

Addendum to the Environmental and Social Impact Assessment – Environmental Management Plan

Project Number: 51274-001
May 2018

THA: Bangkok Mass Rapid Transit (Pink and Yellow Lines)

(Part 1 of 3)

Prepared by BSR Joint Venture for the Asian Development Bank. This is an updated version of the draft originally posted in October 2017 available on <https://www.adb.org/projects/documents/tha-51274-001-eia>.

CURRENCY EQUIVALENTS

Currency unit	–	Baht (THB)
THB 1.00	=	\$0.032
\$1.00	=	THB 31.33

ABBREVIATIONS

AADT	–	Annual average daily traffic
ADB	–	Asian Development Bank
AP	–	Affected person
ATC	–	Automatic Train Control System
BOD	–	Biochemical oxygen demand
CO	–	Carbon monoxide
DMC	–	Developing member country
DOH	–	Department of Highways
EHS	–	Environment, Health and Safety
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
GHG	–	Greenhouse gas
GMS	–	Greater Mekong Subregion
GRM	–	Grievance Redress Mechanism
IEE	–	Initial Environmental Examination
ITF	–	Intermodal Transit Facility
IUCN	–	International Union on Conservation of Nature
M-MAP	–	Mass Rapid Transit Master Plan in Bangkok Metropolitan Area
MOT	–	Ministry of Transport
MRTA	–	Mass Rapid Transit Authority of Thailand
NEQA	–	National Environmental Quality Act
NGO	–	Non-government organization
NO ₂	–	Nitrogen dioxide
NO _x	–	Oxides of nitrogen
ONEP	–	Office of Natural Resources and Environmental Policy and Planning
OTP	–	Office of Transport and Traffic Policy and Planning
PCP	–	ADB Public Communications Policy (2011)
PM ₁₀	–	Particulate matter < 10 micron
PM _{2.5}	–	Particulate matter <2.5 micron
PPP	–	Public-Private Partnership
ROW	–	Right-of-way
SCADA	–	Supervisory Control and Data Acquisition System
SO ₂	–	Sulfur dioxide
SO _x	–	Oxides of sulfur
SPS	–	ADB Safeguard Policy Statement (2009)
TSP	–	Total suspended particulates

WEIGHTS AND MEASURES

a	–	annum
oC	–	degree centigrade
μ	–	micron
cm	–	centimeter
dB(A)	–	A-weighted decibels
h	–	hour
ha	–	hectare
kg/d	–	kilogram per day
km	–	kilometer
km/h	–	kilometer per hour
km ²	–	square kilometer
m	–	meter
m ²	–	square meter
m ³	–	cubic meter
m/s	–	meter per second
m ³ /d	–	cubic meter per day
m ³ /s	–	cubic meter per second
mg/l	–	milligram per liter
mg/m ³	–	milligram per cubic meter
mm	–	millimeter
s	–	second
t	–	metric ton
y	–	year

NOTE

- (i) In this report, "\$" refers to US dollars.

The environmental and social impact assessment is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature. Your attention is directed to the ["terms of use"](#) section on ADB's website.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

Table of Contents

I. Introduction	1
II. Project Summary	3
III. EMP Implementation Arrangements	3
IV. Summary of Potential Impacts and Mitigation Measures	6
V. Environmental Management Plan	8
VI. Environmental Monitoring and Reporting	38
VII. Grievance Redress Mechanism	40
VIII. EMP Capacity Building and Training Plan	49
IX. Information Disclosure, Consultation and Participation	49
X. Mechanism for Feedback and Adjustment	49
Appendixes	51
- Updated Environment Management Plan MRT Yellow Line: Lad Phrao – Samrong	
- Updated Environment Management Plan MRT Pink Line Project: Khae Rai – Min Buri	

I. Introduction

The Yellow and Pink Lines are projects under the Mass Rapid Transit Master Plan in Bangkok Metropolitan Area (M-MAP and M-MAP2) and are part of the government's stimulus measures to improve infrastructure, as an essential part of the country's sustainable development. Both metro lines are feeder lines to diversify the transport modality of the city, and to connect passengers to the main MRT lines, such as passengers going to Bangkok Central Business District (CBD). The projects will mitigate traffic congestion and associated environmental issues, provide a convenient and cost-effective public transportation system, and reduce the government's fiscal burden.

The Thai government approved the implementation of PPP Net Cost Scheme¹ for the monorail system of the MRT Pink Line and Yellow Line projects in Bangkok in March 2016, in which the Mass Rapid Transit Authority of Thailand (MRTA) will be responsible for provision of the land and the right of way, whereas the private sector will invest in all civil works, M&E systems, and rolling stock, including operations & maintenance services.

The Office of Transport and Traffic Policy and Planning (OTP), under the Ministry of Transport (MOT), prepared the feasibility studies, preliminary designs and studies on environmental impacts for both the Yellow and Pink Lines. The original environmental impact assessment (EIA) for both lines were approved by the National Environment Board (NEB) at Meeting No. 2/2555 on 16 March 2012, on condition that in the case of changes or amendments in the measures in or substance of the EIA, a report on the modifications and impact analyses of the proposed modified section (s) will be submitted to the Office of Natural Resources and Environmental Policy and Planning (ONEP) for consideration and approval of the Expert Committee before proceeding.

The Mass Rapid Transit Authority (MRTA) was assigned by the Cabinet to review the details of the feasibility study, to modify the design and to prepare the tender documents for both lines. The MRTA commissioned a group of consulting firms who conducted the feasibility study review and preliminary design modifications; and prepared tender documents for the project and the EIA Addendum Reports.

The feasibility study review for the Pink Line confirmed that the straddle monorail will be adopted for the project. However, six additional stations will be included, to ensure optimal distance between stations; cancellation of the depot and park and ride facility located at Sanambin Nam intersection in Nonthaburi province; the remaining depot at Romklao intersection will be expanded from 50.57 rai to 229 rai to accommodate more trains and increase car parking capacity; and cancellation of the installation of at least 200-meter sound barrier walls in the form of tunnel-like structures in six sections identified as sensitive receptors. Based on the feasibility study review, these structures will not be required since noise levels during operation at sections near these receptors are almost similar to the established baseline noise levels which are higher than the domestic threshold (70 dB(A)). Additionally, there were concerns that the tunnel-like structures may also pose a safety risk during accidents, such as fire, and may hinder passenger evacuation in case of emergencies. Therefore, sound absorptive materials will be installed in selected stations.

¹ Under the PPP Net Cost scheme, the concessionaire of the project is responsible for the costs of civil works, mechanical electrical works, and O&M, while it will be entitled receive the fare revenue and other revenues such as the associated commercial development from the project. If the fare and other revenues will not be sufficient to cover the costs, the government will fill the gap by way of subsidies. In the case of the MRT Pink and Yellow Lines, the key parameter of the tender was the amount of such subsidies from the government that each bidder needs (i.e. minimum subsidy).

For the Yellow Line, a succeeding MRTA feasibility study, which considered the feedback from the public, forecasted number of passengers, changes in the master plan, the cost of constructing and operating two facilities (monorail and heavy rail), land expropriation, and environmental impacts during construction and operation, concluded that the project should use the monorail system for the entire Lat Phrao – Patthanakan – Samrong Section.

The EIA Addendums for both Pink Line and Yellow Line were submitted to the Office of Natural Resources and Environmental Policy and Planning for the approval of the Specialist Committee and was subsequently approved by NEB on 18 March 2015, Meeting No. 1/2558 (Pink Line) and 19 February 2016, Meeting No. 1/2559 (Yellow Line).

The MRTA invited tenders for the MRT Pink Line and Yellow Line projects in July 2016. In December 2016, the BSR Joint Venture (BSR)² was selected as the preferred bidder for both lines. BSR entered into concession agreements with MRTA for the MRT Pink Line and Yellow Line projects, respectively in June 2017. Both Pink and Yellow lines are expected to commence operation in 2020.

The concession period is 33 years and 3 months (divided into 3 years and 3 months for the construction period, and 30 years for the operation period). Under the concession, BSR will obtain the rights to operate the lines, and be entitled to receive farebox revenues, commercial development fees, and parking fees during the concession period. BSR will share the revenues with the MRTA in the amount of B250 million for each line throughout the term of the concession contract.

The proceeds from the proposed ADB direct loan and ADB standby facilities will be used by BSR for financing the construction and operation of the Yellow and Pink lines.

The projects have been screened and classified by the Asian Development Bank based on its Safeguard Policy Statement (SPS, 2009) as category A which requires the preparation of an environmental impact assessment (EIA), including an environmental management plan (EMP). The domestic EIA was prepared in accordance to and subsequently approved based on the applicable laws, regulations and policies of the Kingdom of Thailand. A gap analysis was conducted between domestic requirements and SPS 2009. Additional analyses were conducted to the domestic EIA to ensure compliance with SPS 2009.

This EMP was prepared to collate mitigation measures for potential environmental and social impacts; schedule, parameters and budget allocation for environmental monitoring; institutional responsibilities; reporting requirements, capacity building activities and grievance redress procedures that were defined in the original EIA reports, the EIA Addendum reports, the approved Sor Phor Form 1 and additional studies conducted by ADB for both Yellow and Pink lines.

The mitigation measures will be included in all bidding and contract documents. The obligations and corresponding cost of EMP implementation will be borne by the contractors and will be included on the bids for all project works. All contracts follow a standard fixed price turnkey contract model.

² BSR comprises of BTS Group Holdings Public Company Limited (BTS Group; 75%), the market leader in mass transit business, operating existing Green line, Sino-Thai Engineering and Construction Public Company Limited (Sino-Thai; 15%), major construction company, and Ratchaburi Electricity Generating Holding Public Company Limited (Ratchaburi Electricity; 10%), one of the largest energy investment company.

II. Project Summary

The project will include the construction of two metro lines. The Yellow Line will consist of a 30-kilometer elevated straddle monorail system with single-pillar and twin-pillar 2-direction guideway beams along the alignment of the Lat Phrao, Srinagarindra and Theparak roads and with 23 elevated stations. The Pink Line will consist of a 34.5-kilometer elevated straddle monorail system with one-, two-, or three- pier viaduct 2-direction guideway beams along the alignment of the Rattanathibet, Tiwon, Chaeng Watthana, Ram Inthra and Sihaburanukit roads, with 30 elevated stations.

The stations for both lines will include passenger concourse, intermodal transit facility (ITF) such as parking areas, pick up and drop off areas, and waiting lots for buses, taxis and motorcycles, and interchanges and links to connect stations to stations of other MRT lines and to adjacent buildings. Both lines will also have a park and ride building and depot with stabling yard and maintenance facilities for the trains, an office building area for the operation control center, material storage rooms and other facilities for the train operation.

The project will also include the installation of the: (i) a distribution system to supply power for the monorail operation from traction power substations (TSPs) to the power rails; (ii) supervisory control and data acquisition system (SCADA) at each station and the depot for monitoring and controlling the monorail operation; (iii) telecommunications system; and (iv) signaling system including the Electronic Interlocking and Automatic Train Control System (ATC).

ADB will provide a direct loan of up to \$200 million equivalent in total and standby facility of up to \$200 to \$300 million equivalent in total.

III. EMP Implementation Arrangements

The MRTA will be responsible for the overall implementation and compliance with the EMP, including the environmental monitoring plan, as suggested in the approved EIA Reports for the Pink Line and Yellow Line.

The MRTA will engage a project consultant/firm for each line to provide environmental and social compliance oversight during project implementation. The MRTA, through the consultant/firm for Yellow Line and Pink Line, respectively, will implement the project components, administer and monitor contractors, and ensure quality control and compliance to applicable standards, agreements, and policies. It will ensure that environmental impact prevention and mitigation measures and environmental monitoring and reporting requirements mentioned in the EIA report are implemented, documented and reported to ONEP. The two consultant firms will also coordinate with relevant agencies, the BSRconsortium, and ADB responding to all requests and inquiries.

During the construction phase, the Construction Contractor will be responsible for implementing the mitigation measures and environmental impact monitoring process stipulated in the approved EIA. The costs for implementing the mitigation measures and environmental impact monitoring during construction (approximately 48 months) will be included in the Contractors' bids/contracts. The Contractor will engage a third party environmental compliance auditing firm that, accredited by ONEP, to supervise the project implementation, prepare reports on the compliance with the environmental impact prevention and mitigation measures and evaluate the results of the environmental monitoring process. The third party environmental and social compliance firm will

report the results of its evaluation and monitoring to MRTA, through the consultant/consulting firm for each of the lines, the contractor and ADB.

Figure EMP - 1 presents the synergies between the teams during construction to ensure compliance to the EMP.

The contractor will establish a project management office, for each of the lines, which will be responsible for the day-to-day management of activities related to construction of the Pink and Yellow lines. Qualified staff from the third party compliance auditing firm will be responsible in the implementation of the environmental measures and monitoring process (

Figure EMP - 2).

