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23 ENVIRONMENTAL PROTECTION FOR ECOLOGICAL SENSITIVE SITES – MAJU FOREST AND CLEMENTI FOREST

23.1 General

23.1.1 The Contractor shall comply with the standards and conditions set out in **Clause 23** of Particular Specification and the environmental considerations stated in **Appendix A** of the General Specification. In the event of discrepancy between the EMMP appendix and the other relevant authorities' requirements, the more onerous requirements shall prevail.

23.1.2 An Environmental Management and Monitoring Plan (EMMP) is included **Appendix BD** of the Particular Specification. Upon award of tender, the Contractor shall review the EMMP and submit a contract-specific EMMP based on his detailed construction method following Clause 13 and Clause 23. The Contractor's appointed biodiversity team shall provide inputs to the contract-specific EMMP. This contract-specific EMMP must take into account the EIS that has been carried out with EMMP in **Appendix BD**, NParks S10 requirements and additional requirements made known to the Contractor prior to tender award. Prior to commencement of Works, this contract-specific EMMP shall be submitted to NParks for approval within three months after award date as well as to the Engineer for approval. Where needed, a presentation to Nature Groups may be required prior to the commencement of works. The EMMP shall include but not be limited to the following:

- (a) mitigation measures to be implemented for the project construction;
- (b) environmental monitoring (biodiversity, water, noise, air pollution and vibration) to be conducted during the construction period;
- (c) existing environmental legislation to be followed as well as environmental best practices to be implemented; and
- (d) contingency planning in case of emergency situations.

23.2 Environmental Protection during Construction Phase

23.2.1 Construction phase includes works carried out by Contractor during the entire construction period from site preparation/clearance, project construction (e.g. ground improvement works, underpinning works, TBM works, rock breaking and excavation works, construction of permanent

facility buildings), until the completion of construction (i.e. general landscaping, permanent and reinstatement works).

23.2.2 There should be no above-ground works carried out or equipment used within the CCNR.

23.2.3 The following Clauses 23.3 to 23.10 highlight specific management measures for environment protection during construction phase.

23.3 Terrestrial Ecology during Construction Phase

23.3.1 In addition to contract-specific EMMP, biodiversity performance and reporting should include the following **Clauses 23.3.1 to 23.3.6**.

The following biodiversity performance indicators shall be tracked during the Project development:

- (i) Regulatory fines, Stop Work Orders, Warning letters
- (ii) Non-compliances to EMMP requirements
- (iii) Exceedances of biodiversity trigger levels

23.3.2 All site personnel shall undergo biodiversity awareness training by the Ecologist prior to commencing work at on-site, and regularly (every six months) throughout the duration of the construction. The detailed requirements of the biodiversity awareness training is defined in **Appendix BD**.

23.3.3 The Contractor shall engage and work with their Arborist on the following as defined in **Appendix BD**:

- (a) Conduct Tree Mapping and Assessment.
- (b) Review of method statements for site clearing (i.e. vegetation removal), tree felling and tree transplanting.
- (c) Development of Tree Protection specifications.
- (d) Conduct monthly tree maintenance and care of trees within TPZ, including identification of diseases/impact from work activity and propose recommendations for treatment/mitigation.
- (e) Develop and conduct Tree Transplanting specifications.
- (f) Conduct monthly inspection to monitor of the condition of the trees at the new forest edge.

23.3.4 The Contractor shall work with their Flora Specialist on the following as defined in the **Appendix BD**:

- (a) Review of method statements for site clearing (i.e. vegetation removal) and identify any unauthorized removal of vegetation beyond worksite
- (b) Develop and conduct Sapling Harvesting specifications
- (c) Conduct Weed and Invasive Species management
- (d) Development of Reforestation Planting Palette
- (e) Conduct monthly flora inspection which included forested areas adjacent to the worksite up to 15 m from the hoarding. The following shall be noted during the inspections:
 - Identification of direct/indirect impacts to vegetation and habitats. Such impacts include soil erosion and degradation that have resulted from Main Construction activities.
 - Assessment of the status of invasive flora species and weeds and recommendation to remove them where necessary.
 - Monitoring of the health of all retained and planted flora, including identification of diseases and recommendations for treatment.

