45:01	52.1
14/4/2022 13:50:01	53.1
14/4/2022 13:55:01	52.8
14/4/2022 14:00:01	52.9
14/4/2022 14:05:01	53.3
14/4/2022 14:10:01	52.6
14/4/2022 14:15:01	53.8
14/4/2022 14:20:01	53.4

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
14/6/2022 07:23:32	53.5
14/6/2022 07:28:32	57.6
14/6/2022 07:33:32	54.2
14/6/2022 07:38:32	49.2
14/6/2022 07:43:32	49.6
14/6/2022 07:48:32	50.1
14/6/2022 07:53:32	47.9
14/6/2022 07:58:32	50.6
14/6/2022 08:03:32	47.6
14/6/2022 08:08:32	50
14/6/2022 08:13:32	51.4
14/6/2022 08:18:32	51.3
14/6/2022 08:23:32	48.7
14/6/2022 08:28:32	48
14/6/2022 08:33:32	47.3
14/6/2022 08:38:32	50.7
14/6/2022 08:43:32	51.8
14/6/2022 08:48:32	60.6
14/6/2022 08:53:32	47.1
14/6/2022 08:58:32	47.2
14/6/2022 09:03:32	70.2
14/6/2022 09:08:32	47.2
14/6/2022 09:13:32	48.5
14/6/2022 09:18:32	47.5
14/6/2022 09:23:32	48.2
14/6/2022 09:28:32	57
14/6/2022 09:33:32	48.7
14/6/2022 09:38:32	46.8
14/6/2022 09:43:32	45.8
14/6/2022 09:48:32	49.8
14/6/2022 09:53:32	45.6
14/6/2022 09:58:32	50.5
14/6/2022 10:03:32	46.7
14/6/2022 10:08:32	44.6
14/6/2022 10:13:32	45.8
14/6/2022 10:18:32	47.5
14/6/2022 10:23:32	48.6
14/6/2022 10:28:32	47.5
14/6/2022 10:33:32	47.3
14/6/2022 10:38:32	58.6
14/6/2022 10:43:32	43.7
14/6/2022 10:48:32	48.5
14/6/2022 10:53:32	49.6
14/6/2022 10:58:32	49.7
14/6/2022 11:03:32	47.7
14/6/2022 11:08:32	51.4
14/6/2022 11:13:32	51.2
14/6/2022 11:18:32	45.1
14/6/2022 11:23:32	51

Raw Noise Data from Station N3
7 - 14 April 2022

Date & Time	Leq (dBA)
14/4/2022 14:25:01	53.2
14/4/2022 14:30:01	53.4
14/4/2022 14:35:01	53.5
14/4/2022 14:40:01	62.5
14/4/2022 14:45:01	42.6
14/4/2022 14:50:01	50.5
14/4/2022 14:55:01	41.8

Raw Noise Data from Station N4
7 - 14 June 2022

Date & Time	Leq (dBA)
14/6/2022 11:28:32	44
14/6/2022 11:33:32	39.5
14/6/2022 11:38:32	41.4
14/6/2022 11:43:32	41.2
14/6/2022 11:48:32	44.6

APPENDIX G

Baseline Vibration Level Monitoring Report

GEOTECHNICAL INSTRUMENTATION AND MONITORING WORKS

Instrumentation Works for Dover Forest for Astar Laboratory Pte Ltd

Report No: **001**

Monitoring Date: **25 April, 2022**

PREPARED FOR

Astar Laboratory Pte Ltd
27 Gul Avenue
Singapore 629667

Prepared by:	**Approved by:**
Abdul Khader	**Weerakoon**
Deputy Manager	**Manager**

Issue Date: 16-May-22

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1. Introduction
2. Instrumentation Layout
3. Conclusion
    3.1 - Vibration Meter

Appendix A INSTRUMENTATION PLAN
Appendix B SUMMARY
Appendix C GUIDELINE FOR VM AND NM
Appendix D VIBRATION METER

CAST lab
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1.0 INTRODUCTION

Instrumentation Works for Dover Forest for Astar Laboratory Pte Ltd

This report presents the results of instrumentation monitoring for the following instruments:

- **Vibration Meter** - to monitor the effect of damaging vibration to existing structure, utilities and occupants

The main objective of the instrumentation works is to monitor any ground movement due to the construction activities during the contract period.

2.0 INSTRUMENTS LAYOUT

The numbers of instruments installed are as follows:

Type of Instrument	Quantity Installed	Quantity Monitored	Remarks
Vibration	3	3	

The layout plan, alert Level, suspension level, and monitoring frequency of the instrumentation provided are shown in Appendix: A.

3.0 CONSTRUCTION ACTIVITIES

General construction works in progress.

4.0 CONCLUSION

Monitoring data obtained on **25 April, 2022**

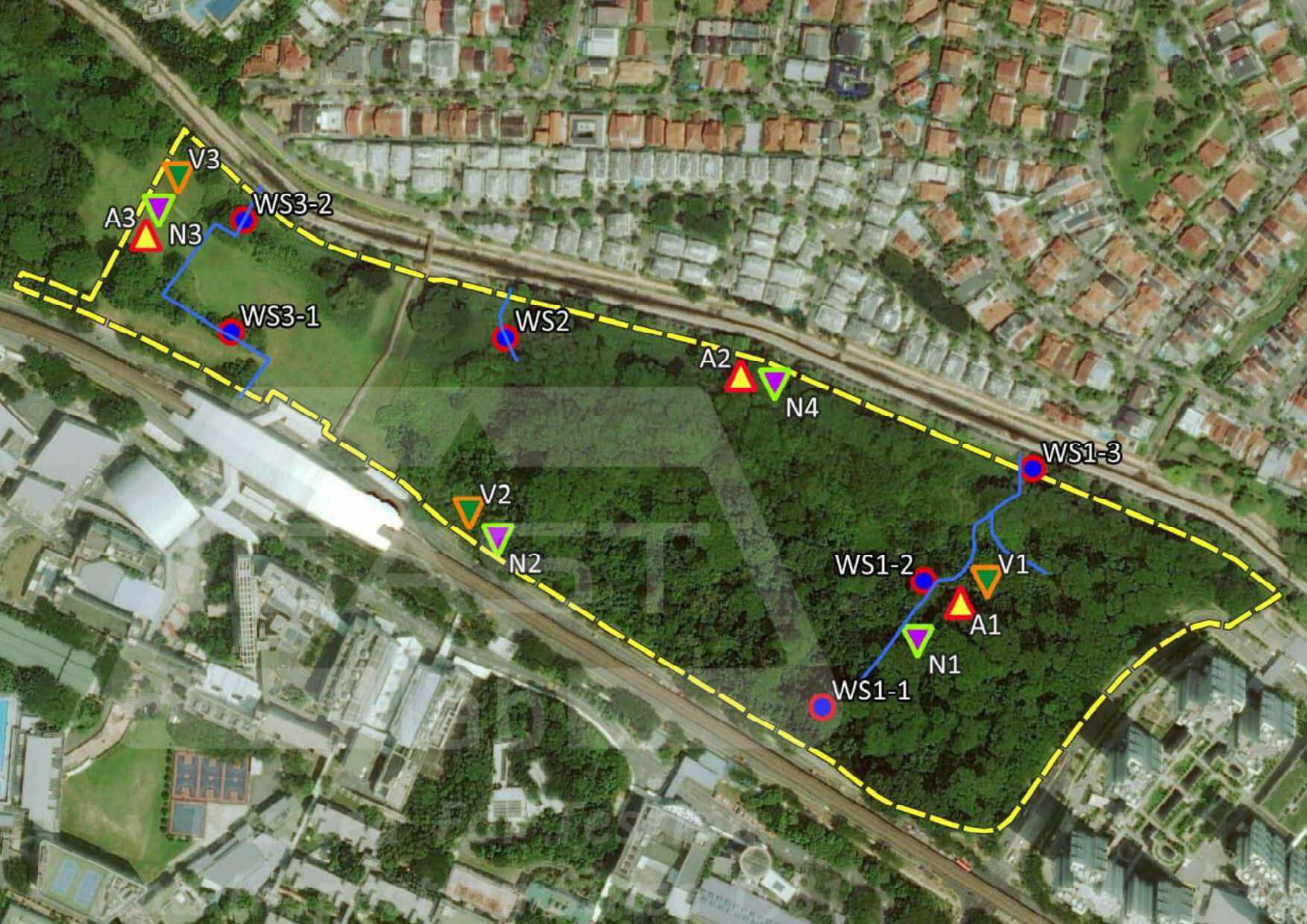
3.1 - Vibration Meter

- VM1 0.35 mm/s
- VM2 0.132 mm/s
- VM3 0.408 mm/s

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Appendix A
INSTRUMENTATION PLAN

CAST lab
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V3
A3
N3
WS3-2
WS3-1
WS2
A2
N4
WS1-3
V2
N2
WS1-2
V1
A1
N1
WS1-1

Appendix B
SUMMARY

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Summary of Monitoring Results

Project: Instrumentation Works for Dover Forest for Astar Laboratory Pte Ltd

Client: Astar Laboratory Pte Ltd

Report No: 001 **Monitoring Date:** 25 April, 2022

Vibration Monitoring

Vibration Monitoring	Alert Level	Suspension Level
	-	-

Ref. No	Monitoring Period Starting	Monitoring Period Ending	Unit Trigger Level (mm/s)	Max. Event Recorded (mm/s)	Remarks
VM 2	9:47:00 AM, 19/4/2022	9:48:00 AM, 20/4/2022	0.13	0.35	-
VM 1	9:55:00 AM, 20/4/2022	9:59:00 AM, 21/4/2022	0.13	0.132	-
VM 1	9:25:00 AM, 24/4/2022	9:52:00 AM, 25/4/2022	0.13	0.408	-

Appendix C
GUIDELINE FOR VM AND NM

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DIN 4150 Part 3

Table 1. Guideline values of vibration velocity, v_i, for evaluating the effects of short-term vibration

Line	Type of structure	Vibration velocity, v_i, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		less than 10 Hz	10 to 50 Hz	50 to 100*) Hz	Frequency mixture
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

*) For frequencies above 100 Hz, at least the values specified in this column shall be applied.