During the operation phase, the Yellow Line and Pink Line operators, under the supervision of the MRTA, will regularly implement the environmental impact monitoring plans included in the EIA report, to monitor the intensity of the impacts throughout the operation phase. This aims to maximize the benefits, efficiency and cost-effectiveness of the project and minimize its impacts on environmental quality and local people.

The Yellow Line and Pink Line operators will engage a third party environmental compliance auditing firm, that has been authorized by the ONEP, to prepare the semi-annual (every January and July) environmental impact monitoring reports, which will be submitted to the ONEP.

ADB will conduct due diligence on the implementation of the mitigation measures and environmental monitoring process through reviews of the semi-annual environmental monitoring reports prepared and submitted by MRTA/operators to ONEP and/or project review missions. Environmental monitoring reports will be disclosed in the ADB website. In case of lapses in the implementation of the mitigation measures and environmental monitoring process, ADB will seek corrective measures and advise on follow-up actions.

Figure EMP - 1. Structure for ensuring compliance to EMP

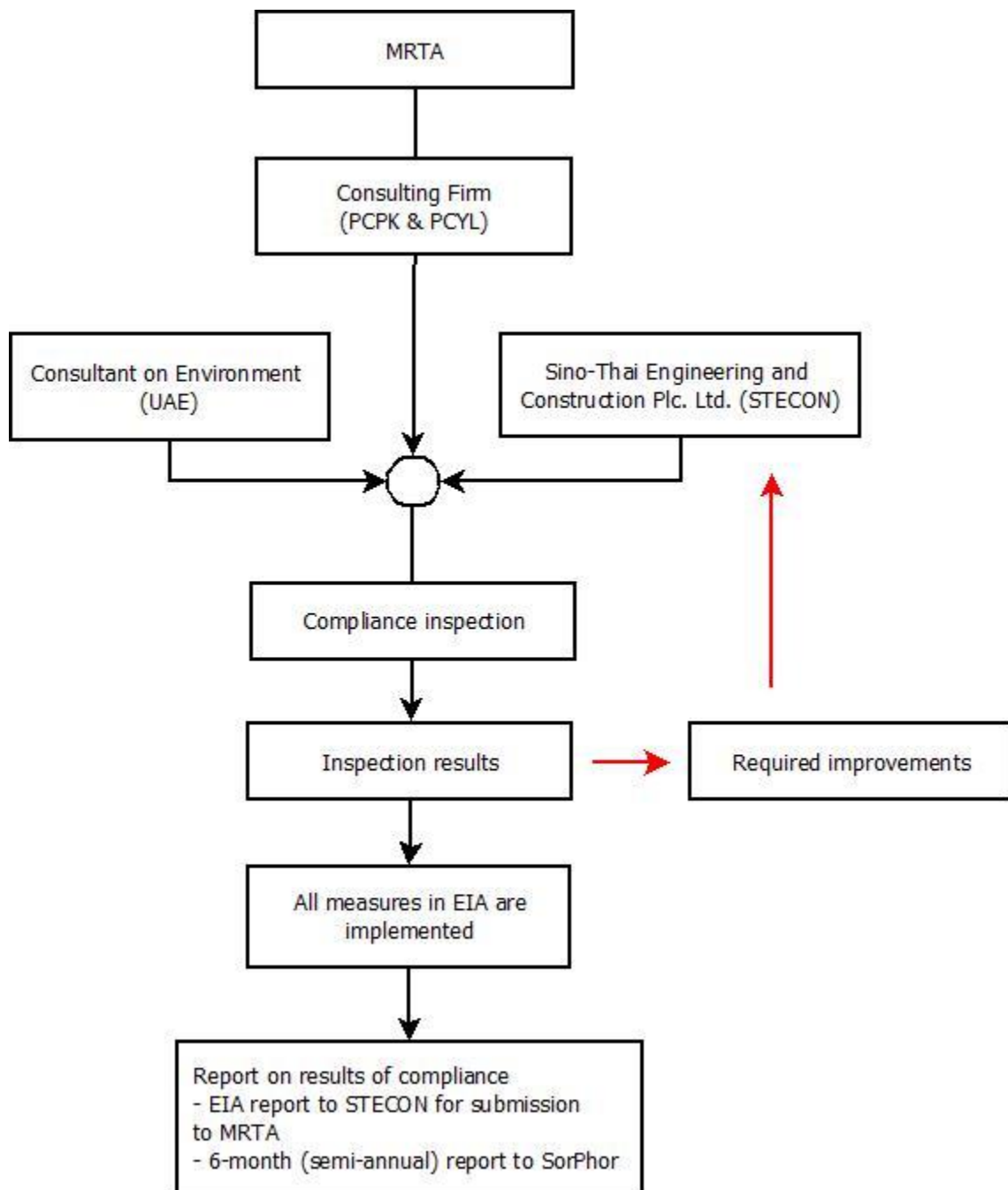
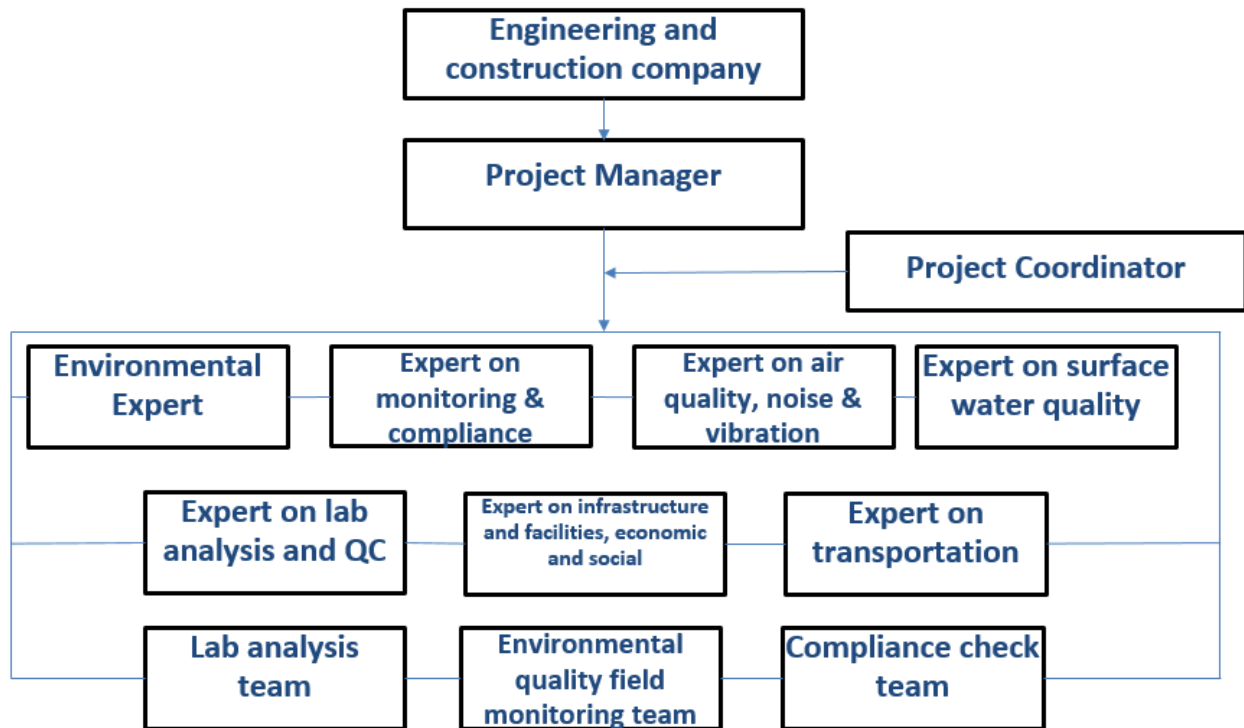


Figure EMP - 2 Personnel in Environmental Quality Monitoring



IV. Summary of Potential Impacts and Mitigation Measures

Area of influence. The project area of influence is defined as 500-meter radius from the center line of the route alignment and 500-meter radius around the proposed park and ride and depot area. There are identified sensitive receptors along the alignment consisting of schools, government offices, hospital and religious buildings. The area of influence is mostly urban and built-up areas.

Siting and Land Acquisition. The track structure project route will be constructed in the middle of the roadway, as much as possible, to minimize land expropriation.

The construction of the Yellow and Pink lines will affect private assets, mainly land and structures which are being acquired in accordance with Thai laws on land ownership and expropriation. The land acquisition process began in December 2014 when the royal decree designating the area for acquisition was issued for the Pink Line and in September 2015 for the Yellow Line. In November 2017, MRTA completed the full inventory of affected people and assets and land acquisition and compensation were 20% complete for the Pink Line and 22% for the Yellow Line. By March 2018, the land acquisition process is expected to be 60% complete for the Pink Line and 75% complete for the Yellow Line. Land acquisition and resettlement activities undertaken by MRTA are not in anticipation of ADB support as it commenced (in 2014 for the Pink Line and 2015 for the Yellow Line) prior to ADB's involvement in the Project in 2017. As a good practice recommended under ADB's draft 2012 Involuntary Resettlement Safeguards: A Planning and Implementation Good Practice Source Book, a Social Compliance Audit is -

underway to identify past or present risks or concerns related to involuntary resettlement impacts. The audit report and corrective measures, if any, will be submitted to MRTA for consideration and disclosed to the public as required by SPS, 2009.

Pre-construction and Design Phase. The design of the track structure along the project route will be optimized to minimize land expropriation, reduce traffic congestion and disturbances to the public. One-, two-, or three- pier viaducts will be used in instances when the pillars cannot be placed in the road median and to avoid potential impacts to existing public utilities, such as plumbing and electricity.

The design of stations, depot, intermodal transportation facilities, interchanges and links, such as covered walkways and footbridges, will incorporate universal design principles and best international safety standards. The design of drainage and flood prevention system of the depot considered the maximum water level of +2.5 meters above sea level like other electric railway projects in Bangkok. Transition structures piers of the viaduct that overlaps with the road surface will have space designed for differential settlement.

Construction Phase. Potential impacts during construction will arise from piling, excavation and leveling works, operation and movement of construction equipment, and operation of offices and workers' camps. Potential environmental impacts during construction include fugitive dust, noise, vibration from piling installation and wastewater generation from construction activities and offices. Potential safety and social issues include workers' camps, disruption of traffic and utilities, and risks to health and safety of the workers and nearby communities. These impacts are short-term and localized and can be effectively mitigated through good construction practices which includes appropriate phasing/scheduling of construction activities; soil and spoil management; dust control; selecting low noise equipment and regular maintenance of equipment to minimize noise generation; onsite sewage treatment facilities, sanitation facilities and waste bins to manage waste and wastewater from construction activities and operation of offices and workers' camps; and implementation of occupational and community health and safety practices. The proposed construction activities will not affect any natural habitats, protected areas, critical habitats or endangered species.

Operation Phase. Potential impacts during operation include noise, waste and waste water generation, poor ventilation under the train stations resulting in dust and higher CO or NO₂, and threats to public safety resulting from emergencies and accidents. Measures that will be adopted to mitigate potential impacts during operation include the availability of waste bins and coordination with the district offices of Bangkok Metropolitan Authority (BMA) for regular collection and disposal of wastes in compliance with applicable sanitary principles, regular maintenance checks on septic tanks and onsite treatment plants and installation of high-pressure spray nozzles and/or fans under the stations. The monorail trains are designed to operate with rubber tires and nave plates covering the wheel. Regular maintenance of the monorail system, regular noise monitoring during operation phase, and installation of noise absorptive materials under stations where noise monitoring results are beyond the applicable noise standard will ensure that noise exceedances will be kept to a minimum. A safety and occupational health management plan based on international standards; and safety measures in the train station will be implemented. An operation plan for the train operation will be developed to ensure safe and efficient transport.

V. Environmental Management Plan

Potential impacts during the pre-construction, construction and operation phases were identified and presented in Table EMP - 1,

Table EMP - 2, and

Table EMP - 3, respectively.

!