23.3.5 The Contractor shall work with their Ecologist on the following as defined in **Appendix BD**:

- (a) Review of method statements for site clearing (i.e. vegetation removal) and identify any unauthorized removal of vegetation beyond worksite.
- (b) Develop and conduct Passive Wildlife Shepherding (i.e. Directional Clearance).
- (c) Conduct Pre-site Clearance Fauna inspection, including Tree Felling inspection.
- (d) Conduct Post-site Clearance inspection.
- (e) Conduct monthly site inspection (including hoarding, erosion control blanket and erosion control measure tank inspection) within worksite.

- (f) Conduct monthly fauna surveys within forest adjacent to the worksite according to methods and locations as deployed during baseline. This includes deployment of at least 23 camera traps across Maju Forest (6) and Clementi Forest (12).
- (g) Develop and conduct Fauna Response Plan.
- (h) Develop and conduct a Light Management Plan if night works are necessary.

23.3.6 This section highlights specific management measures for environmental protection during construction of CR206. This list is not exhaustive and the Contractor shall refer to the **Appendix BD** for details and additional measures.

- (i) Additional Hoarding

The Contractor shall setup temporary barriers of adequate length (e.g. water barrier of 1 m height) when tunnel boring and rock breaking and excavation work are due to occur. During rock breaking / excavation stage / tunnel boring, a barrier of 480 m shall be provided along Clementi Road. At this stage, canvas sheets must be used to cover the 635 m of the permanent BRC fences along Brookvale Drive. In addition, existing railings along Clementi Road must be covered with canvas sheets. Refer to **Appendix BD** of the Particular Specification for details.

23.4 Waste Management during Construction Phase

23.4.1 The Contractor shall refer to **PS13 Clause 13.1.6 of the Particular Specification** for the waste management strategies during construction phase.

23.5 Vector Control during Construction Phase

23.5.1 The Contractor shall refer to **PS13 Clause 13.1.7 of the Particular Specification** for the vector management strategies during construction phase.

23.6 Surface Water during Construction Phase

23.6.1 Before the commencement of construction works, the Contractor shall carry out one-time monitoring for in-situ parameters (i.e. temperature, pH, conductivity, turbidity, total dissolved solids, total suspended solids and dissolved oxygen) and ex-situ parameters (i.e. biochemical oxygen demand, chemical oxygen demand, total nitrogen, nitrate, total phosphorus, orthophosphate, oil & grease [Total], oil & grease

[hydrocarbon], lead, zinc, mercury and enterococcus) at the natural stream in Clementi Forest (i.e. D/S1 and D/S22), refer to the **Appendix BD** of the Particular Specification for details) as the baseline water quality condition before the commencement of any construction works.

- 23.6.2 The Contractor shall carry out online real time monitoring for total suspended solids (TSS) at all the discharge points of the construction site throughout the construction period.
- 23.6.3 The Contractor shall carry out monthly monitoring for in-situ parameters (i.e. temperature, pH, conductivity, turbidity, total dissolved solids and dissolved oxygen) and ex-situ parameters (i.e. biochemical oxygen demand, chemical oxygen demand, total nitrogen, nitrate, total phosphorus, orthophosphate, oil & grease [total], oil & grease [hydrocarbon], lead, zinc, mercury and enterococcus) at the natural streams in Clementi Forest (i.e. D/S1 and D/S22) throughout the construction period as the runoff from construction site drains into it.
- 23.6.4 In addition to the above monitoring list, the Contractor is to ensure that the discharge also complies to NEA's allowable limit for trade effluent discharge - in particular the limits for heavy metals (e.g. through monthly testing).
- 23.6.5 The Contractor shall note that discharge of pumped dewatered groundwater or other wastewaters to sensitive aquatic habitats shall be prohibited (e.g. natural streams within Clementi Forest and Maju Forest).
- 23.6.6 The Contractor shall monitor closely the drainage system within construction site and at immediate vicinity throughout the construction period. Before draining the discharge to public drains or watercourses, the surface runoff from the construction site shall be drained to the treatment system to be filtered and to reduce peak runoff based on Earth Control Measure Guidebook. The hoarding and perimeter drains of construction site should be inspected daily to ensure no surface runoff flowing out from the site untreated and no clogging which would affect the flow capacity of all the construction site drains. During heavy storm event, site inspection should be carried out to ensure no flooding.