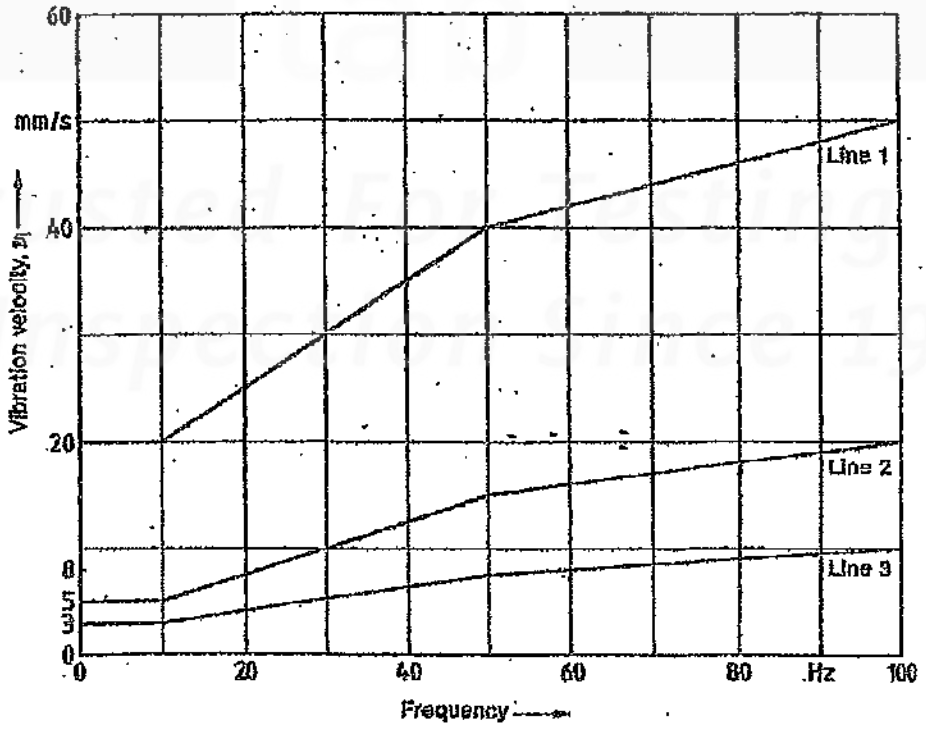


Figure 1. Curves representing the vibration velocity as a function of frequency for the "Foundation" column values as in table 1

Construction Noise Control

Maximum permissible noise levels for construction work commenced on or after 1 October 2007

Mondays to Saturdays

Types of affected buildings	7am - 7pm	7pm - 10pm	10pm - 7am
(a) Hospital, schools, institutions of higher learning, homes for aged sick, etc	60 dBA (Leq* 12 hrs)	50 dBA (Leq 12 hrs)	
	75 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)	
(b) Residential buildings located less than 150m from the construction site	75 dBA (Leq 12 hrs)	65 dBA (Leq 1 hr)	55 dBA (Leq 1 hr)
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)
(c) Buildings other than those in (a) and (b) above	75 dBA (Leq 12 hrs)	65 dBA (Leq 12 hrs)	
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	

Sundays and public holidays

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

*reckoned as the equivalent continuous noise level over the specified period, i.e. 5 mins, 1 hr or 12 hrs.

Source: https://www.nea.gov.sg/our-services/pollution-control/noise-pollution/construction-noise-control

Appendix D
VIBRATION METER

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Vibration Monitoring at Dover forest (Astar)
VM1
Sensor trigger level - 0.125 mm/s

Event Report: Event List - g:\shared drives\clpl sim 2\kumar\dover forest (a-star)\report data\vm\vm-1 (24-04)\24-04-22

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
LOG	BE16338	Apr 24 /22 09:25:04	***	***	***	***	***		***	Start Monitoring
w	BE16338	Apr 24 /22 09:26:07	3	Long	0.175	0.111	0.143	***	0.192	
w	BE16338	Apr 24 /22 10:11:05	3	Vert	0.079	0.143	0.095	***	0.160	
w	BE16338	Apr 24 /22 10:26:54	3	Vert	0.111	0.159	0.095	***	0.178	
w	BE16338	Apr 24 /22 10:33:20	3	Tran	0.127	0.079	0.111	***	0.150	
w	BE16338	Apr 24 /22 12:32:02	3	Long	0.063	0.063	0.127	***	0.128	
w	BE16338	Apr 24 /22 12:36:33	3	Long	0.095	0.079	0.127	***	0.137	
w	BE16338	Apr 24 /22 12:37:38	3	Long	0.095	0.063	0.127	***	0.137	
w	BE16338	Apr 24 /22 13:19:44	3	Tran	0.127	0.063	0.095	***	0.131	
w	BE16338	Apr 24 /22 13:20:46	3	Tran	0.159	0.095	0.143	***	0.178	
w	BE16338	Apr 24 /22 14:07:54	3	Long	0.079	0.063	0.127	***	0.131	
w	BE16338	Apr 24 /22 19:45:05	3	Long	0.079	0.063	0.127	***	0.131	
w	BE16338	Apr 24 /22 21:32:08	3	Tran	0.143	0.127	0.159	***	0.203	
w	BE16338	Apr 24 /22 21:34:51	3	Long	0.127	0.063	0.127	***	0.180	
w	BE16338	Apr 24 /22 21:42:16	3	Long	0.222	0.143	0.317	***	0.325	
w	BE16338	Apr 24 /22 21:43:20	3	Tran	0.175	0.111	0.095	***	0.186	
w	BE16338	Apr 24 /22 21:44:53	3	Tran	0.175	0.079	0.127	***	0.205	
w	BE16338	Apr 24 /22 21:47:04	3	Tran	0.794	0.492	1.222	***	1.458	
LOG	BE16338	Apr 24 /22 23:59:00	***	***	***	***	***		***	Timer Stop
LOG	BE16338	Apr 25 /22 00:00:10	***	***	***	***	***		***	Start Monitoring
w	BE16338	Apr 25 /22 09:49:52	3	Long	0.365	0.270	0.222	***	0.408	
LOG	BE16338	Apr 25 /22 09:52:00	***	***	***	***	***		***	Timer Stop

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Vibration Monitoring at Dover forest (Astar)
VM2
Sensor trigger level - 0.13 mm/s