Table EMP - 1. EMP SUMMARY TABLE – PRE-CONSTRUCTION PHASE

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
1	Siting	Potential loss of land and assets	<p>Public consultation has to be organized to inform affected persons about the project, e.g. project details, expected benefits, procedure/methods of expropriation, as well as rights and duties of affected persons at least 18 months before the construction starts.</p> <p>The royal decree on land demarcation for acquisition will identify the starting-ending points and width of the area boundaries under the royal decree.</p> <p>The royal decree will be posted at different places, e.g. offices of officers, the Bangkok City Hall and the Samut Prakan City Hall, the Land Office of the BMA and its branches, the Samut Prakan Provincial Land Office and its branches, the Chatuchak/Huay Kwang/Wang Thonglang/Bang Kapi/Suan Luang/Prawet/Bang Na District Offices, and the Samut Prakan District Office.</p> <p>Survey of property to expropriate (such as land, structures, and crops) – Acquisition officers will inform the property owners of the date of survey in writing at least 15 days before the survey.</p> <p>A Committee for Appraisal of Land, Property, and Tree Compensation Costs will be formed consisting of representatives of affected persons and local community leaders in affected areas, who will participate in considering and establishing criteria for paying property replacement cost.</p> <p>The property compensation cost should be fair, reasonable, and acceptable to affected persons.</p> <p>The issuance of the Immoveable Property Expropriation Act to transfer the ownership of the property to the government.</p> <p>The issuance of the Eviction Act and the Ministerial Regulations on Eviction of the MRTA.</p>	Areas along the Pink Line and Yellow Line route which will be affected by land acquisition.	MRTA	Operator or Concessionaire		
2	Design of route/alignment, stations, depots and park & ride buildings	Loss of trees and vegetation cover	Coordinate with the agencies concerned in Bangkok, such as District Office of Lat Phrao, Wang Thonglang, Bang Kapi, Suang Luang, Prawet and Bang Na, in Samut Prakan province, namely Samrong Nuea Municipality and Thepharak Administrative Organization; Nonthaburi City Municipality; and Pak Kret City Municipality to discuss about the construction guideline and setting the construction areas to limit the expected effect on trees.	Construction areas for the elevated guideways, MRT stations, depots and park & ride buildings	MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			Survey and estimate the number of trees to be cut down during the project operation and those to be removed from the project area and replanted in specially prepared areas.					
		Impacts from geological conditions and earthquake	<p>The elevated guideways and elevated structures of the MRT stations will be designed according to AASHTO standards with the Acceleration Coefficient (0.075) and Site Coefficient (S) of 1:50 to 2:00</p> <p>Design the settlement modification structure for unbalanced settlement and to include the construction covering the foundation of elevated route line which overlaps with the existing road surface.</p> <p>The Depot and Park & Ride buildings are concrete buildings that will be designed according to the Ministry of Interior "Load resistance and durability of building ground for building vibration resistance of earthquake 2007" issued under the Building Control Act 1979.</p> <p>Use of seismic buffers or stoppers on the superstructure above the column heads for structures that are prone to vibration.</p>	Construction areas for the elevated guideways, MRT stations, depots and park & ride buildings	MRTA, External Environmental Compliance Auditor	Contractor		
		Flooding of low lying sites	<p>The design depot and park & ride building at Rom Klao intersection will include two water retention ponds with a minimum capacity of 5,541.66 m³ for the Zone A retention pond and a capacity of 9,775.91 m³ for the Zone B retention Pond.</p> <p>Installation of 3 sets of pumps (2 on duty, 1 on stand by) for each zone in the depot</p> <p>The design of drainage structures of the elevated guide way on Srinagarindra Road shall remove all water so it does not accumulate on the road surface.</p>	Construction areas for the elevated guideways, MRT stations, depots and park & ride buildings, particularly in Rom Klao intersection (Pink Line) and Srinagarindra Road (Yellow Line)	MRTA, External Environmental Compliance Auditor	Contractor		
		EMP not implemented in all project construction sites.	<p>All environmental impact prevention and mitigation measures and environmental monitoring measures as suggested in the Environmental Impact Assessment (EIA) Report stipulated by the Expert Review Committee will be strictly followed. These commitments will be included as conditions in all contracts for design, construction and project management services.</p> <p>Supervision measures will be put in place for all contractors providing construction drawings and/or construction and project management services to comply with the environmental impact</p>	Construction areas for the elevated guideways, MRT stations, depots and park & ride buildings	MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			prevention and mitigation measures and environmental monitoring measures as suggested in the EIA Report.					
		Disruption to services during relocation of public utilities	<p>Request approval for the construction schedule and breakdown construction schedule.</p> <p>Inform the starting date of the project and coordinate with relevant public and private agencies in Bangkok Metropolitan, Samut Prakan, Nonthaburi City Municipality; and Pak Kret City Municipality areas. This must comply with conditions specified by the agencies.</p> <p>Relocation of utilities must be strictly based on methods of the MWA and other authorities.</p> <p>Appoint the Employment Screening and Supervision Committee of the MRTA and provide the contractor with the list of committee members. After that, the contractor will submit the list of personnel to the MRTA for approval before initiation of construction. These personnel consist of project engineers, representatives of employees, as the representatives with the full authority to implement the project, field managers, foremen, pipe technicians, welders, etc.</p> <p>Conduct PR activities before the construction – The contractor must install different signage, which consist of information signs, construction signs, and traffic signs. The contractor must post all signs 15 days before implementation of construction.</p> <p>Install fences that are at least 2 m high or equivalent to mark the boundary of the areas where public utilities must be relocated.</p> <p>Request approval for traffic management plans - Culvert construction and jacking are usually carried out on the main roads. Although making long grooves using traditional methods is not allowed, activities in the construction process, including relocating machinery and transporting pipes, usually disturb local traffic flows.</p> <p>Relocation of utilities must be strictly based on methods of the MWA and other authorities.</p>	Areas along the route of the elevated guideways and site of MRT stations, depots and park & ride buildings with public utility lines under and/or above ground.	MRTA, External Environmental Compliance Auditor	Contractor		
		Impact to Aesthetics	The detailed design for the stations will involve sustainable urban design, and harmony with the existing environment. It will involve modern, yet simple engineering and architectural forms to reduce impacts and enhance aesthetics and views at metro stations.	Construction areas for the elevated guideways, MRT stations, depots and park & ride buildings	MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
3.	Institutional Strengthening	Occupational, health and safety risks	<p>A safety committee will be established to formulate policies towards safety at work within construction areas, by developing the construction schedule and safety measures, supervising staff and construction workers to ensure their compliance with safety rules or laws, investigating the causes of accidents, and provide training in prudent work practice to all staff.</p> <p>Preparation of construction workers' manual detailing measures for occupational, health and work environment for construction including safe machinery operation.</p> <p>Preparation of Fire Prevention and Control Plan, including inspection, training, and campaign on fire prevention, firefighting, evacuation and relief, in accordance with the guidelines set by the Occupational Safety Bureau, Department of Labor Protection and Welfare.</p>		MRTA, External Environmental Compliance Auditor	Contractor		

Table EMP - 2. EMP SUMMARY TABLE – CONSTRUCTION PHASE

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
1	Construction site development/preparation: <ul style="list-style-type: none"> • Land acquisition • Stripping works and land clearing and grading • Relocation of public utilities 	Generation of dust	<p>A 2-meter high solid fence will be installed along the construction boundary and revolving warning lights placed every 30 meters along the construction area before construction begins.</p> <p>Water will be sprayed on existing road surfaces at least 3 to 4 times a day in the construction site.</p> <p>Removal of construction materials and excavated soil as soon as possible or within 24 hours.</p> <p>At least 3 to 4 staff members will be assigned to clean the construction area at the end of the day to prevent dust from spreading beyond boundaries of the construction site.</p> <p>Covering material piles in construction areas and trucks carrying excavated materials.</p>	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor		
		Emissions from vehicles and equipment	Establish a unit to control, maintain or check the condition of engines and machines used for construction at least once a week to prevent emissions of dust (TSP, PM _{2.5} and PM ₁₀) and CO, NO _x , and SO ₂ .	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor		
		Generation of sediments from construction runoff or rainfall	<p>Major activities, such as relocating public utilities, land levelling and soil excavation, will be implemented during the dry season to avoid soil erosion problems during the rainy season (May to November).</p> <p>Conduct inspection of drains/pipes to ensure that sand or construction materials are not blocking the drainage.</p> <p>Provision of a stormwater collection system to ensure that stormwater contaminated with construction wastes will not flow into nearby water bodies.</p>	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor		
		Generation of construction wastewater	<p>Two septic tanks, with a capacity of 6 m³ each, will be installed to treat construction wastewater.</p> <p>An area will be designated for re-fueling and washing and cleaning of construction equipment/vehicles which will be at least 100 m from surface water sources.</p>	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor		
		Noise and vibration from site preparation activities, movement of vehicles and use of equipment	<p>Two-meter high concrete walls and metal sheet will be installed in each construction site.</p> <p>Use tools, equipment and machines that do not produce loud noise or use noise abatement equipment, such as sound isolation</p>		MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>cover, if the noise level at the source exceeds 90 dB(A) for one hour. Provide protective hearing equipment to all workers.</p> <p>Use of rubber floor instead of steel plate for building temporary road to reduce noise.</p> <p>Assign at least 3 to 4 staff members to control, maintain or check the machines, equipment and vehicles used for construction to ensure that these are in good condition throughout the construction phase to keep the noise level within the standard limit.</p> <p>Implement a speed limit of 30 kilometers per hour (kph) for trucks carrying construction materials when passing sensitive communities, residential areas and commercial areas, healthcare facilities, schools/educational institutes and religious sites such as temples, mosques and churches during school periods, religious practice such as morning and evening prayers (Buddhism and Islam), and resting times.</p> <p>Construction activities, e.g, stripping works, land clearing, grading and excavation works will only take place between 8 a.m. to 6 p.m. This excludes removing the pillars/concrete slab/guideway or removal of unused construction scraps which must be done at night, between 7 p.m. to 9 p.m. to reduce the traffic jams in the area.</p>					
		Soil instability/erosion from exposed soil surfaces	<p>Major activities, such as relocating public utilities, land levelling and soil excavation, will be implemented during the dry season to avoid soil erosion problems during rainy season (May to November).</p> <p>Build earth embankment to prevent soil erosion because of stripping.</p>	<p>Buildings and structures near the rail system including schools, communities and hospitals</p> <p>Utilities near the sidewalks along both sides of the street.</p>	MRTA, External Environmental Compliance Auditor	Contractor		
		Generation of spoils	<p>Excavated soil will be removed from construction area and stored in a MRTA-designated area.</p> <p>Spoils will be transported in covered trucks to MRTA-approved fill areas.</p>	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor,		
		Generation of construction waste	Removal of construction materials and piles of soil from the construction area within 24 hours. Some types of materials, such as wood, can recycled for use during construction and some can be sold for recycling. The rest of the construction wastes will be transported to a government-approved landfill.	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor, BMA		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>General solid waste (e.g., food, waste paper and other domestic waste from the consumption of construction workers) will be collected in container provided by the BMA, or alternatively project staff can coordinate with the BMA to collect the waste for disposal. The general solid waste in Bangkok will be collected and transported to three waste transfer stations, namely the Sai Mai Waste Transfer Station, the Nong Khaem Waste Transfer Station, and the On Nut Waste Transfer Station. From there waste will be transported for disposal to the landfill in Kamphaeng Saen District, Nakhon Pathom Province and the landfill in Phanom Sarakham District, Chachoengsao Province. Organic waste will be used to make compost at the On Nut Fertilizer Plant.</p> <p>Infectious and hazardous waste will be transported and disposed of by third party approved waste handlers at a BMA approved location.</p>					
		Loss of trees and vegetation cover	Use laborers or machines to remove (dig around) the large and important trees (with the diameter at breast height DBH > 10 cm.) from the project area before the construction phase. Trees will be transferred to prepared areas, such as empty space along the project route or inside the depot. The types and number of each tree must be recorded. The workers are allowed to cut down diseased or degenerated trees and disposed of appropriately.	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor		
		Occupational and community health and safety risks	<p>Staff and workers will wear personal protective equipment (PPE) to protect them from dust or pollutants such as CO, NO_x and SO₂ if they work in construction areas where the machines spread the dust or pollutant, especially land excavation, foundation excavation, relocation or removal of construction scrap or concrete mixing.</p> <p>Staff and construction workers are required to use personal protective equipment at all times while operating within the construction areas to prevent hazard and accidents at work, such as hardhats, steel-toed boots, gloves, high visibility vests, dust mask, ear muffs, or earplugs. Workers will be trained in the application and use of all PPE.</p> <p>Sufficient clean drinking water (5 liters/worker/day) and wash water for washing (50 liters/worker/day) will be provided for staff and construction workers working within construction areas or project offices.</p> <p>Sufficient bathrooms-toilets (1 bathroom/toilet/10 people) equipped with a septic tank system will be provided within the project office. Portable toilets will be provided where needed.</p>	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
		Community health and safety risks	<p>Appropriate waste containers will be provided in the construction areas and project offices and coded by color: containers for wet waste (green), containers for dry waste (yellow), and containers for hazardous waste (red or orange).</p> <p>Workers will be provided with temporary shelters for daytime rest in construction areas.</p> <p>Workers will be trained in how to properly use and maintain tools, machinery and devices and to ensure that they are always usable. If any of them is damaged, prompt repair will be taken to prevent accidents.</p> <p>Signage will be provided that indicates the boundary of all construction sites. A public relations program will be carried through several media outlets, particularly in the case when sections on Lat Phrao, Srinagarindra and Theparak Roads have to be blocked for the relocation of public utilities or large construction materials and equipment, concrete beam installation, etc.</p> <p>Adequate supervision will be provided at all construction areas. Security personnel will be hired to conduct monitoring and prevent unauthorized access to active construction sites.</p> <p>Protective equipment or covers will be installed at construction sites such as the structures of elevated guide ways, stations, and other components with mesh or canvas to prevent accidents from falling construction materials or equipment, especially stone, steel, glass, concrete, cement or metal residue caused by fire from electrical welding.</p> <p>Lighting will be installed in areas under the elevated structures, the stations, and the footpaths along the existing road networks.</p> <p>Temporary footpaths and directional signage will be provided in the case when the relocation of public utilities affects public walkways.</p>					
		Traffic disruption/congestion	<p>Traffic should be diverted from roadways adjacent to construction sites to reduce the number of vehicles on the existing road network, especially during morning and afternoon rush hours. Reversible lanes will be provided to facilitate the flow for incoming vehicles, with equal capacity to the pre-construction phase.</p> <p>Designated flagpersons will be in place to direct all traffic in a safe manner balancing the needs of construction while preserving traffic flow.</p>	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor	10,000 baht per point per sampling	