23.7 Soil and Groundwater during Construction Phase

- 23.7.1 All construction debris (under category of construction and demolition waste) shall be disposed of at the gazetted Government dumping grounds or at such other sites or locations as directed by NEA.
- 23.7.2 For the worksite at Clementi Forest, all construction wastewater shall be contained in containment tanks and transported to designated facility for treatment before discharging into public drain.
- 23.7.3 For the worksite at Clementi Forest, all wastewater for the tunneling shall be pumped back to Launched Shaft for treatment and discharge.
- 23.7.4 The Contractor shall deploy only 100% biodegradable Erosion Control Blankets (ECBs). The material specifications of the proposed ECBs shall be submitted for the Engineer's Approval prior to usage onsite.

23.8 Air and Dust during Construction Phase

- 23.8.1 For the worksite at Clementi Forest and Maju Forest, the Contractor shall undertake the following monitoring regime:
- (a) The Contractor shall conduct air quality (PM₁₀ and PM_{2.5}) baseline before commencement for construction works on site at Clementi Forest and Maju Forest for 1 week (Refer to **Appendix BD** of the Particular Specification);
 - (b) Continuous monitoring of dust deposition at Clementi Forest and Maju Forest for the duration of construction; and
 - (c) At least one (1) monitoring location near each worksite will be required. Please refer to the proposed monitoring locations in the **Appendix BD** of the Particular Specification.

23.9 Airborne Noise during Construction Phase

- 23.9.1 The Contractor shall use the noise baseline monitoring results from CR2016 baseline noise monitoring data at one (1) location within Maju Forest which is closest to the construction worksite and two (2) locations at Clementi Forests. For noise monitoring during construction works, the Contractor shall base upon "no worse off than baseline" at the ecologically sensitive sites in the vicinity of construction worksite (Refer to **Appendix BD** of the Particular Specification).
- 23.9.2 For the worksite near Clementi Forests and Maju Forest, continuous noise monitoring (Leq 12 hr, Leq 5min and Leq 1hour) shall be conducted at least

three (3) strategic locations during construction phase as detailed in **Appendix BD** of the Particular Specification.

- 23.9.3 Noise barriers and additional noise mitigation measures are recommended in **Appendix BD** of the Particular Specification based on preliminary estimation of construction methodology. These noise barrier locations are described in **Clauses** Error! Reference source not found..
- 23.9.4 Above-ground works not critical for safety reasons within the CR206 shall only be allowed from Mondays to Saturdays from 7am to 7pm. However, noisy activities shall only be allowed from 9am to 5pm.
- 23.9.5 For the worksite near Clementi Forests and Maju Forest, the Contractor shall erect a 12m height noise barrier with minimum Sound Transmission Class (STC) of 20, along the west boundary of the construction worksite and LTA's standard TBM enclosure (one façade opening at northern side) 15m high at the boundary of Launch shaft worksite. The Contractor shall apply 6m high noise barrier along the south-east boundary of the construction worksite and 12m high noise barrier along the north-east boundary of the noise barriers with minimum Sound Transmission Class (STC) of 20. The Contractor shall use the portable noise barrier close to the noisy equipment/ activities, whichever the equipment is applicable. When portable inflatable noise barrier is used, silent type of gensets shall be used for the barrier. More details on the location of this barrier can be viewed in **Appendix BD** of the Particular Specification.
- 23.10 Ground-borne Vibration during Construction Phase**
 - 23.10.1 The Contractor shall control construction vibration levels using the best available techniques (BAT). The Contractor shall ensure that the vibration levels at Maju Forest and Clementi Forest (excluding the worksite area) do not exceed Peak Particle Velocity PPV, 8 mm/s.
 - 23.10.2 The Contractor shall setup temporary barriers of adequate length (e.g. water barrier of 1 m height) when tunnel boring and rock breaking and excavation work are due to occur. At Stage 2, a barrier of 480 m shall be provided along Clementi Road. At this stage, canvas sheets must be used to cover the 635 m of the permanent BRC fences along Brookvale Drive. In addition, existing railings along Clementi Road must be covered with canvas sheets. Refer to **Appendix BD** of the Particular Specification for details.
 - 23.10.3 At Maju and Clementi Forests, continuous vibration monitoring shall be conducted at one (1) location each before the commencement of construction to obtain baseline levels at each location as detailed in **Appendix AD** of the Particular Specification.