Event Report: Event List - g:\shared drives\clpl sim 2\kumar\dover forest (a-star)\report data\vm\vm-02(19-04)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
LOG	BE16338	Apr 19 /22 09:47:44	***	***	***	***	***		***	Start Monitoring
w	BE16338	Apr 19 /22 09:54:57	3	Vert	0.079	0.127	0.111	***	0.150	
w	BE16338	Apr 19 /22 09:57:22	3	Long	0.079	0.111	0.127	***	0.129	
w	BE16338	Apr 19 /22 09:59:06	3	Long	0.095	0.159	0.222	***	0.248	
w	BE16338	Apr 19 /22 10:00:48	3	Long	0.079	0.190	0.238	***	0.263	
w	BE16338	Apr 19 /22 10:02:57	3	Vert	0.079	0.190	0.238	***	0.295	
w	BE16338	Apr 19 /22 10:04:26	3	Vert	0.079	0.127	0.175	***	0.207	
w	BE16338	Apr 19 /22 10:06:29	3	Long	0.079	0.175	0.143	***	0.208	
w	BE16338	Apr 19 /22 10:09:29	3	Long	0.079	0.127	0.159	***	0.172	
w	BE16338	Apr 19 /22 10:10:35	3	Vert	0.079	0.143	0.111	***	0.150	
w	BE16338	Apr 19 /22 10:11:36	3	Long	0.079	0.159	0.190	***	0.230	
w	BE16338	Apr 19 /22 10:14:40	3	Long	0.095	0.175	0.222	***	0.256	
w	BE16338	Apr 19 /22 10:17:25	3	Long	0.079	0.159	0.175	***	0.241	
w	BE16338	Apr 19 /22 10:18:43	3	Long	0.079	0.175	0.175	***	0.226	
w	BE16338	Apr 19 /22 10:23:04	3	Long	0.079	0.095	0.143	***	0.151	
w	BE16338	Apr 19 /22 10:24:15	3	Vert	0.079	0.175	0.206	***	0.237	
w	BE16338	Apr 19 /22 10:28:02	3	Long	0.079	0.111	0.127	***	0.131	
w	BE16338	Apr 19 /22 10:29:20	3	Long	0.095	0.175	0.238	***	0.247	
w	BE16338	Apr 19 /22 10:30:32	3	Long	0.095	0.143	0.159	***	0.192	
w	BE16338	Apr 19 /22 10:33:53	3	Vert	0.079	0.175	0.175	***	0.214	
w	BE16338	Apr 19 /22 10:34:53	3	Vert	0.079	0.143	0.175	***	0.226	
w	BE16338	Apr 19 /22 10:36:19	3	Long	0.095	0.143	0.175	***	0.203	
w	BE16338	Apr 19 /22 10:38:06	3	Long	0.095	0.190	0.238	***	0.286	
w	BE16338	Apr 19 /22 10:40:36	3	Long	0.079	0.175	0.190	***	0.223	
w	BE16338	Apr 19 /22 10:45:38	3	Long	0.079	0.143	0.159	***	0.172	
w	BE16338	Apr 19 /22 10:48:18	3	Long	0.095	0.190	0.254	***	0.310	
w	BE16338	Apr 19 /22 10:51:45	3	Long	0.063	0.095	0.127	***	0.131	
w	BE16338	Apr 19 /22 10:53:17	3	Long	0.079	0.127	0.190	***	0.223	
w	BE16338	Apr 19 /22 10:56:09	3	Long	0.095	0.143	0.190	***	0.229	
w	BE16338	Apr 19 /22 10:57:40	3	Vert	0.079	0.175	0.159	***	0.192	
w	BE16338	Apr 19 /22 11:00:04	3	Long	0.063	0.095	0.127	***	0.132	
w	BE16338	Apr 19 /22 11:01:49	3	Long	0.063	0.127	0.190	***	0.191	
w	BE16338	Apr 19 /22 11:04:04	3	Long	0.079	0.111	0.127	***	0.137	
w	BE16338	Apr 19 /22 11:07:04	3	Long	0.079	0.111	0.127	***	0.137	
w	BE16338	Apr 19 /22 11:11:13	3	Vert	0.079	0.127	0.143	***	0.147	
w	BE16338	Apr 19 /22 11:14:12	3	Long	0.079	0.175	0.206	***	0.243	
w	BE16338	Apr 19 /22 11:16:45	3	Long	0.079	0.175	0.190	***	0.237	
w	BE16338	Apr 19 /22 11:18:50	3	Long	0.079	0.222	0.238	***	0.278	
w	BE16338	Apr 19 /22 11:21:57	3	Long	0.079	0.159	0.190	***	0.208	
w	BE16338	Apr 19 /22 11:24:50	3	Long	0.079	0.222	0.238	***	0.283	
w	BE16338	Apr 19 /22 11:28:14	3	Vert	0.079	0.206	0.238	***	0.283	
w	BE16338	Apr 19 /22 11:30:14	3	Long	0.079	0.143	0.143	***	0.166	
w	BE16338	Apr 19 /22 11:32:07	3	Long	0.079	0.095	0.127	***	0.132	
w	BE16338	Apr 19 /22 11:34:39	3	Long	0.079	0.190	0.190	***	0.226	
w	BE16338	Apr 19 /22 11:36:57	3	Long	0.079	0.095	0.127	***	0.132	
w	BE16338	Apr 19 /22 11:38:30	3	Long	0.079	0.127	0.159	***	0.169	
w	BE16338	Apr 19 /22 11:40:49	3	Vert	0.079	0.175	0.159	***	0.194	
w	BE16338	Apr 19 /22 11:43:00	3	Vert	0.079	0.143	0.127	***	0.154	
w	BE16338	Apr 19 /22 11:45:55	3	Long	0.079	0.111	0.127	***	0.175	
w	BE16338	Apr 19 /22 11:47:10	3	Vert	0.079	0.159	0.127	***	0.177	
w	BE16338	Apr 19 /22 11:48:28	3	Long	0.079	0.159	0.190	***	0.214	
w	BE16338	Apr 19 /22 11:51:20	3	Vert	0.079	0.127	0.143	***	0.151	
w	BE16338	Apr 19 /22 11:53:20	3	Vert	0.095	0.159	0.190	***	0.237	
w	BE16338	Apr 19 /22 11:57:08	3	Long	0.079	0.127	0.143	***	0.169	
w	BE16338	Apr 19 /22 12:00:44	3	Long	0.079	0.111	0.127	***	0.132	
w	BE16338	Apr 19 /22 12:03:54	3	Long	0.079	0.143	0.143	***	0.191	
w	BE16338	Apr 19 /22 12:07:03	3	Long	0.079	0.175	0.159	***	0.228	
w	BE16338	Apr 19 /22 12:09:18	3	Long	0.079	0.190	0.175	***	0.229	
w	BE16338	Apr 19 /22 12:11:47	3	Long	0.079	0.175	0.206	***	0.247	
w	BE16338	Apr 19 /22 12:14:11	3	Long	0.079	0.111	0.127	***	0.138	
w	BE16338	Apr 19 /22 12:17:02	3	Long	0.095	0.175	0.190	***	0.239	
LOG	BE16338	Apr 19 /22 12:18:02	***	***	***	***	***		***	
w	BE16338	Apr 19 /22 12:18:15	3	Long	0.079	0.159	0.175	***	0.208	
w	BE16338	Apr 19 /22 12:21:49	3	Long	0.063	0.159	0.159	***	0.194	
w	BE16338	Apr 19 /22 12:23:53	3	Long	0.095	0.127	0.127	***	0.143	
w	BE16338	Apr 19 /22 12:25:10	3	Long	0.079	0.111	0.143	***	0.145	
LOG	BE16338	Apr 19 /22 12:26:10	***	***	***	***	***		***	
w	BE16338	Apr 19 /22 12:26:12	3	Long	0.079	0.127	0.159	***	0.162	
w	BE16338	Apr 19 /22 12:27:43	3	Long	0.079	0.095	0.143	***	0.145	
w	BE16338	Apr 19 /22 12:29:39	3	Long	0.079	0.175	0.190	***	0.221	

Vibration Monitoring at Dover forest (Astar)
VM2
Sensor trigger level - 0.13 mm/s