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>Contractors will prepare a traffic plan aligned with the Project construction plan. The plan will be submitted to MRTA, BMA or police stations for required approval at least 30 days prior to the onset of construction in each location.</p> <p>Inform the drivers and pedestrians about construction timing, restrictions and delays via several media outlets, such as billboards, brochures, newspapers, traffic radio stations (Jor Sor 100, Sor Wor Por 91, Ruam Duay Chuay Kan), websites and TV stations. Disseminate the news and information and ask for comments and recommendations of all concerned agencies. Education in schools is recommended to inform children of construction site and traffic risks.</p> <p>Provide adequate signage will be provided advising drivers of all detours, bypasses or diversions allowing them to use alternative routes. Traffic signs and control measures must be set up at least 1 km from each active construction site.</p> <p>Trucks transporting materials and equipment for construction will strictly comply with traffic rules and speeds will be restricted to 30 km/hr in all community areas or sensitive locations, such as temples/religious places, educational institutions, and health facilities.</p> <p>Traffic control measures will be coordinated with police authorities to facilitate smooth traffic flows, the safety of pedestrians and to reduce air pollution caused by traffic jams.</p>					
		Disruption to services during relocation of public utilities	<p>Public utility works will be coordinated with the construction schedule and traffic management plans.</p> <p>Preparation of demolition plan for public utilities and facilities that will be affected by the construction activities in accordance with a public utility and facility system construction plan and propose it to BMTA and relevant organizations for approval 30 days before demolishin public utilitis and facilities.</p> <p>The onset of construction time should be coordinated with relevant public and private agencies in Bangkok Metropolitan and Samut Prakan areas. Works must comply with conditions specified by the agencies.</p> <p>An Employment Screening and Supervision Committee of the MRTA will be appointed and the Contractor provided with the list of committee members. The contractor will submit the list of personnel to the MRTA for approval before the construction. These personnel consist of project engineers, representatives of</p>	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor		<p>Pre Construction:</p> <p>A survey conducted by field interviews. By using the Simple Random Sampling. For selecting sample group enterprise service infrastructure.</p> <p>Indexes - Throughout the relocation/change of public utilities for a phase of two years.</p>

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>employees, as the representatives with the full authority to implement the project; field managers, foremen, pipe technicians, welders, etc.</p> <p>Public Relations activities will be conducted before the onset of construction – The Contractor will install signage, which consists of information signs, construction signs, and traffic signs. Signage must be installed 15 days before initiation of construction. Traffic flows will be maintained to the best extent possible.</p> <p>Solid fences, at least 2 m in height, will be installed to mark the boundary of the areas where public utilities are to be relocated.</p> <p>All water lines will be relocated based on methods of the MWA and other authorities.</p> <p>Relocation of public utilities and facilities such as water pipes, drains, high-voltage power transmission towers, overhead power lines and electrical equipment, telephone conduits and traffic signs will be carried out during 9:00 pm but not later than 5:00 am of the next day.</p> <p>All vehicles used for transporting utility equipment will be covered in mesh or canvas to prevent them from falling onto the road surface. Vehicle speeds will not exceed 30 km/hour in construction areas.</p> <p>Temporary footpaths and signage will be provided to allow for safe passage of pedestrians around active construction sites. If there is a complaint from the public or road users that 'the relocation of public utilities' has caused trouble and nuisance or caused damage to existing public utilities, corrective actions will be urgently taken in accordance with the Project Grievance Resolution Mechanism.</p> <p>Restore road surface, footpaths, road side, trees, and grass that are damaged by the relocation of public utilities according to standard requirements identified in drawings or per owner request so that sites are returned to original conditions. Before and after photos will assist in this process.</p>					<p>Budget: 250,000 baht/year, total 500,000 baht</p> <p>Agency in charge - Mass Rapid Transit Authority of Thailand. (MRTA)</p>
		Loss/relocation of cultural resources and impact to aesthetics	<p>Install solid fences at least 2m in height to define the boundary of construction sites; provide signage that identifies the boundary of construction areas and show a rendering of the completed Project in future. This will reduce the impact of construction disturbance.</p> <p>Avoid creating unsightly views within the construction areas by, for example, leaving garbage outside the waste containers, disorderly placement of construction equipment and material waste, or leaving them without plastic or canvas covers.</p>	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.	MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
		Flooding of low lying construction sites	<p>Filling and levelling of low lying and flooded sites up to 1.5 meters above sea level (masl) using excavated soil.</p> <p>Provision of drainage system, gutters and sedimentation ponds of sufficient capacity to accommodate stormwater before discharging into public drainage system and to prevent flooding in construction areas and nearby areas.</p>	Construction sites in lowland and flooded soils	MRTA, External Environmental Compliance Auditor	Contractor		
		Temporary land occupation	<p>The issuance of the Eviction Act and the Ministerial Regulations on Eviction of the MRTA Construction activities must be implemented in the construction site, depot and park & ride buildings only.</p> <p>A specific area will be provided to store construction materials so that they are well organized and not piled up outside the construction area.</p>	Construction sites for the elevated guideways, MRT stations, depot and park & ride buildings.				
		Complaints from communities and/or affected persons	<p>The project outline must be publicized through the Bangkok Metropolitan Administration local agencies (District offices) or municipalities at least 30 days in advance. The local agencies will further publicize this through community leaders, who will inform community members.</p> <p>An information and complaint center will be established at the project office, to receive project information or complaints from affected people. Signage will be provided which contains a phone number, e-mail address, and contact information 24 hours a day.</p> <p>If any complaints are sent to the information and complaint center, the contractor has to assign relevant staff to investigate the damage and has to be responsible for the damage cost on a fair and reasonable basis or on the actual basis.</p> <p>A mobile mass relations unit will be established to carry out public relations activities on a periodic basis and to create a positive understanding between the contractor and local communities near the construction areas. This unit has to publicize information about the characteristics and steps of the construction process, the disaster prevention system, and the monitoring system to avoid impacts.</p> <p>MRTA must provide a mass relations unit, which will participate in activities within local communities along the construction areas to create familiarity and acceptance by local people.</p>		MRTA, External Environmental Compliance Auditor	Contractor, MRTA		<p>Socio-economic survey to be conducted once a year throughout the construction phase, each consisting of at least 500 sets of questionnaires.</p> <p>Budget: 300,000 baht/time Agency in Charge: MRTA</p>
2	Construction of:	Generation of dust	A 2-meter high solid fence will be installed along the construction boundary and revolving warning lights placed every 30 meters along the construction area boundary before construction begins.	Construction sites for the elevated guideways, MRT	MRTA, External Environmental	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
	<ul style="list-style-type: none"> Elevated guideway and MRT stations depot, park and ride building, and other facilities for the operation and maintenance of the monorail power rails, TPSs and substation 		<p>Use of ready-mixed concrete.</p> <p>Water will be sprayed on existing road surfaces at least 3 to 4 times a day in the construction site.</p> <p>Bare and open area for material storage will be covered with gravel, crushed stone, canvas or ground cover.</p> <p>All construction materials and excess spoil will be removed from the construction area within 24 hours.</p> <p>At least 3 to 4 staff members will be assigned to clean the construction area at the end of the day to prevent dust from spreading beyond boundaries of the construction site.</p> <p>Small mesh nets or canvas will be used to cover or separate the station entrance or exit to prevent dust impacts caused by the construction.</p>	stations, depot and park & ride buildings.	Compliance Auditor			
		Emissions from vehicles and equipment	<p>A unit will be established to control, maintain and check the condition of engines and machines used for construction at least once a week to prevent emissions of dust (TSP and PM₁₀, PM_{2.5}), CO, NO_x, and SO₂.</p> <p>A wheel cleaning area will be established to wipe, clean or remove dirt or mud in tires every time vehicles leave the construction area at the elevated guideway and MRT stations.</p> <p>A designated area for washing mud, cement or sand of tires will be provided to prevent materials being deposited on the road surface outside of construction areas.</p>					
		Generation of construction wastewater/runoff	<p>Temporary solid fencing, at least 2 meters high, will be installed around the construction area to prevent sediments from flowing into canals, wetlands and surface water.</p> <p>Double sheet piles will be installed in construction areas near surface water to prevent erosion or movement of soft ground.</p> <p>A net or canvas cover will be installed under the construction of elevated guideway and MRT stations that are less than 50 meters from surface water bodies.</p> <p>An area will be designated for refuelling and washing and cleaning of construction equipment and vehicles which will be at least 100 m from surface water.</p>	Construction sites for the stations and elevated guideways that are less than 50 meters from bodies of water (Lat Phrao 101, Kalantan, Suan Luang Roy 9, Khlong Bang Talat, Khlong Prapa, Khlong Prem Prachakon, Khlong Thanon/Khlong Bang Bua and Khlong Song Ton Nun)	MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>Two septic tanks will be installed, with a capacity of 6 m³ each, to treat construction wastewater.</p> <p>Temporary sedimentation tanks will be constructed south of the depot construction area with over 5,100 m³ capacity and temporary gutters will be built to prevent sedimentation from construction run-off or rainfall from flowing into surface water, canals or wetlands.</p> <p>Construction of temporary drainage ditches, 0.60 x 0.60 m² and 2 sediment traps at the end of temporary drains around the construction area of the depot and park & ride building at Rom Klao intersection (Pink Line).</p> <p>Construction stockpiles will be located away from surface water bodies or canals.</p> <p>Construction equipment or tools will not be stored in areas that obstruct water flows.</p>	South of Yellow Line depot construction area				
		Noise from construction activities, movement of vehicles and use of equipment.	<p>Two-meter high concrete walls and metal sheet will be installed as required in each construction site.</p> <p>Tools, equipment and machines will be used that do not produce loud noise, or noise abatement equipment shall be used, such as sound isolation cover, if the noise level at the source exceeds 90 dB(A) for one hour.</p> <p>The contractor will assign at least 3 to 4 staff members to control, maintain or check machinery, equipment and vehicles used for construction to ensure they are in good condition throughout construction to maintain noise levels within the standard limit.</p> <p>Trucks carrying construction materials will be restricted to a speed limit of 30 kph when passing sensitive communities, residential areas and commercial areas, healthcare facilities, schools/educational institutes and religious places such as temples, mosques and churches during school periods, religious practice such as morning and evening prayers (Buddhism and Islam), and resting times.</p> <p>Construction will start from 8 a.m and conclude at 6 p.m.</p> <p>Major construction activities such as foundation excavation of elevated guideways and MRT stations and cementing of the piers of elevated guideway and the floor of MRT stations will not be done between 9 pm and 5 am of the following day to avoid</p>	Vulnerable areas along the project route within 30 meters from the center line of the route within the Right of Way	MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>disturbing the communities within the existing road network. This excludes removal of pillars/concrete slab/guideway or removal of unused construction scraps which must be done at night, between 7 p.m. to 9 p.m. to reduce the traffic jam in the area.</p> <p>The contractor must install the sound absorptive materials under 4 MRT Yellow Line stations, namely Phawana, Chok Chai 4, Lat Phrao 101 and Samrong.</p>					
		Vibration from construction activities, movement of vehicles and use of equipment.	<p>The detailed design and construction of the elevated guideway, MRT stations, depot, and park & ride buildings must be able to safely absorb the vibration of earthquake or other geological event in compliance with the the Ministry of Interior regulation B.E. 2554 on weight bearing, the durability of building and resistance to earthquake vibration which is issued in compliance with the Building Control Act, B.E. 2522.</p> <p>Prior to any construction activities that could create vibration to households and properties, civil engineer/structural engineer will inspect and record current conditions.</p> <p>During the foundation construction to support the elevated guideway and MRT stations, sheet piles will be installed 18 meters deep in the soft to medium clay layer to help reduce vibration and prevent disturbance to the existing road network, especially near the sensitive areas along the route.</p> <p>Construction that will cause vibration such as foundation excavation to support the elevated road, MRT stations, depot and park & ride buildings, can start at 8 am and finish no later than 6 p.m. to avoid disturbing communities' daily activities, religious practice such as morning and evening prayers (Buddhism and Islam), and resting times.</p> <p>If construction activities continue to cause vibration, especially foundation excavation, it will be necessary to reduce the energy used for the pier excavation and increase the frequency of excavation to reduce the vibration.</p> <p>Ensure that the vehicles transporting materials and equipment strictly follow the traffic law and speed limit of 30 kph and contain a load under 25 tons in residential or commercial zones, or sensitive areas such as healthcare facilities, schools/education institutes or religious places namely temples, mosques and churches.</p> <p>In case of complaints made by landlords of buildings or commercial buildings near the construction areas of elevated guideways and MRT stations, civil engineers must be sent to inspect and analyze the damage and urgently find the solution.</p>	<p>Construction site for the elevated guideways, MRT stations, depot and park and ride building.</p> <p>Sensitive areas for the Yellow Line: Suan Luang Church, Chularat 2 Hospital and Chulavej Hospital</p> <p>Sensitive areas for the Pink Line: Business Administration Technological College (SBAC), Boromarajonani College of Nursing, Central Chest Institute of Thailand, Saman Pichakorn School, Quartermaster Department Royal Thai Army, Cholaprathan Songkro School, Sri Sangwan School, Khlong Klua School, Apakorn Kindergarten, Charoenphol Wittaya School, Phranakhon Rajabhat University, Wat Phrasimahathat Secondary Demonstration School, The Constitution Protection Monument and Synphaet General Hospital</p>	MRTA, External Environmental Compliance Auditor	Contractor	18,000 baht per point per sampling	