- 23.10.4 At Maju and Clementi Forests, continuous vibration monitoring shall be conducted at one (1) location each throughout the entire construction phase as detailed in **Appendix AD** of the Particular Specification.
- 23.11 Environmental Protection during Commissioning Phase**
- 23.11.1 Commissioning phase is a short transitional period specified for EMMP purpose, where environmental monitoring works are proposed and to be conducted by the Contractor before handing over to the rail operator in operational phase.
- 23.11.2 The following **Clauses 23.12 to 23.15** highlight specific management measures for environmental protection during commissioning phase (i.e. after completion of all the major construction activities).
- 23.12 Terrestrial Ecology Protection at CR206 during Commissioning Phase**
- 23.12.1 Monthly Flora Inspection
- (a) The Contractor shall work with their Arborist to conduct monthly tree inspections as defined in **Appendix BD** of the Particular Specification.
 - (b) The Contractor shall work with their Flora specialist to conduct monthly flora inspections as defined in **Appendix BD** of the Particular Specification.
 - (c) Monthly flora inspections shall be conducted within the former worksite boundary and in forested areas adjacent to the former worksite up to 15m from the boundary. The following shall be noted during the inspections:

- (i) Identification of direct/indirect impacts to vegetation and habitats. Such impacts include soil erosion and degradation that have resulted from operation activities.
- (ii) Identification of forest edge effects and recommendation of mitigation measures where necessary.
- (iii) Assessment of the status of invasive flora species and weeds and recommendation to remove them where necessary.
- (iv) Inspection of areas cleared of weeds to detect any seedlings of invasive species.
- (v) Monitoring of the health of all retained and planted flora, including identification of diseases and recommendations for treatment.

23.12.2 Fauna Management Plan

- (a) Fauna Monitoring
 - (i) The Contractor shall work with their Ecologist to conduct monthly fauna inspections as defined in **Appendix BD** of the Particular Specifications.
 - (ii) The Ecologist shall carry out fauna monitoring (including both terrestrial transect surveys, aquatic sampling and camera trap monitoring) at least for a duration of 6 months after completion of the construction stage. Such monitoring shall be extended for another 6 months if the findings from the first 6-month monitoring is insufficient/non conclusive if required by the Authority and/or relevant authorities.
 - (iii) Terrestrial sampling routes and aquatic sampling locations shall be situated as closely as possible to those undertaken during the construction stage.
 - (iv) Camera trap monitoring shall be situated as closely as possible to those deployed during construction monitoring.
 - (v) Where monitoring indicates that impacts to fauna are occurring due to commissioning activities, the Ecologist shall formulate and implement an appropriate action plan.

23.13 Surface Water at CR206 during Commissioning Phase

- 23.13.1 The Contractor shall carry out monthly monitoring for in-situ parameters (i.e. temperature, pH, conductivity, total dissolved solids, turbidity, total suspended solids and dissolved oxygen) and ex-situ parameters (i.e. biochemical oxygen demand, chemical oxygen demand, total nitrogen, nitrate, total phosphorus, orthophosphate and enterococcus) at the main outlets/drains of the Project Site, as well as sensitive streams in Clementi Forest (i.e. D/S1 and D/S22).
- 23.13.2 The Contractor shall monitor the quality of all discharge water against Singapore NEA's Allowable Limits for Trade Effluent Discharge to Sewer/Watercourse/Controlled Watercourse for the duration of commissioning phase.
- 23.13.3 The Contractor shall inspect the drainage system of Project Site and at immediate vicinity especially during heavy storm event to ensure no flooding for the duration of commissioning phase.

23.14 Soil and Groundwater at CR206 during Commissioning Phase

- 23.14.1 The Contractor shall submit monthly monitoring records of the amount and type of toxic chemical waste generated during the first three (3) months of commissioning period.
- 23.14.2 The Contractor shall submit monthly inspection of hazardous chemical/substances storage conditions during the first three (3) months of commissioning period.

23.15 Airborne Noise at CR206 during Commissioning Phase

- 23.15.1 The Contractor shall note that continuous noise monitoring ($L_{eq\ 5min}$ and $L_{eq\ 1hour}$) shall be conducted at least three (3) locations during commissioning phases as shown in the **Appendix BD** of the Particular Specification. Six (6) additional noise monitoring ($L_{eq\ 15min}$) will be required at the east, north and south of the boundary of ventilation shaft building for one (1) day (24 hours) during commissioning phase as detailed in the **Appendix BD** of the Particular Specification.

