Location (see Figure 13-15)	Parameters	Frequency and Duration
		• **Throughout construction period:** Continuous monitoring at this location for the entire duration of construction.
Clementi Forest: Two (2) monitoring location within Clementi Forest and closest to northern and southern part of construction worksite		• **Prior to site clearance:** To conduct one-time (i.e, 1 week period) at these locations to re-establish the baseline noise levels for reference/ comparison purposes before any construction works commence. • **Throughout construction period:** Continuous monitoring at this location for the entire duration of construction.

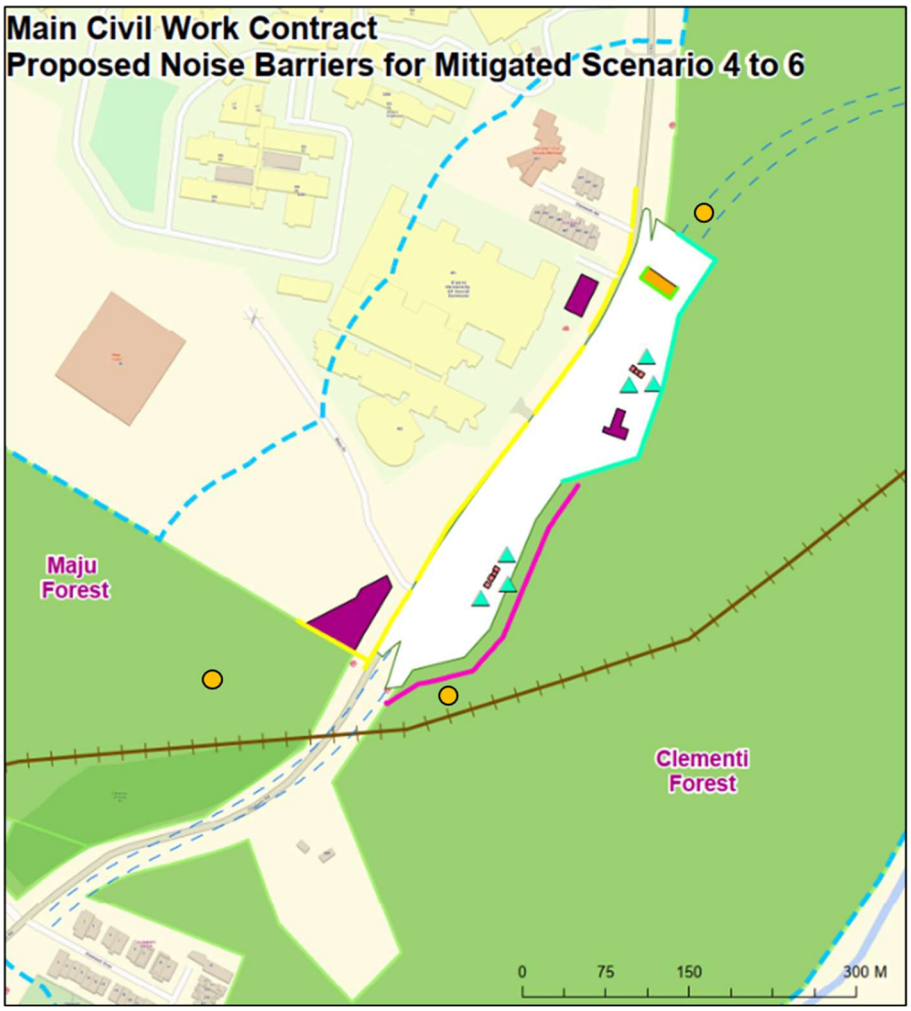

Figure 13-15 Proposed Noise Monitoring Locations with Construction Noise Barriers

(Yellow / Blue / Purple Line – Noise Barriers to NParks and NEA's Approval and the Engineer's Acceptance; Orange dot – Monitoring Locations during Construction Phase; Blue Triangle – Monitoring Locations during Commissioning Phase)

13.10.2 Commissioning Phase

During commissioning phase, continuous airborne noise monitoring ($L_{eq\ 5min}$ and $L_{eq\ 1\ hour}$) shall be conducted for the three (3) monitoring locations in Maju Forest and Clementi Forest (as per Figure 13-15) for three (3) months of the commissioning phase.