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			Construction plans will be promoted at least 3 months in advance to affected persons over a duration of 15 days.					
		<p>Erosion from construction sites</p> <p>Movement of soft clay layer</p> <p>Generation of spoils</p>	<p>Piling and excavation works are to be conducted during the dry season.</p> <p>For the construction of elevated structures and stations, replace the volume of soil dug in construction areas located along mild to moderate soft clay to a depth of about 18 meters if drilling circular bored pile or barette pile which is 1.5 meters to 1.8 meters in diameter.</p> <p>Use of steel sheet piles around construction area where piling is required and in construction areas near surface water bodies or with loose soil.</p> <p>For the construction site of the depot and park and ride building replace the volume of soil dug out with the maximum height of 15 meters (2-storeys) along mild to moderate soft clay to a depth of about 18 meters to 20 meters if drilling circular bored pile from 0.35 m in diameter.</p> <p>Use materials such as polymer slurry to increase the side force friction between the bored pile and sand layer to prevent soil erosion, stabilize the bore hole and prevent disturbance to groundwater.</p> <p>Excavated soil piles will not be allowed in the construction site.</p> <p>Spoil material will be transported in covered trucks to MRTA-approved fill areas.</p> <p>After excavation and land filling, disturbed areas will be compacted and revegetated to prevent erosion.</p>	Construction site for the elevated guideways, MRT stations, depot and park and ride building.	MRTA, External Environmental Compliance Auditor	Contractor		
		Generation of solid wastes	<p>Construction materials and soil piles will be removed from the construction area within 24 hours.</p> <p>Solid waste (general waste and construction waste) will be collected and deposited in containers provided by the BMA, or project staff can coordinate with the BMA to collect the waste for disposal. Solid waste will then be transported to three waste stations, namely the Sai Mai Waste Transfer Station, the Nong Khaem Waste Transfer Station, and the On Nut Waste Transfer Station.</p>	Construction site for the elevated guideways, MRT stations, depot and park and ride building.	MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>General solid waste, e.g., food waste, paper waste and other wastes from construction workers' consumption, will be transferred to the landfill in Kamphaeng Saen District. Nakhon Pathom Province and the landfill in Phanom Sarakham District, Chachoengsao Province. Some organic waste will be used to make compost at the On Nut Fertilizer Plant.</p> <p>Construction material wastes, e.g., cement waste, wood waste, wire and other metal scraps, will be recycled.</p> <p>Infectious and hazardous waste will be transported and disposed of by third party approved waste handlers at a BMA approved location.</p>					
		Loss of vegetation from cutting/removal of trees (over 10 meters in height) to be obstructed by construction	<p>Sufficient additional soil material must be provided when replanting trees to ensure their survival.</p> <p>All excavation will be conducted in such a way to avoid damaging nearby trees.</p> <p>The Project may ask for planting advice or saplings from BMA, Samut Prakan province, Royal Forest Department and National Park, Wildlife and Plant Conservation and Department. The selected types of trees and plants should be suitable for an urban location, and not obstruct the view during operations.</p> <p>For example, climbing plants should be selected, such as medium or heavy vines, to soften the look of of elevated guide way or MRT stations and to increase green areas. Small gardens, if possible should be arranged in areas under the MRT stations and elsewhere along the route of each line.</p> <p>Trees should be placed in scarified soil, fertilized and weeded.</p>	Construction site for the elevated guideways, MRT stations, depot and park and ride building.	MRTA, External Environmental Compliance Auditor	Contractor		
		Occupational health and safety risks	<p>Staff and workers will wear proper PPE to protect them from dust or pollutants such as CO, NO_x and SO₂ particularly in areas of land excavation, foundation excavation, relocation, removal of construction waste and concrete mixing.</p> <p>Staff and construction workers are required to use PPE at all times while operating within construction areas to prevent workplace hazards and accidents, including hardhats, steel-toed boots, gloves, dust mask, and hearing protection.</p> <p>The contractor must strictly comply with measures for preventing and mitigating impacts on air quality during construction.</p>	Construction site for the elevated guideways, MRT stations, depot and park and ride building.	MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>Workers in construction areas for 8 to 10 consecutive hours must wear protective hearing equipment.</p> <p>Workers in construction areas for at least 15 consecutive days must be rotated.</p> <p>Sufficient clean drinking water (5 liters/worker/day) and wash water (50 liters/worker/day) must be provided to all workers throughout the construction site.</p> <p>Sufficient bathrooms-toilets (1 bathroom/toilet/10 people) which are equipped with a septic tank system will be provided within the project office.</p> <p>Appropriate waste containers will be provided in the construction areas and project offices and coded by color: containers for wet waste (green), containers for dry waste (yellow), and containers for hazardous waste (red or orange).</p> <p>Workers will be provided with temporary shelters for daytime rest in construction areas.</p> <p>A safety committee will be established to formulate policies towards safety at work within construction areas, by developing the construction schedule and safety measures, supervising staff and construction workers to ensure their compliance with safety rules or laws, investigating the causes of accidents, and provide training to all staff in prudent work practices.</p> <p>Workers will be trained in how to properly use and maintain tools, machinery and devices and to ensure that they are always usable. If any of them is damaged, prompt repair will be taken to prevent accidents.</p> <p>Workers are required to use personal protective equipment at all times while operating within the construction areas to prevent workplace hazards and accidents such as helmets, gloves, dust mask, ear muffs, or earplugs.</p> <p>Signage will be provided to indicate the boundary of the construction site and conduct a public relations program through media outlets, particularly for sections on Lat Phrao, Srinagarindra and Theparak Roads that have to be blocked for the relocation of public utilities, or large construction materials and equipment, concrete beam laying, etc.</p> <p>Adequate supervision will be provided at all construction areas.</p>					

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
		Community health and safety risks	<p>Security personnel will be hired to conduct monitoring and prevent unauthorized access to active construction sites.</p> <p>Install mesh or canvas to prevent material waste, noise walls, sound barriers, and water traps; keep material waste away from the road surface; ensure safety of people concerned and local people who travel past the construction areas. If any complaints are sent to the information and complaint center, the contractor will assign relevant staff to investigate the damage and has to be responsible for the damage cost on a fair and reasonable basis, or on the actual basis.</p> <p>Use precast concrete that is produced and mixed outside the construction site to prevent and mitigate potential impacts to surrounding communities.</p> <p>Assign at least 3 or 4 staff to clean the existing road network where the elevated guideway or MRT stations are constructed. The cleaning should be conducted during the night time at least 4 days a week starting midnight to 3 am the following day.</p> <p>Install lighting in areas under the stations and footpaths along the existing road networks to illuminate the road surface. The illumination should be at least 21.50 lux, and similar to natural lighting as much as possible to prevent accidents.</p> <p>If there are construction activities that will block travel on the footpaths, provide temporary pedestrian walkways and install directional signage to ensure the safety of transit users.</p>					
		<p>Traffic disruption/congestion due to construction activities</p> <p>Disruption to services</p> <p>Damage to existing roads.</p>	<p>Traffic control measures will be coordinated with police authorities to facilitate smooth traffic flows, the safety of pedestrians and to reduce air pollution caused by traffic jams.</p> <p>Offer options, e.g., route options and use of public transportation, for passengers to reduce number of vehicles on the existing road networks during the construction phase.</p> <p>Provide adequate signage will be provided advising drivers of all detours, bypasses or diversions allowing them to use alternative routes. Traffic signs and control measures must be set up at least 1 km from each active construction site.</p> <p>Pier foundations of elevated guideways will be designed to adjust the differential settlement between the project structures and the road.</p> <p>Install a structure to cover the pier foundations of elevated guideways and MRT stations that overlaps with the road surface to provide additional space in case of differential settlement when the</p>	Construction site for the pier foundations of the elevated guideways and MRT stations.	MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>road and pier foundation moves vertically which will avoid damages to road surface.</p> <p>Removal of the pillars/concrete slab/guideway or removal of unused construction scraps must be done at night, between 7 p.m. to 9 p.m. to reduce traffic jams.</p> <p>Improve the road surface on the existing road networks under the structures of elevated guide way and stations and associated areas to ensure its evenness. After construction is complete, clearly mark and repaint the boundary of traffic lanes.</p>					
		<p>Flooding of low lying construction sides due to obstruction from construction materials and wastes</p>	<p>Contractors will provide 2-3 construction workers regularly stationed at the construction site to remove construction wastes, such as dirt, stone, sand, and cement falling in the construction areas or on the road surface on a daily basis to prevent obstruction of drainage.</p> <p>If there are leftover materials from construction, they will be removed from construction areas as soon as possible, or within 24 hours to prevent obstruction to natural water flows, especially during the rainy season.</p> <p>Construction material will be stored in locations that do not obstruct water flowing into canals, wetlands and surface water bodies during the rainy season, e.g. Nam Kaeo Canal, Bang Sue Canal, Lat Phrao Canal, branch canals of Yai Phuean Canal, Saen Saeb Canal, Hua Mak Canal, Ban Ma Canal, Prawet Burirom Canal, Khlet Canal, Khlong Bang Talat, Khlong Prapa, Khlong Premprachakorn, Khlong Tanon/Khling Bang Bua, and Khlong Song Ton Nun.</p> <p>Provide appropriate drainage system, gutter and sump to manage rain water.</p> <p>Provision of pumps for pumping out water from flooded areas due to the construction project.</p>	<p>Construction site for the pier foundations of the elevated guideways and MRT stations, particularly in Donmuang Elevated Tollway Section 1 (Pink Line) where obstructions in the waterflow may cause floods along Viphavadi Road</p>	<p>MRTA, External Environmental Compliance Auditor</p>	<p>Contractor</p>		
		<p>Complaints from communities and/or affected persons.</p>	<p>At least two security staff will be provided at each construction site to monitor the construction areas, control access and facilitate traffic during construction activities.</p> <p>If complaints are sent to the information and complaint center, Contractors will ensure the complaint is investigated for any damages and that compensation has offered on a fair and reasonable basis agreeable to the complainant.</p>	<p>All construction sites</p>	<p>MRTA, External Environmental Compliance Auditor</p>	<p>Contractor</p>		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			Public relations activities will be carried out on a periodic basis to create a positive understanding between the contractor, communities and affected persons near each construction area.					
3	Establishment and operation of construction office (s) and workers' camp (s)	Generation of domestic wastewater	<p>The workers' camp will be separate from the office, in a location that is approved by MRTA and at least 5 km from the project site, and strictly complies with the laws and regulations of local administrative offices on the residence construction, Building Control Act, B.E.2522, the regulation of the Ministry of Interior No. 55 B.E. 2543, and Engineering Institute of Thailand's Standards on temporary buildings for construction workers (EIT Standard 1010-30).</p> <p>The project office and workers' camps will have restrooms (10 people per restroom) that meet applicable sanitary standard.</p> <p>Provision of common bathing and washing areas, each with 4.8 m³ capacity.</p> <p>Provision of temporary ditches and sediment traps around the camp site.</p> <p>The project office will have 5 septic tanks with 2 m³ capacity each while the workers' camps will have 20 septic tanks with capacity of 12 m³ each to treat wastewater.</p>		MRTA, External Environmental Compliance Auditor	Contractor		
		Generation of domestic waste	<p>Eight waste bins with 0.24 m³ capacity each will be distributed in different locations in the Project Office.</p> <p>Fifty waste bins with 0.24 m³ capacity each, will be distributed in groups of 10 at different locations in the office and workers' camp.</p> <p>Waste will be collected and disposed by the District Officer under the Bangkok Metropolitan Administration (BMA) or local administrative offices in Samut Prakan province in compliance with waste disposal procedures.</p>		MRTA, External Environmental Compliance Auditor	Contractor		
		Disturbance to terrestrial ecology	<p>After the construction is completed, the workers' camps must be immediately taken apart and removed from the construction site. Restored sites will be returned to their previous condition, prior to construction. Tree planting, should be initiated as soon as possible.</p>		MRTA, External Environmental Compliance Auditor	Contractor		
		Health risks from HIV/AIDS/STIs and other communicable diseases and drug problems	<p>Workers will be informed and trained on disease prevention measures and awareness of STIs. Cooperation should be sought from local hospitals or Health Centers at the onset of construction.</p> <p>The use of drugs or alcohol at the worksite will be prohibited. Severe penalties will be imposed on all violators.</p>		MRTA, External Environmental Compliance Auditor	Contractor		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
		Conflict with adjacent communities	<p>To create benefits for local employment and acceptance to local commuters, Contractors will recruit skilled workers or unskilled construction workers from the Bangkok Metropolitan Area or Samut Prakan Province and those individuals who can show evidence that they are domiciled in the Bangkok Metropolitan Area or Samut Prakan province.</p> <p>Contractors will ensure all workers will behave in a way that does not create nuisance, trouble, or disputes with local residents or users of the existing road network.</p> <p>If complaints are received from residents near construction areas, Contractors will immediately determine the cause and take appropriate corrective action and inform the public of the result.</p>					