23.16 Complaint Handling and Corrective Plan during Both Construction and Commissioning Phases

- 23.16.1 During the construction and commissioning phase, complaint investigation shall be carried out upon receipt of complaints. Complaint investigation report and corrective action plan shall be prepared and

submitted to the Authority within 24 hours upon receipt of complaints for approval.

23.17 Deliverables

23.17.1 Plans/reports/records listed in the table below shall be documented by the Contractor and submitted to the Client and relevant agencies (MND/URA, NParks, NEA and PUB) on the frequency specified in the **Appendix BD** of the Particular Specification.

23.17.2 Biodiversity related deliverables

Phases	Document	Submission Milestones and Frequency	Action by
Pre-construction	<p>Contract-specific EMMP (refer to Clause 23.1.2 - inputs from biodiversity team) should include the following (but not limited to):</p> <ul style="list-style-type: none"> • Method statement for site clearance and tree felling (Clause 23.3.3) • Method statement for fauna response plan (Clause 23.3.5) • Tree protection specifications (Clause 23.3.3) • Sapling harvesting specifications (Clauses 23.3.3 and 23.3.4) • Tree transplanting recommendations (Clause 23.3.3) • Method statement for fauna management during site clearance (Clause 23.3.5) • Reforestation planting palette and plant salvaging for reforestation and landscaping (Clause 23.3.4) • Tree maintenance and care recommendations (Clause 23.3.3) 	Within one (1) month after Contract award	Arborist, Flora Specialist, Ecologist

Phases	Document	Submission Milestones and Frequency	Action by
	Tree mapping and assessment (Clause 23.3.3)	Within seven (7) working days after each assessment	Arborist
	Weed and invasive species management (Clause 23.3.4)	Within seven (7) working days after each assessment	Flora Specialist
	Verification of tree protection checklist (Clause 23.3.3)	Within five (5) working days after TPZ installation	Arborist
	Hoarding inspection report (Clause 23.3.4)	Within 24 hr of each inspection	Ecologist
	Pre-site clearance camera trap monitoring report (Clause 23.3.5)	Within 24 hr of each inspection	Ecologist
	Pre-felling fauna inspection report (Clause 23.3.5)	Within 24 hr of each inspection	Ecologist
	Wildlife exit point camera trap monitoring and post-site clearance fauna inspection report (Clause 23.3.5)	Within 24 hr of each inspection	Ecologist
Construction	Monthly tree inspection report (Clause 23.3.3)	Within five (5) working days after each inspection	Arborist
	Monthly flora inspection Report (Clause 23.3.4)	Within five (5) working days after each inspection	Flora Specialist
	Fauna monitoring report for terrestrial transect surveys,	Within five (5) working	Ecologist

Phases	Document	Submission Milestones and Frequency	Action by
	aquatic sampling, and camera trapping (Clause 23.3.5)	days after each inspection	
	Monthly fauna inspection report (Clause 23.3.5)	Within five (5) working days after each inspection	Ecologist
	Wildlife incident report (Clause 23.3.5)	Within 24 hr of each wildlife encounter	Ecologist
Commissioning	Monthly flora inspection report (Clause 23.12.1)	Within five (5) working days after each inspection	Flora Specialist
	Monthly fauna inspection report (Clause 23.12.2)	Within five (5) working days after each inspection	Ecologist
	Wildlife incident report (Clause 23.12.2)	Within 24 hr of each wildlife encounter	Ecologist

23.17.3 Other deliverables

Phases	Document	Submission Milestones and Frequency	Action by
Pre-construction	Contract-specific EMMP (refer to Clause 23.1.2 herein - inputs from the other environmental team) should include the following plans (but not limited to):	Within one (1) month after Contract award	Environmental Consultant

Phases	Document	Submission Milestones and Frequency	Action by
	<ul style="list-style-type: none"> Waste Management (Clause 23.4) Vector Control (Clause 23.5) Surface Water (Clause 23.6) Soil and Groundwater (Clause 23.7) Air and Dust (Clause 23.8) Airborne Noise (Clause 23.9) Ground-borne Vibration (Clause Error! Reference source not found.) Complaint handling and corrective action plans (Clause 23.16) 		
Construction and commissioning	Monthly monitoring report for waste management, vector control, surface water, soil and groundwater, air and dust, airborne noise, ground-borne and vibration (Clauses 23.4 to 23.15)	End of each month	Environmental Consultant
	Complaint investigation report and corrective action plan (Clause 23.16)	Within 24 hr upon receipt of complaints	Environmental Consultant