Event Report: Event List - g:\shared drives\clpl sim 2\kumar\dover forest (a-star)\report data\vm\vm-02(19-04)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
w	BE16338	Apr 19 /22 12:31:31	3	Long	0.079	0.127	0.127	***	0.139	
w	BE16338	Apr 19 /22 12:32:32	3	Vert	0.095	0.175	0.190	***	0.216	
w	BE16338	Apr 19 /22 12:34:48	3	Long	0.079	0.175	0.190	***	0.221	
w	BE16338	Apr 19 /22 12:35:54	3	Vert	0.079	0.143	0.095	***	0.150	
w	BE16338	Apr 19 /22 12:38:38	3	Long	0.079	0.111	0.190	***	0.197	
w	BE16338	Apr 19 /22 12:40:37	3	Long	0.079	0.111	0.143	***	0.147	
w	BE16338	Apr 19 /22 12:41:44	3	Long	0.079	0.190	0.206	***	0.230	
w	BE16338	Apr 19 /22 12:43:07	3	Vert	0.079	0.175	0.222	***	0.243	
w	BE16338	Apr 19 /22 12:50:04	3	Vert	0.079	0.175	0.143	***	0.209	
w	BE16338	Apr 19 /22 12:54:41	3	Long	0.079	0.159	0.206	***	0.239	
w	BE16338	Apr 19 /22 12:55:57	3	Vert	0.063	0.143	0.127	***	0.145	
w	BE16338	Apr 19 /22 13:00:43	3	Long	0.079	0.175	0.143	***	0.200	
w	BE16338	Apr 19 /22 13:02:40	3	Long	0.079	0.159	0.175	***	0.238	
w	BE16338	Apr 19 /22 13:07:13	3	Long	0.079	0.127	0.159	***	0.194	
w	BE16338	Apr 19 /22 13:08:16	3	Long	0.127	0.143	0.206	***	0.217	
w	BE16338	Apr 19 /22 13:09:36	3	Long	0.079	0.159	0.206	***	0.253	
w	BE16338	Apr 19 /22 13:12:16	3	Long	0.079	0.111	0.127	***	0.151	
w	BE16338	Apr 19 /22 13:14:28	3	Vert	0.095	0.159	0.190	***	0.214	
w	BE16338	Apr 19 /22 13:16:33	3	Long	0.079	0.111	0.127	***	0.180	
w	BE16338	Apr 19 /22 13:19:07	3	Vert	0.079	0.175	0.143	***	0.207	
w	BE16338	Apr 19 /22 13:21:00	3	Vert	0.079	0.127	0.127	***	0.150	
w	BE16338	Apr 19 /22 13:24:04	3	Long	0.079	0.127	0.159	***	0.166	
w	BE16338	Apr 19 /22 13:26:09	3	Vert	0.079	0.143	0.127	***	0.147	
w	BE16338	Apr 19 /22 13:28:08	3	Vert	0.095	0.127	0.111	***	0.153	
w	BE16338	Apr 19 /22 13:31:11	3	Long	0.079	0.175	0.159	***	0.194	
w	BE16338	Apr 19 /22 13:32:28	3	Vert	0.063	0.127	0.111	***	0.147	
w	BE16338	Apr 19 /22 13:37:06	3	Long	0.079	0.143	0.159	***	0.169	
w	BE16338	Apr 19 /22 13:38:39	3	Vert	0.079	0.127	0.127	***	0.169	
w	BE16338	Apr 19 /22 13:40:55	3	Long	0.079	0.190	0.159	***	0.236	
w	BE16338	Apr 19 /22 13:43:53	3	Long	0.063	0.111	0.127	***	0.139	
w	BE16338	Apr 19 /22 13:45:09	3	Long	0.079	0.127	0.159	***	0.169	
w	BE16338	Apr 19 /22 13:47:40	3	Long	0.063	0.111	0.127	***	0.147	
w	BE16338	Apr 19 /22 13:51:41	3	Vert	0.079	0.143	0.159	***	0.194	
w	BE16338	Apr 19 /22 13:52:55	3	Long	0.079	0.127	0.143	***	0.169	
w	BE16338	Apr 19 /22 13:56:31	3	Vert	0.063	0.143	0.111	***	0.158	
w	BE16338	Apr 19 /22 14:02:02	3	Long	0.079	0.143	0.143	***	0.182	
w	BE16338	Apr 19 /22 14:05:24	3	Long	0.079	0.159	0.159	***	0.214	
w	BE16338	Apr 19 /22 14:06:46	3	Long	0.079	0.238	0.206	***	0.264	
w	BE16338	Apr 19 /22 14:11:27	3	Vert	0.079	0.143	0.111	***	0.154	
w	BE16338	Apr 19 /22 14:12:52	3	Vert	0.079	0.143	0.190	***	0.216	
w	BE16338	Apr 19 /22 14:17:55	3	Long	0.079	0.127	0.159	***	0.175	
w	BE16338	Apr 19 /22 14:20:09	3	Vert	0.063	0.127	0.175	***	0.191	
w	BE16338	Apr 19 /22 14:26:22	3	Vert	0.079	0.159	0.127	***	0.204	
w	BE16338	Apr 19 /22 14:29:43	3	Vert	0.079	0.175	0.206	***	0.247	
w	BE16338	Apr 19 /22 14:31:25	3	Vert	0.079	0.143	0.143	***	0.175	
w	BE16338	Apr 19 /22 14:36:53	3	Long	0.111	0.127	0.159	***	0.216	
w	BE16338	Apr 19 /22 14:38:06	3	Long	0.111	0.159	0.159	***	0.223	
w	BE16338	Apr 19 /22 14:39:11	3	Long	0.079	0.127	0.127	***	0.150	
w	BE16338	Apr 19 /22 14:40:43	3	Long	0.079	0.175	0.190	***	0.208	
w	BE16338	Apr 19 /22 14:43:53	3	Vert	0.079	0.127	0.111	***	0.132	
w	BE16338	Apr 19 /22 14:45:20	3	Long	0.079	0.222	0.159	***	0.233	
w	BE16338	Apr 19 /22 14:49:18	3	Long	0.095	0.159	0.222	***	0.234	
w	BE16338	Apr 19 /22 14:50:38	3	Vert	0.095	0.175	0.175	***	0.214	
w	BE16338	Apr 19 /22 14:56:03	3	Long	0.079	0.175	0.143	***	0.180	
w	BE16338	Apr 19 /22 14:59:03	3	Vert	0.063	0.175	0.159	***	0.203	
w	BE16338	Apr 19 /22 15:00:59	3	Long	0.079	0.111	0.143	***	0.145	
w	BE16338	Apr 19 /22 15:02:35	3	Long	0.079	0.175	0.175	***	0.216	
w	BE16338	Apr 19 /22 15:04:52	3	Long	0.095	0.206	0.175	***	0.217	
w	BE16338	Apr 19 /22 15:08:53	3	Vert	0.063	0.143	0.111	***	0.158	
w	BE16338	Apr 19 /22 15:12:24	3	Long	0.095	0.175	0.206	***	0.207	
w	BE16338	Apr 19 /22 15:16:57	3	Long	0.079	0.159	0.175	***	0.208	
w	BE16338	Apr 19 /22 15:17:57	3	Long	0.079	0.143	0.127	***	0.158	
w	BE16338	Apr 19 /22 15:19:07	3	Long	0.079	0.127	0.127	***	0.142	
w	BE16338	Apr 19 /22 15:21:12	3	Long	0.079	0.111	0.143	***	0.169	
w	BE16338	Apr 19 /22 15:23:01	3	Vert	0.095	0.190	0.190	***	0.229	
w	BE16338	Apr 19 /22 15:26:14	3	Long	0.095	0.159	0.175	***	0.192	
w	BE16338	Apr 19 /22 15:27:23	3	Long	0.079	0.143	0.175	***	0.216	
w	BE16338	Apr 19 /22 15:30:11	3	Long	0.063	0.111	0.143	***	0.144	
w	BE16338	Apr 19 /22 15:32:14	3	Vert	0.095	0.159	0.206	***	0.221	
w	BE16338	Apr 19 /22 15:35:35	3	Long	0.079	0.175	0.175	***	0.228	

Vibration Monitoring at Dover forest (Astar)
VM2
Sensor trigger level - 0.13 mm/s