Table EMP - 3. EMP SUMMARY TABLE – OPERATION PHASE

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
1	Operation of the elevated guideways and MRT Stations	Generation of dust and air pollution from emissions (CO and NO ₂ among others) from exhaust of vehicles passing underneath the elevated structures and MRT stations, especially during traffic jams.	<p>Re-vegetation of the route alongside the structures with medium-sized trees, shrubs and grass,</p> <p>Coordinate with the police stations in charge of each section of the route to organize the traffic system on the existing road network under the elevated guide way and MRT stations to ensure flexibility and reduce the traffic congestion.</p> <p>Install traffic signals to inform the direction and speed limit under the train station.</p> <p>Coordinate with the Department of Land Transport, Pollution Control Department and police stations to control and ban medium and large sized trucks on the existing road network under the elevated guide way and train station during the morning rush hours (7 am to 9 am) and evening rush hours (4 pm to 7 pm); and to clearly set up the prohibited entry signs and redirect them to alternative routes to reduce the pollution caused by the exhaust, especially CO and NO₂.</p> <p>If the result of dust analysis underneath any train station yields higher value than the standard of atmospheric air quality for five consecutive days based on the announcement of National Environment Board No. 24 (B.E. 2547), a high-pressure spray nozzle will be immediately installed under the MRT stations and turned on during the morning rush hours (7 am to 9 am) and evening rush hours (4 pm to 7 pm); especially in highly populated commercial areas.</p> <p>If the result of air pollution analysis, such as CO or NO₂, yields higher value than the standard of atmospheric air quality, fans will be installed to ventilate the area beneath the MRT stations and reduce the accumulative air pollution under the MRT stations.</p> <p>Coordinate with Bangkok Metropolitan Administration (BMA) and Samut Prakan Municipality to monthly clean and vacuum the dust off the road surface.</p> <p>Set up no parking signs for all types of vehicles (except buses) under the MRT stations.</p>	Areas near the elevated structures along the route of the Pink (especially in Samakkhi Station and Phranakhon Rajabhat Station) and Yellow Lines	MRTA	Contractor, Operator or Concessionaire		
		Erosion and sediment generation from the median strip of the road where the pillar and MRT stations were built	Re-vegetation of the route alongside the structures with medium-sized trees, shrubs and grass to mitigate soil erosion and prevent sediments from getting into public sewers and public water sources.	Areas alongside the pillars in the road median, MRT stations and former construction sites.	MRTA	Contractors, Operator/Concessionaire		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
		Wastewater generation from restrooms in the stations	<p>Wastewater septic tanks with the capacity of 2 m³ will be installed in all stations</p> <p>Regular checks of septic tanks in every train station.</p>		MRTA	Operator/Concessionaire		
		Generation of waste	<p>Waste bins with lids and separated by type (trash/grabage/hazardous waste) will be available in all stations. Provide waste containers at the entrance and exit of the stations.</p> <p>Investigate the conditions of solid waste management on a regular basis.</p> <p>The Project will coordinate with the District Office under the BMA or local administrative office in Samut rakan province to ensure that collection and disposal of waste is in compliance with applicable sanitary regulations.</p>		MRTA	Operator/Concessionaire		
		Noise from the operation of the trains and from the operation of MRT stations	<p>Check the conditions and effectiveness of the materials installed along the route or under the MRT stations at least once a month. In case of damage or finding that its effectiveness decreases by more than 40%, the Project should consider replacing it immediately.</p> <p>If analysis of noise level in the operation phase under any train stations yields higher than the noise standard indicated in the announcement No. 15 of the National Environment Board B.E. 2540 (louder than 70 dB (A) for five consecutive days, the absorptive material must be installed under the MRT stations to reduce the noise level.</p> <p>For the Pink Line, contractors will complete the installation of sound absorbing materials under 2 train stations, i.e. PK04 Samakkhi and PK15 Phranakhon Rajabhat to reduce noise levels. Also, contractors will consider using sound absorbing materials of aluminum sheet with pressed fiberglass to reduce the echo from the traffic against the ceilings installed under the stations. The materials to be used for the project must have sound absorption coefficient of no less than 70% at a frequency of 400 Hz, and 80% at a frequency of 1,000 Hz.</p> <p>Replacement of noise absorbing materials if capacity to absorb noise is less than 40%.</p> <p>Set up the traffic signs, such as direction, speed limit and no honking, in the area before and after each train station.</p>	Areas under the MRT stations and areas under the route of the elevated guideways	MRTA	Operator/Concessionaire		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>Regularly check and maintain the train system, especially the wheels and guide way (or follow the manufacturers' terms) to keep them in good condition and avoid the noise problem.</p> <p>Design the guide way to ensure an eventop and side surface.</p> <p>The monorail train is designed to operate with rubber tires only. All rubber tires of the monorail trains must be strictly checked and replaced as scheduled.</p> <p>The monorail train must have the nave plates designed to cover the whole wheel to reduce the noise caused by the running train throughout the operation.</p>					
		Vibration from train operation	Inspection of the route condition including the flexibility of rubber tires, which must be strictly replaced as scheduled by manufacturers.		MRTA	Operator/Concessionaire		
		Disturbance to terrestrial ecology	<p>Control and prevent the woodcutting in the project area by coordinating with the agencies concerned in Bangkok Metropolitan Area, such as the District Office of Lat Phrao, Wang Thonglang, Bang Kapi, Suan Luang, Prawet and Bang Na; in Samut Prakan province, namely Samrong Nuea Municipality and Thepharak Administrative Organization; Nonthaburi City Municipality; and Pak Kret City Municipality.</p> <p>Maintain all planted trees and replace dead ones as necessary.</p>		MRTA	Operator/Concessionaire		
		Traffic jams and accidents along the road network underneath the MRT stations, along the route of the elevated guideways and surrounding areas.	<p>Conduct public relations activities and campaigns for encouraging those with personal vehicles to shift to the mass transit system to resolve the problems of traffic jams and air and noise pollution.</p> <p>Incentive can be implemented on a periodic basis, such as offering discounted fares during festivals, offering a monthly ticket with a discount of at least 20 percent, and waiving the fares for people aged 60 or above.</p> <p>Install non-parking signs for all types of vehicles on the existing road networks throughout the length of the stations for approximately 250 m and approximately 50 m ahead and behind the stations.</p> <p>Coordinate with related agencies, such as the Bangkok Metropolitan Administration (responsible for the Bangkok Mass Transit system) or the Marine Department (responsible for boats) to connect to other public transport systems to transport passengers with the maximum efficiency.</p>		MRTA	Operator/Concessionaire		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			Request cooperation from relevant authorities, particularly police stations with areas of responsibility along the project alignments, in order to ensure that the management of traffic on the existing road networks and connected areas will be in line with project schedules.					
		Impacts from electromagnetic emissions and power supply in the MRT electrical system.	The MRT driving system, design and installation of electrical systems will be in accordance with the requirements of the Electromagnetic Compatibility (EMC) Standard (IEC 6100).					
		Reduction of income/economic opportunities due to the operation of the MRT (e.g., businesses that will be obstructed due to the construction of the pillars.	If small establishments located near the stations are entirely or inevitably affected, they will receive special benefits such as granting them the privilege to work or do business on the stations, or entitling them to receive fair compensation and business opportunity costs.		MRTA	Operator/Concessionaire		
		Community health and safety risks	<p>Strict implementation of air quality and noise impact prevention and mitigation measures during system operation.</p> <p>There must be campaigns for encouraging the public and personal vehicle users to use the electric train to reduce air pollution and noise levels, which will reduce health problems, especially respiratory and hearing systems.</p> <p>Drivers of personal vehicles or public transport must strictly comply with traffic rules to reduce accidents, especially in areas under the MRT stations.</p> <p>Carry out a public relations program through via several media, such as billboards, brochures, newspapers, traffic radio stations (Jor Sor 100, Sor Wor Por 91, Ruam Duay Chuay Kan), websites and TVstations; and educate the public about the significance and potential impacts of air pollution from vehicles.</p> <p>Implement the impact prevention and mitigation measures for surface water quality during the operational period.</p> <p>Implement the impact prevention and mitigation measures for solid waste management.</p>		MRTA	Operator/Concessionaire		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
		Occupational, health and safety risks.	<p>Prepare a safety and occupational health management plan based on an international standard.</p> <p>Conduct at least two drills a year for the emergency action plan for safety during critical situations, such as a fire incident on the station, street level, ticketing floor, and platform; evacuation of passengers out of the station/train; stopping train operation; and provision of assistance to passengers during evacuation/train derailment.</p> <p>Provide red boundary lines, which identify areas which passengers cannot cross over when the train is coming and stopping on the platform, and prepare rough surface for the platform floor.</p> <p>Provide public insurance on the lives and property of passengers and the third party.</p> <p>Provide an annual health checkup program to all workers.</p> <p>Provide personal protective equipment for employees who are exposed to dangers and ensure that they wear the equipment every time they work.</p> <p>Provide emergency drills at least once a year, including Fire Prevention and Suppression.</p> <p>Strictly comply with air quality impact mitigation measures.</p> <p>Provide alarm buttons at the stations or platforms and signs that are clearly visible if an emergency or a fire incident happens at the station or platform and provide security staff that can reach the scene immediately.</p> <p>Provide an automatic fire alarm system and automatic fire sprinkler system at the platform and station areas.</p> <p>Provide fire extinguishers with instructions at the doors between staff rooms, cabins, and stations.</p> <p>Provide emergency stop buttons on the platform floor, which are pressed when an emergency occurs to stop the train from coming to the station when, for example, a passenger or thing falls onto the rail.</p> <p>Provide CCTV cameras at the platform and station areas, which are always monitored by staff at the control center.</p> <p>Provide evacuation routes, which connect the platform to the monorail in an emergency only.</p>		MRTA	Operator/Concessionaire		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>Provide first-aid rooms, with necessary equipment and drugs for emergency use, which must be looked after by a doctor always.</p> <p>Set up a center for coordination with other agencies located near the stations, such as hospitals, police stations, and fire stations.</p> <p>Provide training and drills for staff working on emergency prevention and security on trains and stations on a regular basis to ensure preparedness always.</p>					
2	Operation of the depot and Park & Ride Buildings	Erosion and sediment generation from the median strip of the road where the pillar and MRT stations were built	Areas around the depot and Park & Ride buildings will consist of concrete floor and fencing and ground will be covered by shrubs and trees.	Areas around the depot and Park & Ride buildings	MRTA	Contractors, Operator/Concessionaire		
		Wastewater generation from the traffic control centers, staff dormitory, canteen and train maintenance and cleaning.	<p>Construction and operation of three 50 m³ onsite treatment plants (Septic - Anaerobic Filter and Contact Aeration Process), totaling 150 m³, along with the retention pond. The wastewater from the office, control center and employee dormitory will be treated in the onsite treatment plant. The wastewater from the canteen, maintenance and train washing will flow through the oil separator, which separates the grease and oil, before running into the onsite treatment plant and finally into Khlong Khlet canal (Yellow Line).</p> <p>Construction and operation of three 100 m³ on site waste water treatment plants (Septic - Anaerobic Filter and Contact Aeration Process), totaling 300 m³, along with the retention pond for on-site treatment before discharging into public drains and into Khlong Song Tong Nun canal (Pink Line).</p> <p>Implementation of water saving measures for train wash, such as use of high pressure water jet, regular maintenance, water recycling.</p>	<p>Depot and park and ride building at Si Lam interchange (Yellow Line)</p> <p>Depot and park & ride building at Rom Klao intersection (Pink Line)</p>	MRTA	Operator/Concessionaire		
		Solid waste generation from the operation of the depot and park & ride buildings, such as the waste from cleaning of compartment interior, scraps in the office, dust from roads and foot path, material fragments	<p>Provision of 240-liter waste bins with lids (separated as trash/garbage/hazardous waste) in the depot.</p> <p>Carry out a public relations program and campaign for encouraging staff in depot and park & ride building to sort solid waste into wet and dry waste before putting it in waste containers. Glass and paper waste shall be sorted for selling to reduce the amount of solid waste. Hazardous waste, such as batteries must be put in provided waste containers.</p>		MRTA	Operator/Concessionaire		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
		from the workshop, waste from septic tank and garbage waste.	<p>Designation of staff members to collect the waste and keep these in garbage storage building until the agencies in charge can collect and dispose the wastes.</p> <p>Investigate the conditions of solid waste management on a regular basis.</p> <p>Ensure that the garbage storage building is large enough to keep the waste for at least 3 days (with capacity of 152m³).</p> <p>For the waste management, the hazardous waste, such as oil, grease and chemicals, must be kept in the dangerous goods building until the agencies in charge can collect and dispose the waste in the appropriate location, such as Samae Dam Industrial Waste Disposal Center in Bang Khun Thian, Bangkok. The building will be designed with pallet racking system and the roof so that the cranes and trucks can easily and safely collect and transport the hazardous wastes.</p>					
		Noise from the activities in the depot and Park & Ride buildings	Plant tall trees with thick leaves in at least two zigzag rows, such as Mast Tree, Devil Tree or Mahogany, around the area as the buffer zone to reduce the noise from running vehicles/electric train or train maintenance, around the depot and park & ride buildings.		MRTA	Operator/Concessionaire		
		Flooding	<p>The depot manager will be tasked to monitor and maintain the drainage system and areas around the automated drainage system of retention ponds at least once per month, especially before the rainy season or the time when it is expected that out-season heavy raining will occur.</p> <p>Pump rainwater from rainwater retention ponds of the project to release to Khlet Canal after rain stops.</p> <p>Check the levels of water in Khlet Canal before releasing it from the project areas. In the case when the level of water in the canal is over 0.50 m below the bank, pump it out. If the water level in the canal reaches 0.10 m from the bank level, wait until the water level decreases before pumping, so this will not affect drainage or flooding outside the project areas.</p>					
		Community health and safety risks	<p>Strict implementation of air quality and noise impact prevention and mitigation measures during the operation</p> <p>Campaigns shall be used for encouraging the public and personal vehicle users to use the electric train to reduce air pollution and noise levels, which will reduce health problems, especially for the respiratory and hearing systems.</p>		MRTA	Operator/Concessionaire		