Apart from that, six (6) additional airborne noise monitoring ($L_{eq\ 15min}$) will be required at the east, north and south of the boundary of ventilation shaft building at station for one (1) day (24 hours) within the commissioning phase, to monitor the potential airborne noise impact arising from the air conditioning and mechanical ventilation (ACMV) equipment which will be operating during commissioning phase. This indicates a total of nine (9) airborne noise monitoring locations during commissioning phase.

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Site Responsibility	Triggers[1,2]
			• Use water-assisted dust sweeper(s) on the access and affected local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use. • Avoid dry sweeping of large areas. • Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. • Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. • Record all inspections of haul routes and any subsequent action in a site log book. • Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned. • Site access gates to be located at least 10m from receptors where possible					
Airborne Noise	Noise from construction machines and equipment, especially rotational and vibratory equipment (e.g. dozers, cranes, excavators, trailers, generators, etc.)	Minimum Controls: • Construction prohibition period should be followed, as per fourth schedule of Environment Protection and Management regulation; • Prepare a Construction Noise Management Plan, to establish baseline monitoring prior to site clearance, plan for monitoring during the construction phase, and procedure for complaint handling; • The Contractor shall review the equipment to be used on site and erect localised noise barriers prior to undertaking high noise generating work; • Machines (such as trucks) that may be in intermittent use shall be shut down between work periods or shall be throttled down to a minimum; • Only well-maintained plants shall be utilised on-site and plants shall be serviced regularly during the entire construction period; • The number of PMEs shall be reduced as far as practicable when construction works are carried out at areas close to the noise sensitive receivers: • Silencers or mufflers on construction equipment shall be utilised and shall be properly maintained during the construction programme; • Behavioural practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items shall be ensured; • Construction respite: Restrict high noise generating drilling activities only in continuous blocks, not	MITIGATION MEASURES FOR GENERAL CONSTRUCTION NOISE CONTROL: • Control of noise sources at the source from construction site – Analyse construction inventory list and check equipment causing high noise levels. The equipment with lower noise level hall be prioritised. • Where controlling noise sources at the source is not feasible, acoustic enclosures or sheds are to be introduced to mitigate noise at the source. Typical acoustic enclosure covers the machine as fully as possible (with or without ventilation where applicable) to provide sound insulation. MITIGATION MEASURES FOR CONSTRUCTION NOISE: <u>Noise Barrier to meet the relevant authorities / agencies' requirements are to be erected at all the locations presented in Figure 13-15 in order to mitigate the construction noise to the noise sensitive receptors. These locations are:</u> For Main civil work, • <u>Noise barriers at the construction boundary of Main construction work worksite fronting noise sensitive receptors,</u>	Leq 12hours, Leq 1hour and Leq 5mins	One (1) location at Maju Forest boundary and closest to construction worksite (see Figure 13-15)	Before commencement of any construction works (including site clearance) • One-time airborne noise monitoring for 1 week at this location, for establishment of latest baseline. During Construction Phase • Continuous monitoring at this location for the entire duration of construction.	CT, EM/ECO	Investigation and corrective actions to be taken, when: 1. Any of the following documentation are found inadequate / missing: • Construction Noise Management Plan; • Monitoring Log. 2. If the monitored parameters exceed applicable values of EPM regulations. 3. If complaints are received due to project activities. 4. If visual non-compliance to any of the minimum control or mitigation measures are observed on-site. 5. If there are any cracks / leaks present on the noise barrier erected.
					Two (2) locations within Clementi Forest and closest to northern and southern part of construction worksite (see Figure 13-15)	Before commencement of any construction works (including site clearance) • One-time airborne noise monitoring for 1 week at these locations, for establishment of latest baseline. During Construction Phase • Continuous monitoring at this location for the entire duration of construction.		