Event Report: Event List - g:\shared drives\clpl sim 2\kumar\dover forest (a-star)\report data\vm\vm-02(19-04)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
w	BE16338	Apr 19 /22 15:37:10	3	Long	0.079	0.159	0.190	***	0.203	
w	BE16338	Apr 19 /22 15:39:17	3	Long	0.079	0.143	0.175	***	0.208	
w	BE16338	Apr 19 /22 15:40:40	3	Long	0.063	0.111	0.127	***	0.127	
w	BE16338	Apr 19 /22 15:42:08	3	Vert	0.079	0.159	0.143	***	0.184	
w	BE16338	Apr 19 /22 15:43:11	3	Long	0.063	0.222	0.206	***	0.242	
w	BE16338	Apr 19 /22 15:44:34	3	Vert	0.079	0.159	0.143	***	0.182	
w	BE16338	Apr 19 /22 15:46:08	3	Long	0.079	0.175	0.159	***	0.203	
w	BE16338	Apr 19 /22 15:51:59	3	Long	0.079	0.206	0.159	***	0.248	
w	BE16338	Apr 19 /22 15:53:31	3	Long	0.063	0.159	0.159	***	0.194	
w	BE16338	Apr 19 /22 15:54:45	3	Long	0.063	0.159	0.143	***	0.203	
w	BE16338	Apr 19 /22 15:56:40	3	Long	0.095	0.111	0.127	***	0.143	
w	BE16338	Apr 19 /22 15:58:22	3	Vert	0.079	0.127	0.111	***	0.151	
w	BE16338	Apr 19 /22 16:00:38	3	Long	0.079	0.127	0.143	***	0.172	
w	BE16338	Apr 19 /22 16:01:58	3	Vert	0.079	0.143	0.175	***	0.194	
w	BE16338	Apr 19 /22 16:03:37	3	Long	0.095	0.175	0.159	***	0.214	
w	BE16338	Apr 19 /22 16:06:24	3	Long	0.063	0.111	0.127	***	0.146	
w	BE16338	Apr 19 /22 16:07:32	3	Vert	0.111	0.175	0.159	***	0.216	
w	BE16338	Apr 19 /22 16:09:35	3	Vert	0.095	0.159	0.159	***	0.204	
w	BE16338	Apr 19 /22 16:10:54	3	Long	0.095	0.175	0.159	***	0.181	
w	BE16338	Apr 19 /22 16:12:07	3	Vert	0.079	0.159	0.190	***	0.226	
w	BE16338	Apr 19 /22 16:22:28	3	Long	0.079	0.175	0.159	***	0.231	
w	BE16338	Apr 19 /22 16:23:32	3	Vert	0.079	0.175	0.190	***	0.226	
w	BE16338	Apr 19 /22 16:30:34	3	Long	0.079	0.111	0.127	***	0.129	
w	BE16338	Apr 19 /22 16:32:33	3	Vert	0.079	0.190	0.222	***	0.258	
w	BE16338	Apr 19 /22 16:33:39	3	Vert	0.079	0.190	0.190	***	0.238	
w	BE16338	Apr 19 /22 16:34:53	3	Long	0.079	0.127	0.143	***	0.192	
w	BE16338	Apr 19 /22 16:39:29	3	Long	0.079	0.127	0.143	***	0.160	
w	BE16338	Apr 19 /22 16:41:09	3	Long	0.079	0.143	0.175	***	0.207	
w	BE16338	Apr 19 /22 16:43:06	3	Long	0.063	0.095	0.127	***	0.136	
w	BE16338	Apr 19 /22 16:48:29	3	Long	0.079	0.159	0.175	***	0.205	
w	BE16338	Apr 19 /22 16:49:31	3	Vert	0.079	0.127	0.111	***	0.132	
w	BE16338	Apr 19 /22 16:52:52	3	Long	0.079	0.159	0.175	***	0.226	
w	BE16338	Apr 19 /22 16:54:00	3	Long	0.063	0.111	0.143	***	0.151	
w	BE16338	Apr 19 /22 16:55:31	3	Long	0.079	0.143	0.127	***	0.160	
w	BE16338	Apr 19 /22 16:56:31	3	Vert	0.095	0.159	0.127	***	0.191	
w	BE16338	Apr 19 /22 16:59:37	3	Long	0.079	0.175	0.175	***	0.214	
w	BE16338	Apr 19 /22 17:02:35	3	Vert	0.079	0.143	0.159	***	0.177	
w	BE16338	Apr 19 /22 17:04:09	3	Vert	0.079	0.190	0.175	***	0.216	
w	BE16338	Apr 19 /22 17:05:21	3	Vert	0.079	0.206	0.175	***	0.242	
w	BE16338	Apr 19 /22 17:09:51	3	Vert	0.079	0.127	0.111	***	0.132	
w	BE16338	Apr 19 /22 17:13:26	3	Long	0.079	0.127	0.143	***	0.164	
w	BE16338	Apr 19 /22 17:14:28	3	Vert	0.079	0.143	0.143	***	0.175	
w	BE16338	Apr 19 /22 17:20:22	3	Long	0.079	0.127	0.143	***	0.181	
w	BE16338	Apr 19 /22 17:22:49	3	Vert	0.095	0.143	0.159	***	0.196	
w	BE16338	Apr 19 /22 17:24:21	3	Long	0.079	0.095	0.127	***	0.130	
w	BE16338	Apr 19 /22 17:28:59	3	Long	0.079	0.143	0.143	***	0.164	
w	BE16338	Apr 19 /22 17:30:13	3	Long	0.095	0.190	0.159	***	0.221	
w	BE16338	Apr 19 /22 17:31:38	3	Vert	0.079	0.127	0.127	***	0.169	
w	BE16338	Apr 19 /22 17:32:50	3	Long	0.079	0.175	0.175	***	0.197	
w	BE16338	Apr 19 /22 17:34:35	3	Long	0.063	0.127	0.127	***	0.169	
w	BE16338	Apr 19 /22 17:37:13	3	Vert	0.079	0.143	0.127	***	0.181	
w	BE16338	Apr 19 /22 17:38:41	3	Vert	0.079	0.159	0.190	***	0.221	
w	BE16338	Apr 19 /22 17:40:27	3	Vert	0.079	0.143	0.175	***	0.231	
w	BE16338	Apr 19 /22 17:41:28	3	Long	0.063	0.095	0.143	***	0.151	
w	BE16338	Apr 19 /22 17:42:32	3	Long	0.079	0.159	0.143	***	0.208	
w	BE16338	Apr 19 /22 17:43:36	3	Long	0.063	0.111	0.127	***	0.129	
w	BE16338	Apr 19 /22 17:45:37	3	Long	0.079	0.159	0.206	***	0.242	
w	BE16338	Apr 19 /22 17:50:31	3	Long	0.079	0.190	0.206	***	0.259	
w	BE16338	Apr 19 /22 17:52:34	3	Long	0.063	0.111	0.143	***	0.160	
w	BE16338	Apr 19 /22 17:53:47	3	Long	0.095	0.175	0.159	***	0.196	
w	BE16338	Apr 19 /22 17:55:20	3	Vert	0.079	0.127	0.127	***	0.169	
w	BE16338	Apr 19 /22 17:57:01	3	Long	0.079	0.159	0.159	***	0.214	
w	BE16338	Apr 19 /22 17:58:03	3	Long	0.079	0.222	0.222	***	0.277	
w	BE16338	Apr 19 /22 17:59:48	3	Long	0.079	0.159	0.159	***	0.216	
w	BE16338	Apr 19 /22 18:01:38	3	Long	0.079	0.095	0.143	***	0.145	
w	BE16338	Apr 19 /22 18:03:21	3	Long	0.079	0.143	0.127	***	0.172	
w	BE16338	Apr 19 /22 18:06:23	3	Long	0.063	0.111	0.127	***	0.169	
w	BE16338	Apr 19 /22 18:10:10	3	Long	0.063	0.111	0.127	***	0.137	
w	BE16338	Apr 19 /22 18:12:07	3	Long	0.079	0.175	0.206	***	0.249	
w	BE16338	Apr 19 /22 18:14:50	3	Vert	0.095	0.127	0.190	***	0.223	

Vibration Monitoring at Dover forest (Astar)
VM2
Sensor trigger level - 0.13 mm/s

Event Report: Event List - g:\shared drives\clpl sim 2\kumar\dover forest (a-star)\report data\vm\vm-02(19-04)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
w	BE16338	Apr 19 /22 18:16:43	3	Long	0.079	0.222	0.159	***	0.249	
w	BE16338	Apr 19 /22 18:17:46	3	Long	0.079	0.190	0.206	***	0.260	
w	BE16338	Apr 19 /22 18:18:52	3	Long	0.079	0.143	0.175	***	0.216	
w	BE16338	Apr 19 /22 18:21:44	3	Long	0.079	0.127	0.127	***	0.150	
w	BE16338	Apr 19 /22 18:24:29	3	Long	0.063	0.159	0.143	***	0.192	
w	BE16338	Apr 19 /22 18:25:40	3	Vert	0.079	0.222	0.159	***	0.227	
w	BE16338	Apr 19 /22 18:27:57	3	Long	0.079	0.159	0.175	***	0.207	
w	BE16338	Apr 19 /22 18:29:49	3	Vert	0.079	0.127	0.222	***	0.253	
w	BE16338	Apr 19 /22 18:36:23	3	Long	0.063	0.127	0.143	***	0.181	
w	BE16338	Apr 19 /22 18:42:31	3	Long	0.063	0.111	0.127	***	0.139	
w	BE16338	Apr 19 /22 18:45:06	3	Long	0.079	0.143	0.159	***	0.175	
w	BE16338	Apr 19 /22 18:46:47	3	Vert	0.079	0.206	0.159	***	0.244	
w	BE16338	Apr 19 /22 18:48:05	3	Long	0.079	0.095	0.127	***	0.128	
w	BE16338	Apr 19 /22 18:51:07	3	Long	0.079	0.143	0.175	***	0.214	
w	BE16338	Apr 19 /22 18:52:47	3	Long	0.079	0.175	0.190	***	0.216	
w	BE16338	Apr 19 /22 18:54:00	3	Long	0.079	0.175	0.175	***	0.217	
w	BE16338	Apr 19 /22 18:55:31	3	Long	0.079	0.127	0.127	***	0.169	
w	BE16338	Apr 19 /22 18:59:37	3	Vert	0.079	0.127	0.111	***	0.137	
w	BE16338	Apr 19 /22 19:02:38	3	Long	0.079	0.175	0.190	***	0.239	
w	BE16338	Apr 19 /22 19:04:41	3	Vert	0.079	0.143	0.127	***	0.153	
w	BE16338	Apr 19 /22 19:05:44	3	Long	0.079	0.127	0.127	***	0.158	
w	BE16338	Apr 19 /22 19:08:15	3	Vert	0.079	0.127	0.127	***	0.147	
w	BE16338	Apr 19 /22 19:11:21	3	Long	0.079	0.111	0.127	***	0.137	
w	BE16338	Apr 19 /22 19:13:32	3	Long	0.063	0.095	0.127	***	0.135	
w	BE16338	Apr 19 /22 19:17:03	3	Vert	0.079	0.143	0.111	***	0.154	
w	BE16338	Apr 19 /22 19:18:17	3	Long	0.095	0.127	0.127	***	0.146	
w	BE16338	Apr 19 /22 19:22:43	3	Long	0.079	0.127	0.143	***	0.156	
w	BE16338	Apr 19 /22 19:25:25	3	Long	0.079	0.111	0.143	***	0.158	
w	BE16338	Apr 19 /22 19:33:03	3	Long	0.079	0.175	0.159	***	0.201	
w	BE16338	Apr 19 /22 19:35:04	3	Long	0.079	0.143	0.159	***	0.182	
w	BE16338	Apr 19 /22 19:36:23	3	Vert	0.063	0.127	0.095	***	0.129	
w	BE16338	Apr 19 /22 19:41:09	3	Long	0.079	0.159	0.175	***	0.212	
w	BE16338	Apr 19 /22 19:42:49	3	Long	0.079	0.127	0.159	***	0.204	
w	BE16338	Apr 19 /22 19:48:21	3	Long	0.079	0.095	0.127	***	0.132	
w	BE16338	Apr 19 /22 19:51:40	3	Long	0.095	0.159	0.143	***	0.192	
w	BE16338	Apr 19 /22 19:53:47	3	Long	0.079	0.143	0.159	***	0.205	
w	BE16338	Apr 19 /22 19:56:18	3	Long	0.079	0.127	0.127	***	0.129	
w	BE16338	Apr 19 /22 19:59:22	3	Vert	0.079	0.127	0.111	***	0.140	
w	BE16338	Apr 19 /22 20:03:22	3	Long	0.095	0.175	0.238	***	0.263	
w	BE16338	Apr 19 /22 20:05:29	3	Vert	0.079	0.127	0.127	***	0.160	
w	BE16338	Apr 19 /22 20:07:50	3	Long	0.079	0.143	0.222	***	0.251	
w	BE16338	Apr 19 /22 20:09:24	3	Long	0.063	0.111	0.127	***	0.129	
w	BE16338	Apr 19 /22 20:10:36	3	Long	0.079	0.190	0.159	***	0.194	
w	BE16338	Apr 19 /22 20:16:51	3	Long	0.079	0.095	0.127	***	0.139	
w	BE16338	Apr 19 /22 20:22:44	3	Long	0.079	0.175	0.159	***	0.187	
w	BE16338	Apr 19 /22 20:26:44	3	Vert	0.079	0.159	0.127	***	0.163	
w	BE16338	Apr 19 /22 20:29:29	3	Long	0.079	0.111	0.127	***	0.147	
w	BE16338	Apr 19 /22 20:30:45	3	Long	0.079	0.079	0.127	***	0.131	
w	BE16338	Apr 19 /22 20:35:08	3	Long	0.095	0.143	0.159	***	0.186	
w	BE16338	Apr 19 /22 20:36:15	3	Long	0.063	0.095	0.127	***	0.129	
w	BE16338	Apr 19 /22 20:43:44	3	Long	0.079	0.143	0.143	***	0.180	
w	BE16338	Apr 19 /22 20:46:00	3	Vert	0.079	0.127	0.111	***	0.160	
w	BE16338	Apr 19 /22 20:47:05	3	Long	0.063	0.095	0.127	***	0.129	
w	BE16338	Apr 19 /22 20:48:53	3	Vert	0.079	0.175	0.190	***	0.223	
w	BE16338	Apr 19 /22 20:50:40	3	Long	0.079	0.111	0.143	***	0.151	
w	BE16338	Apr 19 /22 20:55:32	3	Long	0.079	0.095	0.127	***	0.139	
w	BE16338	Apr 19 /22 20:59:44	3	Vert	0.079	0.159	0.127	***	0.182	
w	BE16338	Apr 19 /22 21:02:44	3	Long	0.079	0.143	0.127	***	0.166	
w	BE16338	Apr 19 /22 21:04:58	3	Long	0.079	0.175	0.159	***	0.203	
w	BE16338	Apr 19 /22 21:08:07	3	Vert	0.079	0.143	0.190	***	0.221	
w	BE16338	Apr 19 /22 21:13:15	3	Long	0.079	0.159	0.190	***	0.223	
w	BE16338	Apr 19 /22 21:16:09	3	Vert	0.079	0.143	0.206	***	0.247	
w	BE16338	Apr 19 /22 21:21:19	3	Long	0.079	0.143	0.190	***	0.206	
w	BE16338	Apr 19 /22 21:23:48	3	Vert	0.063	0.143	0.159	***	0.214	
w	BE16338	Apr 19 /22 21:25:32	3	Long	0.079	0.111	0.127	***	0.129	
w	BE16338	Apr 19 /22 21:26:53	3	Long	0.079	0.143	0.143	***	0.154	
w	BE16338	Apr 19 /22 21:28:31	3	Vert	0.063	0.143	0.143	***	0.181	
w	BE16338	Apr 19 /22 21:30:59	3	Long	0.063	0.111	0.127	***	0.128	
w	BE16338	Apr 19 /22 21:35:47	3	Vert	0.063	0.127	0.127	***	0.158	
w	BE16338	Apr 19 /22 21:39:15	3	Long	0.063	0.127	0.143	***	0.159	