No	Project Activity	Potential Impact	Proposed Mitigation Measures	Location	Responsibility		Costs	Additional Requirements
					Supervision	Implementation		
			<p>Implement the impact prevention and mitigation measures for surface water quality during the operational period.</p> <p>Implement the impact prevention and mitigation measures for solid waste management.</p> <p>Provision of insurance to properties and passengers.</p>					
		Occupational, health and safety risks	<p>Prepare a safety and occupational health management plan based on an international standard.</p> <p>Conduct at least two drills a year for the emergency action plan for safety during critical situations, such as a fire incident on the station, street level, ticketing floor, and platform; evacuation of passengers out of the station/train; stopping train operation; and provision of assistance to passengers during evacuation/train derailment.</p> <p>Provide public insurance on the lives and property of passengers and the third party.</p> <p>Provide an annual health checkup program.</p> <p>Provide personal protective equipment for employees who are exposed to dangers and ensure that they wear the equipment every time they work.</p> <p>Provide emergency drills at least once a year, including Fire Prevention and Suppression.</p> <p>Provide first-aid rooms, with necessary equipment and drugs for emergency use, which must be looked after by a doctor always.</p> <p>Provide training and drills for staff working on emergency prevention and security on trains and stations on a regular basis to ensure preparedness always.</p>		MRTA	Operator/Concessionaire		

VI. Environmental Monitoring and Reporting

Construction Phase.

Compliance monitoring and reporting of Contractor/Consortium to MRTA

To ensure compliance, construction sites will be inspected as follows:

1. A meeting of Inspection Team comprising consultant firms, contractors, project owner and its consultant will be held for explanation of the main objectives of compliance measures.
2. Joint actual Inspection of construction sites to determine possible impacts and sensitive areas mentioned in compliance measures. During inspection, contractors will be asked questions about possible issues. If they cannot fully comply with the measures, their limitations will be used as guidelines on resolving the issues or suggestions of solutions based on technical reasons.
3. Record inspection results on the inspection report form.
4. At the end of each inspection, assessment and summary will be made for acknowledgement of project owner. If environmental impacts have to be prevented or reduced, the consultant firms will request for immediate actions to stop the immediate impacts first. After that, long-term reduction of impacts will be introduced. The summary will have details and pictures for clear understanding of the objects of inspection.
5. Minutes of Meeting must be published within 5 days of inspection.
6. Hand the inspection report to the constructors and project owner for consideration

Semi-annual reports. Every six months, six monthly Thai reports on inspection of compliance with measures for prevention, alleviation and monitoring of environmental impacts will be issued to Sino-Thai Engineering and Construction Plc. for submission to MRTA.

Compliance monitoring and reporting of MRTA to ONEP and other government agencies

The designers, construction contractors and project management firms should be monitored to ensure compliance with the above measures.

Third parties shall be hired to follow up compliance with the above measures. The costs thereof should be included in the project costs. Such follow-up should be monitored by MRTA and/or project implementing agency.

A Measures Compliance Monitoring Commission should be formed with the following members to monitor compliance with the entire project environmental measures:

- MRTA
- Representatives from Natural Resource and Environment Policy and Planning Office
- Representatives from SRT

- Representatives from Highway Department
- Representatives from Pollution Control Department
- Representatives from Samut Prakan Administration
- Representatives from BMA
- Representatives from Consumer Protection Board
- Specialists in environment

Semi- annual monitoring during construction and operation. Every six months, MRTA will submit a compliance report to ONEP and other agencies (in January and July of every year).

Third Party Monitoring

A third party environmental compliance auditing firm that has been authorized by ONEP will supervise the project implementation, prepare reports on the compliance with the environmental impact prevention and mitigation measures and evaluate the results of the environmental monitoring process. The third party environmental compliance audit firm will report the results of its evaluation and monitoring to the contractor for submission to relevant parties, e.g., MRTA, the consortium, and ADB.

The consulting firm UAE will conduct environmental impact assessment. UAE is registered with ONEP and Industrial Works Department. They have to capacity to conduct complete environment audit and monitoring as required by the EIA Report

Monitoring Frequency

Monitoring of surface water quality will be conducted once, one month before the construction starts to establish the baseline data. Monitoring of air quality, noise and vibration will be conducted for 5 consecutive days, including working days and public holidays, one month before the construction starts to establish the baseline data. For the Pink Line, measurement and recording of traffic volume will be conducted once in one month, for 2 consecutive days (covering working days and holidays), prior to the beginning of construction works to be used as baseline data. Interviews with at least 500 household heads, entrepreneurs, community leaders, and representatives of educational institutes and religious places within a 500-m radius from the right-ofway and around the depot and park & ride building (community leaders and indirectly affected people) will also be conducted 1 month prior to the commencement of project construction works.

Operation Phase.

The operator (s) for the Yellow Line and Pink Line, under the supervision of the MRTA, will regularly implement the environmental impact monitoring plans included in the EIA report. A third party environmental compliance auditing firm that has been authorized by ONEP will be employed to prepare environmental impact monitoring reports, which will be submitted to the ONEP once six months (in January and July of every year).

The environmental monitoring results from identified sampling points both during the construction and operation phases will be compared with the applicable performance standards (**Table EMP - 4**). Results will be reported in the semi-annual monitoring reports that will be submitted to ONEP.

VII. Grievance Redress Mechanism

During project construction, MRTA, contractors, and any entities providing construction and project management services shall be responsible for taking preventive and remedial action to address any actual or perceived environmental problems/issues related to the construction which caused or may cause environmental impacts or complaints and inform ONEP and other concerned agencies of such issues.

The MRTA will establish an Information and Complaints Center at the Project Office to receive information or complaints from the public and to publicize procedures for lodging complaints and communication channels, such as Call Center Numbers and E-mail Address. The center will provide staff on a 24-hour basis to gather and process complaints and suggestions to solve problems. Such suggestions will be presented to MRTA once a month to help alleviate construction impacts to the public.

If there are complaints from existing business operators and/or residents along the construction areas, affected persons must be allowed to express their opinions about resolving or alleviating the problem under the “public participation” principle based on rights specified in the Constitution of the Kingdom of Thailand, B.E. 2550 (2017).

The Information and Complaints Center will be responsible for receiving and recording complaints from the public. The Complaints Receiving Department will forward the complaints to the Investigation Department. Complaints will be investigated and analyzed to determine if the damage was caused by the construction work. If this is found, damages will be assessed and a solution will be reached to provide immediate assistance to affected persons. Complaints that may require compensation will be referred to the Negotiation and Compensation Department who will propose fair compensation to affected persons. The proposed solution and/or compensation will be forwarded to the Department Chief for action of the Project Manager or the Compensation Department.

Solutions to complaints that do not require compensation will be reported to the Project Manager for immediate action of engineers and other relevant parties. The contractor will assign relevant staff to investigate the damage and will be responsible for rectifying the damage and will bear the cost of rectifying the damage. Complaints requiring compensation will be forwarded to the Compensation Department for immediate information and payment to the affected persons.

The steps and responsible parties for addressing complaints during project construction are presented in Error! Reference source not found..

During operation, the project will use existing platform in its offices and website³ for receiving complaints and feedback from the public.

³ MRTA Complaints Service. http://www.mrta.co.th/th/comment/complaints_service/
Pink Line Project Facebook Page. <https://www.facebook.com/CRSTECOMPINKLINE/>
Yellow Line Project Facebook Page. <https://www.facebook.com/CRSTECONYL/>

Table EMP - 4. Monitoring Plan

Item	Monitoring Parameter	Monitoring Location	Frequency and Duration	Implementing Entity	Supervising Entity	Cost
Pre Construction						
Impacts caused by the relocation of public utilities	A survey conducted by field interviews. By using the Simple Random Sampling. For selecting sample group enterprise service infrastructure.		Throughout the relocation/change of public utilities for a phase of two years.		MRTA	250,000 baht/year, total 500,000 baht
Construction Phase						
Surface water quality	Temperature Total Suspended Solids Conductivity pH Dissolved Oxygen BOD Phosphate Oil & Grease Total Coliform Bacteria Fecal Coliform	<p>Pink Line Station W1: Khlong Bang Talat Station W2: Khlong Prapa Station W3: Khlong Prem Prachakon Station W4: Khlong Lam Chala Station W5: Khlong Song Ton Nun</p> <p>Yellow Line Station : 1 Nam Kaeo Canal Station : 2 Lat Phrao Canal Station : 3 Chan Canal Station : 4 Saen Saeb Canal Station : 5 Hua Mak Canal Station : 6 Prawet Burirom Canal Station : 7 Tachang Canal Station : 8 Khlet Canal Station : 9 Bang Na Canal Station : 10 Samrong Canal</p>	Pink and Yellow Lines Once a month until the construction of MRT stations or Depot and Park and Ride Buildings is completed.	Contractor	MRTA	<p>Pink Line 17,000 baht/time/station, total of 1,020,000 baht/year</p> <p>Yellow Line 4,000 baht/point, total 40,000 baht/time</p>
Aquatic Ecology	Biodiversity Type and density of phytoplankton and zooplankton Benthos abundance	<p>Pink Line Station W1: Khlong Bang Talat Station W2: Khlong Prapa Station W3: Khlong Prem Prachakon Station W4: Khlong Lam Chala Station W5: Khlong Song Ton Nun</p> <p>Yellow Line None</p>	Every month during the construction phase	Contractor	MRTA	22,000 baht/time/station, total of 1,320,000 baht/year
Air Quality	Total Suspended Particulate (TSP) Particulate Matter less than 10 microns (PM - 10) Particulate Matter less than 2.5 microns (PM - 2.5) Carbon monoxide (CO) Nitrogen dioxide (NO2) Wind speed and direction	<p>Pink Line Station A1: Central Chest Institute of Thailand Station A2: Chonprathansongkhro School Station A3: Khlong Kluea School Station A4: Phranakhon Rajabhat University Station A5: Synphaet General Hospital Station A6: Min Prasat Witthaya School</p> <p>Yellow Line Station : 1 Judicial Training Institute Station : 2 Pibool Upphatham School</p>	Every month for 5 consecutive days, including working days and public holidays, within 1 km radius of the construction sites and from the monitoring stations.		MRTA?	<p>Pink Line 63,000 baht/station, total of 1,512,000 baht/year</p> <p>Yellow Line 35,000 baht/point, total 910,000 baht/time</p>