Environmental Parameter	Environmental Issue	Minimum Control Measures	Mitigation Measures	Monitoring Parameter	Monitoring Locations	Recommended Frequency of Monitoring	Site Responsibility	Triggers[1,2]
		exceeding 3 hours each, with a minimum respite period of one hour between each block, if possible; • Periodic noise monitoring by an independent third party, to establish compliance with requirements and to advise on equipment causing concern, and additional potential mitigation measures; • Plan the layout of the site by considering using materials and other large structural equipment as noise barriers; • Plant known to emit noise strongly in one direction shall, wherever possible, be orientated so that the noise is directed away from the nearby NSRs; and • Material stockpiles and other structures shall be effectively utilised, wherever practicable, in screening noise from on-site construction activities. • The optimisation of worksite to be situated away from the Biodiversity Study Area as far as practicable. • Acoustic sheds should be provided at the locations of the noise generating activity such as operation of hand-held breaker. • All construction works should be conducted within the daytime period. TBM works are to be conducted in the daytime as much as possible.	• LTA's standard 15m high TBM enclosure (one facade opening at northern side) at boundary of launch shaft. • Above-ground works not critical for safety reasons to be restricted to weekdays (avoiding works on Sunday and Public holidays) • No night works after 7pm for all non-safety critical activities since the site is next to Biodiversity Study Area • Portable noise barrier were highly recommended close to the noisy equipment/ activities • For noisy machinery such as the Secant Pile Auger - that typically operate for long period, the soundproof baffles can be mounted directly on the machine around the engine cowling.		For all monitoring locations	• Records on noise levels from construction sites should be properly kept and produced when requested.		
Ground-borne Vibration	Ground-borne vibration from construction machines and equipment (e.g. vibratory roller, hydraulic hammer/rock breaker, pipe jacking), rock breaking and excavation and tunnel boring machine.	• Equipment Selection and Maintenance. Associated with the piling during the construction of the viaducts, facility buildings, cut and cover tunnel, at-grade ramp, plus the operation of the TBM. • Works Scheduling and Respite Periods. • Community Consultation. It is recommended that the surrounding community be notified before commencing any piling and TBM related works, as a matter of good community relations.	• Optimise the worksite for smallest footprint within this area. • Schedule rock breaking and excavation activities during day time. • Restrict high amplitude vibratory compactors, pipe jacking, rock breaking and tunnel boring to below vibration threshold of PPV, 8 mm/s. • Use of tri-axle trucks to reduce truck trips on the road. • No night works should be conducted after 7pm for all non-safety critical activities. • Temporary barriers (i.e. water barriers of 1 m height) should be implemented along Brookvale Drive and Clementi Road as seen in Figure 13-16. Canvas sheets should also be used to cover the holes on the existing railings along Brookvale Drive and Clementi Forest. Hoardings must be ensured at the worksites and at the existing construction beside Maju Forest. • The Contractor shall control construction vibration levels using best available techniques (BAT) for tunnel boring and rock breaking and excavation at Stage 2. • The Contractor shall ensure that the vibration levels for any construction activities at Maju Forest and Clementi Forest (excluding the worksite area) do not exceed PPV, 8 mm/s. • Ecologist and Environmental Officer to identify burrows before the start of construction and monitoring burrow collapse during construction activities;	PPV, mm/s	One (1) location each at Maju Forest and Clementi Forest boundary and closest to construction worksite (see Figure 13-16)	Before commencement of any construction works (including site clearance) • One-time vibration monitoring for 1 week at this location, for establishment of latest baseline. During Construction Phase • Continuous monitoring at this location during rock breaking and excavation, piling and tunnel boring activities. • In the event of a valid complaint, until the complaint has been resolved. • Routine environmental audit by independent EMMP Consultant during construction phase.	CT, EM/ECO	Investigation and corrective actions to be taken, when: 1. If the monitored parameters exceed applicable limits. 2. If complaints are received due to project activities. 3. If visual non-compliance to any of the minimum control or mitigation measures are observed on-site.