Vibration Monitoring at Dover forest (Astar)
VM2
Sensor trigger level - 0.13 mm/s

Event Report: Event List - g:\shared drives\clpl sim 2\kumar\dover forest (a-star)\report data\vm\vm-02(19-04)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
w	BE16338	Apr 19 /22 21:43:52	3	Long	0.079	0.111	0.143	***	0.144	
w	BE16338	Apr 19 /22 21:45:21	3	Long	0.079	0.159	0.175	***	0.208	
w	BE16338	Apr 19 /22 21:47:20	3	Long	0.079	0.127	0.127	***	0.147	
w	BE16338	Apr 19 /22 21:54:52	3	Vert	0.063	0.127	0.111	***	0.132	
w	BE16338	Apr 19 /22 21:56:30	3	Vert	0.079	0.159	0.111	***	0.180	
w	BE16338	Apr 19 /22 22:00:11	3	Vert	0.063	0.127	0.159	***	0.171	
w	BE16338	Apr 19 /22 22:01:17	3	Vert	0.079	0.127	0.111	***	0.144	
w	BE16338	Apr 19 /22 22:03:31	3	Long	0.079	0.143	0.143	***	0.184	
w	BE16338	Apr 19 /22 22:08:24	3	Long	0.063	0.111	0.127	***	0.158	
w	BE16338	Apr 19 /22 22:10:09	3	Long	0.079	0.127	0.143	***	0.147	
w	BE16338	Apr 19 /22 22:12:00	3	Vert	0.079	0.127	0.111	***	0.129	
w	BE16338	Apr 19 /22 22:17:12	3	Vert	0.079	0.143	0.127	***	0.157	
w	BE16338	Apr 19 /22 22:19:31	3	Vert	0.063	0.127	0.111	***	0.135	
w	BE16338	Apr 19 /22 22:22:26	3	Long	0.095	0.175	0.190	***	0.226	
w	BE16338	Apr 19 /22 22:25:02	3	Long	0.079	0.175	0.190	***	0.231	
w	BE16338	Apr 19 /22 22:29:23	3	Long	0.063	0.095	0.143	***	0.144	
w	BE16338	Apr 19 /22 22:34:19	3	Long	0.079	0.175	0.175	***	0.237	
w	BE16338	Apr 19 /22 22:36:06	3	Long	0.079	0.175	0.190	***	0.223	
w	BE16338	Apr 19 /22 22:39:16	3	Long	0.079	0.095	0.127	***	0.142	
w	BE16338	Apr 19 /22 22:42:38	3	Long	0.063	0.127	0.143	***	0.154	
w	BE16338	Apr 19 /22 22:44:25	3	Long	0.079	0.222	0.238	***	0.273	
w	BE16338	Apr 19 /22 22:55:59	3	Long	0.079	0.175	0.190	***	0.214	
w	BE16338	Apr 19 /22 22:58:25	3	Vert	0.079	0.127	0.111	***	0.158	
w	BE16338	Apr 19 /22 23:00:56	3	Long	0.079	0.159	0.143	***	0.172	
w	BE16338	Apr 19 /22 23:03:29	3	Long	0.079	0.206	0.175	***	0.237	
w	BE16338	Apr 19 /22 23:05:33	3	Long	0.079	0.159	0.175	***	0.194	
w	BE16338	Apr 19 /22 23:07:21	3	Long	0.079	0.159	0.175	***	0.207	
w	BE16338	Apr 19 /22 23:12:57	3	Long	0.079	0.159	0.190	***	0.231	
w	BE16338	Apr 19 /22 23:18:02	3	Long	0.079	0.175	0.143	***	0.214	
w	BE16338	Apr 19 /22 23:19:56	3	Long	0.063	0.111	0.143	***	0.145	
w	BE16338	Apr 19 /22 23:24:36	3	Long	0.079	0.159	0.190	***	0.214	
w	BE16338	Apr 19 /22 23:27:21	3	Long	0.063	0.143	0.159	***	0.194	
w	BE16338	Apr 19 /22 23:34:31	3	Long	0.079	0.143	0.127	***	0.160	
w	BE16338	Apr 19 /22 23:35:55	3	Long	0.095	0.143	0.127	***	0.160	
w	BE16338	Apr 19 /22 23:37:04	3	Long	0.095	0.206	0.190	***	0.249	
w	BE16338	Apr 19 /22 23:38:22	3	Long	0.079	0.143	0.143	***	0.182	
w	BE16338	Apr 19 /22 23:47:43	3	Long	0.079	0.111	0.127	***	0.180	
w	BE16338	Apr 19 /22 23:49:26	3	Long	0.063	0.111	0.127	***	0.144	
w	BE16338	Apr 19 /22 23:58:16	3	Vert	0.079	0.127	0.127	***	0.142	
w	BE16338	Apr 20 /22 00:07:34	3	Long	0.063	0.095	0.127	***	0.131	
w	BE16338	Apr 20 /22 00:13:40	3	Long	0.063	0.127	0.143	***	0.146	
w	BE16338	Apr 20 /22 00:29:27	3	Vert	0.063	0.143	0.159	***	0.163	
w	BE16338	Apr 20 /22 00:43:11	3	Vert	0.079	0.143	0.127	***	0.157	
w	BE16338	Apr 20 /22 00:44:33	3	Long	0.079	0.111	0.127	***	0.132	
w	BE16338	Apr 20 /22 00:55:29	3	Long	0.079	0.111	0.127	***	0.128	
w	BE16338	Apr 20 /22 01:06:55	3	Long	0.079	0.175	0.206	***	0.259	
w	BE16338	Apr 20 /22 01:11:52	3	Long	0.079	0.143	0.143	***	0.147	
w	BE16338	Apr 20 /22 01:25:50	3	Vert	0.095	0.127	0.095	***	0.128	
w	BE16338	Apr 20 /22 01:35:00	3	Vert	0.063	0.127	0.095	***	0.139	
w	BE16338	Apr 20 /22 01:51:51	3	Long	0.063	0.127	0.143	***	0.160	
w	BE16338	Apr 20 /22 02:06:52	3	Long	0.079	0.206	0.190	***	0.272	
w	BE16338	Apr 20 /22 02:19:31	3	Vert	0.063	0.143	0.159	***	0.186	
w	BE16338	Apr 20 /22 02:26:45	3	Long	0.079	0.127	0.143	***	0.178	
w	BE16338	Apr 20 /22 03:58:49	3	Vert	0.095	0.127	0.095	***	0.137	
w	BE16338	Apr 20 /22 04:45:55	3	Long	0.095	0.190	0.206	***	0.238	
w	BE16338	Apr 20 /22 04:54:49	3	Vert	0.095	0.143	0.111	***	0.160	
w	BE16338	Apr 20 /22 04:56:18	3	Vert	0.063	0.127	0.095	***	0.132	
w	BE16338	Apr 20 /22 05:03:11	3	Vert	0.079	0.127	0.095	***	0.128	
w	BE16338	Apr 20 /22 05:09:04	3	Long	0.095	0.286	0.238	***	0.318	
w	BE16338	Apr 20 /22 05:15:54	3	Long	0.079	0.111	0.127	***	0.133	
w	BE16338	Apr 20 /22 05:22:27	3	Long	0.079	0.127	0.175	***	0.201	
w	BE16338	Apr 20 /22 05:35:29	3	Long	0.095	0.190	0.206	***	0.236	
w	BE16338	Apr 20 /22 05:37:30	3	Vert	0.079	0.143	0.143	***	0.149	
w	BE16338	Apr 20 /22 05:42:48	3	Vert	0.079	0.143	0.143	***	0.182	
w	BE16338	Apr 20 /22 05:44:06	3	Long	0.111	0.254	0.222	***	0.283	
w	BE16338	Apr 20 /22 05:45:19	3	Long	0.079	0.127	0.127	***	0.169	
w	BE16338	Apr 20 /22 05:47:35	3	Vert	0.079	0.190	0.222	***	0.249	
w	BE16338	Apr 20 /22 05:51:02	3	Long	0.079	0.159	0.175	***	0.238	
w	BE16338	Apr 20 /22 05:53:28	3	Vert	0.079	0.270	0.206	***	0.300	
w	BE16338	Apr 20 /22 05:56:51	3	Long	0.079	0.143	0.127	***	0.144	

Vibration Monitoring at Dover forest (Astar)
VM2
Sensor trigger level - 0.13 mm/s

Event Report: Event List - g:\shared drives\clpl sim 2\kumar\dover forest (a-star)\report data\vm\vm-02(19-04)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
w	BE16338	Apr 20 /22 05:59:09	3	Long	0.079	0.175	0.159	***	0.194	
w	BE16338	Apr 20 /22 06:01:53	3	Vert	0.095	0.143	0.190	***	0.201	
w	BE16338	Apr 20 /22 06:06:17	3	Long	0.079	0.111	0.190	***	0.193	
w	BE16338	Apr 20 /22 06:07:19	3	Long	0.095	0.254	0.222	***	0.281	
w	BE16338	Apr 20 /22 06:10:00	3	Long	0.079	0.127	0.127	***	0.143	
w	BE16338	Apr 20 /22 06:12:35	3	Long	0.079	0.190	0.222	***	0.256	
w	BE16338	Apr 20 /22 06:14:50	3	Long	0.079	0.127	0.159	***	0.172	
w	BE16338	Apr 20 /22 06:16:46	3	Vert	0.079	0.143	0.159	***	0.183	
w	BE16338	Apr 20 /22 06:18:12	3	Vert	0.095	0.127	0.159	***	0.169	
w	BE16338	Apr 20 /22 06:21:03	3	Long	0.079	0.206	0.238	***	0.287	
w	BE16338	Apr 20 /22 06:23:04	3	Vert	0.079	0.127	0.111	***	0.137	
w	BE16338	Apr 20 /22 06:24:04	3	Long	0.079	0.127	0.127	***	0.143	
w	BE16338	Apr 20 /22 06:25:08	3	Long	0.079	0.159	0.190	***	0.226	
w	BE16338	Apr 20 /22 06:32:33	3	Long	0.079	0.143	0.159	***	0.165	
w	BE16338	Apr 20 /22 06:33:33	3	Long	0.079	0.159	0.127	***	0.192	
w	BE16338	Apr 20 /22 06:34:48	3	Long	0.079	0.206	0.190	***	0.230	
w	BE16338	Apr 20 /22 06:35:50	3	Long	0.063	0.095	0.127	***	0.127	
w	BE16338	Apr 20 /22 06:37:19	3	Long	0.079	0.159	0.143	***	0.182	
w	BE16338	Apr 20 /22 06:39:33	3	Long	0.079	0.159	0.206	***	0.230	
w	BE16338	Apr 20 /22 06:41:15	3	Long	0.063	0.095	0.127	***	0.136	
w	BE16338	Apr 20 /22 06:44:23	3	Long	0.095	0.190	0.190	***	0.248	
w	BE16338	Apr 20 /22 06:45:24	3	Long	0.079	0.190	0.222	***	0.274	
w	BE16338	Apr 20 /22 06:47:45	3	Long	0.079	0.190	0.190	***	0.225	
w	BE16338	Apr 20 /22 06:50:29	3	Vert	0.095	0.206	0.238	***	0.264	
w	BE16338	Apr 20 /22 06:52:10	3	Long	0.079	0.143	0.143	***	0.182	
w	BE16338	Apr 20 /22 06:53:14	3	Long	0.079	0.143	0.143	***	0.147	
w	BE16338	Apr 20 /22 06:57:09	3	Long	0.079	0.175	0.190	***	0.237	
w	BE16338	Apr 20 /22 06:59:02	3	Long	0.095	0.159	0.159	***	0.214	
w	BE16338	Apr 20 /22 07:00:27	3	Long	0.079	0.127	0.159	***	0.194	
w	BE16338	Apr 20 /22 07:01:49	3	Vert	0.063	0.127	0.111	***	0.131	
w	BE16338	Apr 20 /22 07:03:25	3	Long	0.095	0.159	0.190	***	0.234	
w	BE16338	Apr 20 /22 07:05:08	3	Long	0.079	0.190	0.190	***	0.226	
w	BE16338	Apr 20 /22 07:06:25	3	Long	0.095	0.143	0.206	***	0.242	
w	BE16338	Apr 20 /22 07:08:15	3	Long	0.079	0.270	0.222	***	0.305	
w	BE16338	Apr 20 /22 07:09:33	3	Long	0.079	0.190	0.175	***	0.206	
w	BE16338	Apr 20 /22 07:13:54	3	Long	0.079	0.111	0.143	***	0.150	
w	BE16338	Apr 20 /22 07:14:57	3	Long	0.079	0.159	0.206	***	0.218	
w	BE16338	Apr 20 /22 07:16:03	3	Vert	0.095	0.190	0.206	***	0.242	
w	BE16338	Apr 20 /22 07:18:40	3	Long	0.095	0.143	0.159	***	0.166	
w	BE16338	Apr 20 /22 07:20:44	3	Long	0.079	0.206	0.190	***	0.234	
w	BE16338	Apr 20 /22 07:23:38	3	Long	0.079	0.111	0.143	***	0.157	
w	BE16338	Apr 20 /22 07:29:21	3	Long	0.079	0.127	0.143	***	0.172	
w	BE16338	Apr 20 /22 07:30:24	3	Long	0.095	0.143	0.159	***	0.205	
w	BE16338	Apr 20 /22 07:32:51	3	Long	0.095	0.270	0.238	***	0.327	
w	BE16338	Apr 20 /22 07:36:27	3	Long	0.111	0.159	0.190	***	0.214	
w	BE16338	Apr 20 /22 07:37:40	3	Long	0.111	0.190	0.206	***	0.239	
w	BE16338	Apr 20 /22 07:38:59	3	Long	0.079	0.175	0.175	***	0.217	
w	BE16338	Apr 20 /22 07:40:09	3	Long	0.079	0.127	0.127	***	0.151	
w	BE16338	Apr 20 /22 07:43:11	3	Long	0.079	0.127	0.143	***	0.146	
w	BE16338	Apr 20 /22 07:44:53	3	Long	0.095	0.222	0.270	***	0.314	
w	BE16338	Apr 20 /22 07:46:41	3	Vert	0.079	0.127	0.127	***	0.139	
w	BE16338	Apr 20 /22 07:48:07	3	Vert	0.095	0.190	0.238	***	0.241	
w	BE16338	Apr 20 /22 07:49:46	3	Long	0.079	0.175	0.206	***	0.255	
w	BE16338	Apr 20 /22 07:51:11	3	Long	0.095	0.127	0.127	***	0.172	
w	BE16338	Apr 20 /22 07:52:22	3	Long	0.079	0.143	0.175	***	0.182	
w	BE16338	Apr 20 /22 07:57:05	3	Long	0.111	0.206	0.238	***	0.283	
w	BE16338	Apr 20 /22 07:59:00	3	Long	0.111	0.222	0.238	***	0.283	
w	BE16338	Apr 20 /22 08:01:12	3	Vert	0.079	0.143	0.127	***	0.159	
w	BE16338	Apr 20 /22 08:05:49	3	Long	0.079	0.111	0.127	***	0.132	
w	BE16338	Apr 20 /22 08:07:17	3	Long	0.079	0.127	0.143	***	0.147	
w	BE16338	Apr 20 /22 08:12:05	3	Long	0.079	0.190	0.175	***	0.231	
w	BE16338	Apr 20 /22 08:14:04	3	Long	0.079	0.127	0.127	***	0.153	
w	BE16338	Apr 20 /22 08:15:20	3	Long	0.079	0.159	0.175	***	0.212	
w	BE16338	Apr 20 /22 08:18:02	3	Long	0.063	0.095	0.159	***	0.166	
w	BE16338	Apr 20 /22 08:20:47	3	Long	0.095	0.175	0.254	***	0.262	
w	BE16338	Apr 20 /22 08:23:42	3	Long	0.095	0.238	0.222	***	0.305	
w	BE16338	Apr 20 /22 08:26:08	3	Long	0.079	0.190	0.222	***	0.274	
w	BE16338	Apr 20 /22 08:27:21	3	Long	0.079	0.190	0.270	***	0.300	
w	BE16338	Apr 20 /22 08:29:31	3	Long	0.079	0.143	0.127	***	0.172	
w	BE16338	Apr 20 /22 08:31:23	3	Long	0.079	0.254	0.270	***	0.315	

Vibration Monitoring at Dover forest (Astar)
VM2
Sensor trigger level - 0.13 mm/s

Event Report: Event List - g:\shared drives\clpl sim 2\kumar\dover forest (a-star)\report data\vm\vm-02(19-04)

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
w	BE16338	Apr 20 /22 08:34:41	3	Long	0.079	0.238	0.302	***	0.350	
w	BE16338	Apr 20 /22 08:35:45	3	Long	0.079	0.175	0.159	***	0.214	
w	BE16338	Apr 20 /22 08:39:02	3	Long	0.095	0.190	0.190	***	0.249	
w	BE16338	Apr 20 /22 08:41:11	3	Vert	0.079	0.143	0.159	***	0.204	
w	BE16338	Apr 20 /22 08:43:17	3	Long	0.079	0.238	0.159	***	0.242	
w	BE16338	Apr 20 /22 08:46:13	3	Vert	0.095	0.190	0.222	***	0.264	
w	BE16338	Apr 20 /22 08:50:31	3	Long	0.079	0.254	0.254	***	0.318	
w	BE16338	Apr 20 /22 08:52:55	3	Long	0.095	0.175	0.206	***	0.261	
w	BE16338	Apr 20 /22 08:53:56	3	Long	0.095	0.254	0.222	***	0.319	
w	BE16338	Apr 20 /22 08:55:10	3	Vert	0.079	0.190	0.190	***	0.258	
w	BE16338	Apr 20 /22 08:56:19	3	Long	0.095	0.159	0.206	***	0.207	
w	BE16338	Apr 20 /22 08:59:06	3	Vert	0.079	0.127	0.111	***	0.132	
w	BE16338	Apr 20 /22 09:02:14	3	Long	0.079	0.175	0.143	***	0.197	
w	BE16338	Apr 20 /22 09:03:59	3	Vert	0.095	0.190	0.222	***	0.283	
w	BE16338	Apr 20 /22 09:05:10	3	Vert	0.079	0.175	0.190	***	0.228	
w	BE16338	Apr 20 /22 09:06:45	3	Long	0.079	0.175	0.159	***	0.192	
w	BE16338	Apr 20 /22 09:09:42	3	Long	0.079	0.143	0.143	***	0.184	
w	BE16338	Apr 20 /22 09:10:56	3	Vert	0.079	0.175	0.159	***	0.186	
w	BE16338	Apr 20 /22 09:13:04	3	Long	0.079	0.190	0.222	***	0.275	
w	BE16338	Apr 20 /22 09:16:32	3	Vert	0.095	0.143	0.190	***	0.199	
w	BE16338	Apr 20 /22 09:18:11	3	Vert	0.079	0.159	0.190	***	0.239	
w	BE16338	Apr 20 /22 09:22:22	3	Long	0.095	0.175	0.159	***	0.212	
w	BE16338	Apr 20 /22 09:26:38	3	Long	0.079	0.190	0.222	***	0.260	
w	BE16338	Apr 20 /22 09:28:24	3	Long	0.079	0.190	0.238	***	0.286	
w	BE16338	Apr 20 /22 09:29:51	3	Vert	0.079	0.127	0.127	***	0.156	
w	BE16338	Apr 20 /22 09:31:00	3	Long	0.095	0.175	0.175	***	0.214	
w	BE16338	Apr 20 /22 09:32:57	3	Long	0.095	0.254	0.254	***	0.303	
w	BE16338	Apr 20 /22 09:37:04	3	Vert	0.095	0.206	0.206	***	0.243	
w	BE16338	Apr 20 /22 09:38:07	3	Long	0.079	0.206	0.222	***	0.263	
w	BE16338	Apr 20 /22 09:40:26	3	Long	0.079	0.190	0.222	***	0.266	
w	BE16338	Apr 20 /22 09:42:23	3	Vert	0.079	0.175	0.206	***	0.244	
w	BE16338	Apr 20 /22 09:43:31	3	Long	0.063	0.143	0.159	***	0.169	
w	BE16338	Apr 20 /22 09:45:43	3	Long	0.079	0.159	0.206	***	0.250	
w	BE16338	Apr 20 /22 09:48:36	3	Long	0.079	0.111	0.143	***	0.156	

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Vibration Monitoring at Dover forest (Astar)
VM3
Sensor trigger level - 0.125 mm/s

Event Report: Event List - g:\shared drives\clpl sim 2\kumar\dover forest (a-star)\report data\vm\vm-03 (20-04)\20-04-22

Type	Serial No.	Date/Time	No. Chan	Trigger	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	Mic Peak (pa./dB)	PVS1 (mm/s)	Description
LOG	BE16338	Apr 20 /22 09:55:18	***	***	***	***	***		***	Start Monitoring
w	BE16338	Apr 20 /22 14:42:51	3	Long	0.079	0.063	0.127	***	0.127	
LOG	BE16338	Apr 20 /22 23:59:00	***	***	***	***	***		***	Timer Stop
LOG	BE16338	Apr 21 /22 00:00:10	***	***	***	***	***		***	Start Monitoring
w	BE16338	Apr 21 /22 09:32:09	3	Long	0.063	0.063	0.127	***	0.132	
LOG	BE16338	Apr 21 /22 09:59:00	***	***	***	***	***		***	Timer Stop

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APPENDIX H

Wildlife Incident Report Form

WILDLIFE INCIDENT FORM

Part A – Wildlife Incident Details

The CEMMP In-charge is to complete the Form and submit to PM within 24 hours of reporting incident.

Reference No. (by CEMMP In-charge)			
Personnel	**Reporting Person**	**Witness**	
Name:			
Contact Number:			
Title / Company:			
Time / Date of Wildlife Encounter	**Date**	**Time**	
Affected Area			
Weather:	☐ Clear	☐ Overcast	☐ Thunderstorm
	☐ Sunny	☐ Others (To Describe):	
Actual Location:			
Description of Area:	☐ Vegetated area	☐ Non-vegetated area	
	☐ Excavated area	☐ Others (to describe):	
Activities Carried Out Nearby at Time of Incident:	If there are no active works near wildlife encountered, please state so.		

Details of Animal			
Animal:	Where identifiable, please provide [Common Name (Scientific Name)] If animal cannot be identified, carcass to be described to the best of ability.		
Animal Condition:	☐ Active	☐ Outwardly injured (e.g. bleeding, limping)	☐ Flattened
	☐ Stationary	☐ Decomposed	☐ Trapped
	☐ Others (to describe):		
Photographs:	1) Close-up of Animal ☐ No Close-up available Please provide reason here if close-up photographs could not be obtained, e.g. unsafe to approach		
	2) Animal with surroundings or showing full width of road (if roadkill), indicating where the animal is.		
	☐ No photographs available. Reason: e.g. animal moved away too quickly		

Incident Details	
Incident Summary: To be filled by reporting party	Briefly describe when, what, who, where and how the incident happened. *Sample incident summary:* *[Personnel] was conducting [activity] on [date/time] when he observed an [animal] at [location]. The animal was observed to be [condition]. [Personnel] reported the incident to [contractor representative] who contacted the WMO. While awaiting wildlife response, [contractor] barricaded the area and continued monitoring for movement of animal.* If EMMP Specialist (Fauna) visited site: Recommended actions
Follow-up Actions: To be filled by CEMMP In-charge	☐ Animal rescued to NParks Shelter ☐ Immediate relocation ☐ Carcass transported to disposal location ☐ Others:_____
	☐ No Action Taken by CEMMP In-charge

Part B – Closure of Incident

Possible Causes What is/are the possible cause/s of the incident? (Man / Machine / Management / Medium / Mission)		
Preventive/Corrective Actions To be filled by CEMMP In-charge	**Close-up** To be filled by reporting party	
1)	Close-up Action.	Close-up Date
2)		Close-up Date

Closure of Incident Report	
Date of Closure of Incident Report:	
Acknowledged by PM (Name/Title):	