Item	Monitoring Parameter	Monitoring Location	Frequency and Duration	Implementing Entity	Supervising Entity	Cost
		Station : 3 Chok Chai 4 Police Station Flat Station : 4 Thanornpitvithaya School Station : 5 Bangkok Suksa School Station : 6 Big C Superstore (Lat Phrao) Station : 7 Wat Mae Phra Kularb Tip (Maria Rosa Mystica Church) Station : 8 Vejthani Hospital Station : 9 The Mall Bang Kapi Station : 10 Fatthullbalee Mosque Station : 11 Sudnaree Kindergarten Station : 12 Huamak Municipality School Station : 13 Jamiul Idhard Mosque (Hua Mak Yai) Station : 14 Huamak School Station : 15 Klongkalantan School Station : 16 Suraomai School Station : 17 Khajonsiri Temple Station : 18 Darul Amin Mosque Station : 19 Dusit Thani College Station : 20 Bangkok Metropolitan Land Office, Phra Khanong Branch Station : 21 Si lam Temple Station : 22 Big C Srinagarindra (former Carrefour Srinagarindra) Station : 23 Klongkratumratutit School Station : 24 Siriwutti Wittaya school Station : 25 Chularat2 Hospital Station : 26 Chulavej Hospital				
Noise	Pink Line Leq 24 hr Ldn Lmax L90 Yellow Line Leq 24 hr Ldn Lmax L10, L90	Pink Line Station A1: Central Chest Institute of Thailan Station A2: Chonprathansongkhro School Station A3: Khlong Kluea School Station A4: Phranakhon Rajabhat University Station A5: Synphaet General Hospital Station A6: Min Prasat Witthaya School Yellow Line Station : 1 Judicial Training Institute Station : 2 Pibool Upphatham School Station : 3 Chok Chai 4 Police Station Flat Station : 4 Thanornpitvithaya School Station : 5 Bangkok Suksa School Station : 6 Big C Superstore (Lat Phrao) Station : 7 Wat Mae Phra Kularb Tip (Maria Rosa Mystica Church) Station : 8 Vejthani Hospital Station : 9 The Mall Bang Kapi Station : 10 Fatthullbalee Mosque Station : 11 Sudnaree Kindergarten	Pink Line Every 3 months (4 times/year) by measuring for 5 consecutive days (covering working days and holidays) until the completion of project construction Yellow Line Once a month, each for five consecutive days, which include working days and public holidays, during construction within a radius of 1 km and from the measurement stations throughout the construction phase.	Contractor	MRTA	Pink Line 25,000 baht/day/station, total of 600,000 baht/year Yellow Line 6,000 baht/point, total 156,000 baht/time

Item	Monitoring Parameter	Monitoring Location	Frequency and Duration	Implementing Entity	Supervising Entity	Cost
		Station : 12 Huamak Municipality School Station : 13 Jamiul Idhard Mosque (Hua Mak Yai) Station : 14 Huamak School Station : 15 Klongkalantan School Station : 16 Suraomai School Station : 17 Khajonsiri Temple Station : 18 Darul Amin Mosque Station : 19 Dusit Thani College Station : 20 Bangkok Metropolitan Land Office, Phra Khanong Branch Station : 21 Si lam Temple Station : 22 Big C Srinagarindra (former Carrefour Srinagarindra) Station : 23 Klongkratumratutit School Station : 24 Siriwutti Wittaya school Station : 25 Chularat2 Hospital Station : 26 Chulavej Hospital				
Vibration	Peak Particle Velocity (PPV) in mm/sec Frequency in Hz	Pink Line Station A1: Central Chest Institute of Thailan Station A2: Chonprathansongkhro School Station A3: Khlong Kluea School Station A4: Phranakhon Rajabhat University Station A5: Synphaet General Hospital Station A6: Min Prasat Witthaya School Yellow Line Station : 1 Judicial Training Institute Station : 2 Pibool Upphatham School Station : 3 Chok Chai 4 Police Station Flat Station : 4 Thanormpitvithaya School Station : 5 Bangkok Suksa School Station : 6 Big C Superstore (Lat Phrao) Station : 7 Wat Mae Phra Kularb Tip (Maria Rosa Mystica Church) Station : 8 Vejthani Hospital Station : 9 The Mall Bang Kapi Station : 10 Fathullbalee Mosque Station : 11 Sudnaree Kindergarten Station : 12 Huamak Municipality School Station : 13 Jamiul Idhard Mosque (Hua Mak Yai) Station : 14 Huamak School Station : 15 Klongkalantan School Station : 16 Suraomai School Station : 17 Khajonsiri Temple Station : 18 Darul Amin Mosque Station : 19 Dusit Thani College	Pink Line Every 3 months (4 times/year) by measuring for 5 consecutive days (covering working days and holidays) until the completion of project construction Yellow Line Once a month, each for five consecutive days, which include working days and public holidays, during construction within a radius of 1 km and from the measurement stations throughout the construction phase.	Contractor	MRTA	Pink Line 30,000 baht/day/station, total of 720,000 baht/year Yellow Line 18,000 baht/point, total 468,000 baht/time

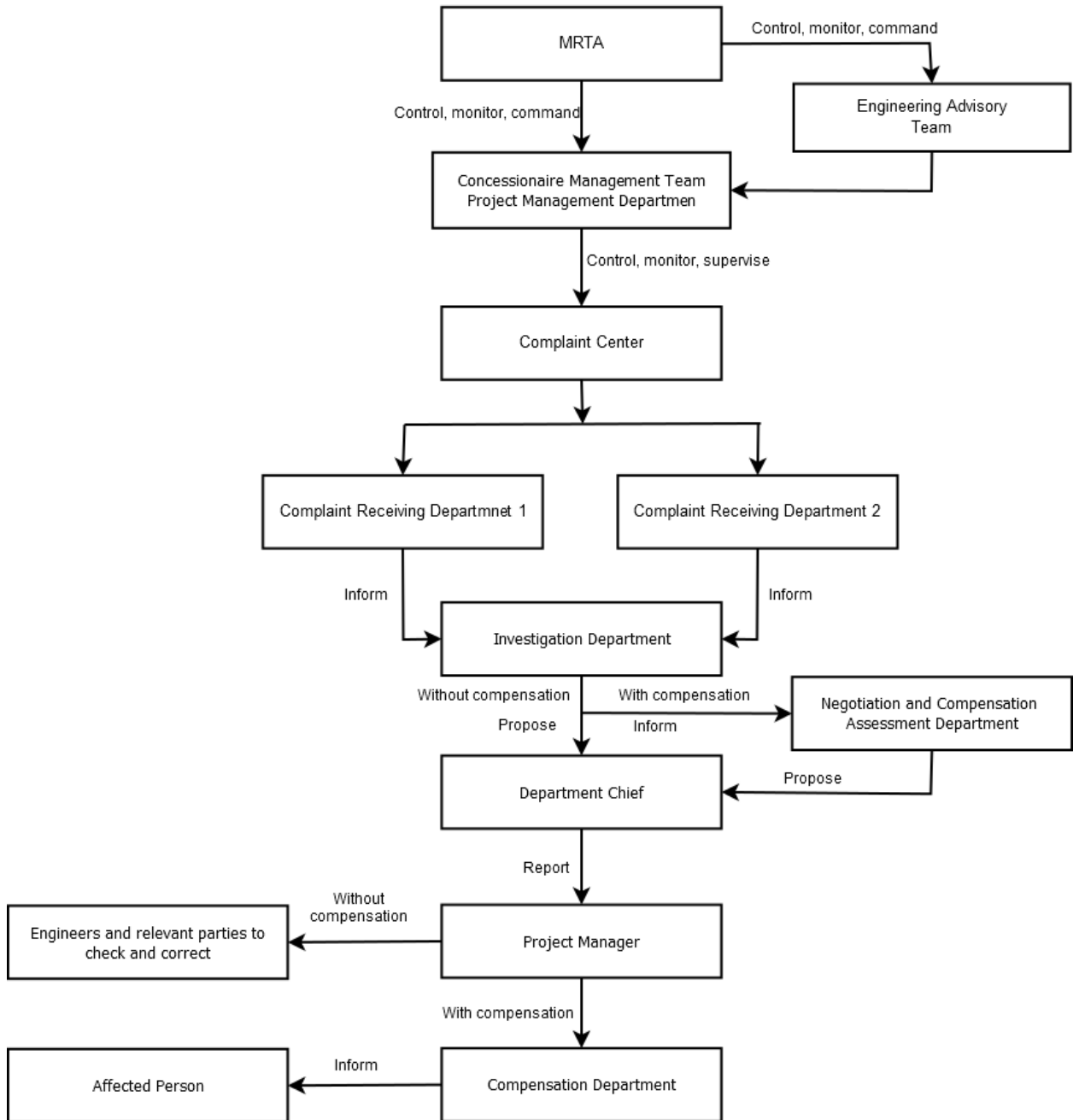
Item	Monitoring Parameter	Monitoring Location	Frequency and Duration	Implementing Entity	Supervising Entity	Cost
		Station : 20 Bangkok Metropolitan Land Office, Phra Khanong Branch Station : 21 Si lam Temple Station : 22 Big C Srinagarindra (former Carrefour Srinagarindra) Station : 23 Klongkratumratutit School Station : 24 Siriwutti Wittaya school Station : 25 Chularat2 Hospital Station : 26 Chulavej Hospital				
Transportation and accidents	Number, types and directions of vehicles at the measurement points at different intersections that serve as the routes for transporting construction materials and equipment for the analysis of traffic volume on the highways. Statistics of accidents. Causes and levels of severity of accidents.	Pink Line Khae Rai intersection Sanambin Nam intersection Pak Kret intersection Vibhavadi Rangsit Interchange Siam Park intersection Min Buri intersection Yellow Line Ratchada-Lat Phrao Intersection Phawana Intersection Chok Chai 4 Intersection Pradit Manuntham Intersection Bang Kapi Intersection Lam Sali Interchange Krung Thep Kritha Intersection Rama IV Srinagarind Interchange Phatthanakan Intersection On Nut Intersection Udomsuk Intersection Si lam Interchange Thepharak Intersection Samrong Intersection	Pink Line Monitoring of traffic count once every month, covering 2 consecutive days (including working days and holidays) until the completion of Project Construction and monitoring of accident statistics once a month throughout the Construction phase. Yellow Line Once a month, each covering three consecutive days, which include working days and public holidays during morning peak hours (07:00-09:00 hrs), evening peak hours (16:00-19:00 hrs), and night peak hours (22:00-24:00 hrs). The monitoring will be conducted until the construction of the structures of elevated ways, MRT stations or Depot, and Park and Ride Buildings is completed.	Contractor	MRTA	Pink Line 10,000 baht/time, total of 720,000 baht/year Yellow Line 10,000 baht/point, total 140,000 baht/time
Socio-economic impacts	Basic data of households Socio-economic data, opinions about the project development, problems, impacts during the construction phase, as well as other suggestions, data on accidents and complaints.	Pink Line People residing within a 500-m radius from the right-of-way and around the depot and park & ride building (community leaders and indirectly affected people) Yellow Line People living within the right-of-ways who have to relocate, establishments located near right-of-ways, community leaders, as well as the representatives of educational institutions and religious places. People living within the right-of-ways who have to relocate, establishments located near right-of-ways, community leaders, as well as the representatives of educational institutions and religious places.	Pink Line Twice a year throughout the Construction phase Yellow Line Once a year, each consisting of at least 500 sets of questionnaires, throughout the construction phase.	Contractor	MRTA	515 baht/sample, total of 515,000 baht/year 300,000 baht/time

Item	Monitoring Parameter	Monitoring Location	Frequency and Duration	Implementing Entity	Supervising Entity	Cost
Operation Phase						
Surface water quality	Temperature Suspend Solids Conductivity pH Dissolved Oxygen BOD Phosphate Oil & Grease Fecal Coliform Bacteria3/ Sulfide TKN - Nitrogen Total Coliform Bacteria	Pink Line Station W1: Khlong Bang Talat Station W2: Khlong Prapa Station W3: Khlong Prem Prachakon Station W4: Khlong Lam Chala Station W5: Khlong Song Ton Nun Retention Pond Zone A Retention Pond Zone B Yellow Line Station : 1 Lat Phrao Canal Station : 2 Saen Saeb Canal Station : 3 Phra Khanong Canal Station : 4 Samrong Canal Station : 5 Khlet Canal Station : 6 Retention pond nearby Srinagarindra road, Pond No.1. Station : 7 Retention pond nearby Srinagarindra road, Pond No. 2	Pink Line Every month for 5 consecutive years after the start of services, and twice a year in the wet and dry seasons after the first 5 years. Yellow Line Twice a year, for five consecutive years. If the measurement results are not significantly different, this will be conducted once a year	Operator or Concessionaire	MRTA?	Pink Line 17,000 baht/time/station total of 1,428,000 baht/year Yellow Line 6,000 baht/point, total 42,000 baht/time
Aquatic Ecology	Biodiversity Type and density of phytoplankton and zooplankton Benthos abundance	Pink Line Station W1: Khlong Bang Talat Station W2: Khlong Prapa Station W3: Khlong Prem Prachakon Station W4: Khlong Lam Chala Station W5: Khlong Song Ton Nun Retention Pond Zone A Retention Pond Zone B Yellow Line None	Every month for 5 consecutive years after the start of services, and twice a year in the wet and dry seasons after the first 5 years.			22,000 baht/time/station, total of 1,848,000 baht/year
Air Quality	Pink Line Yellow Line Total Suspended Particulate (TSP) Particulate Matter less than 10 microns (PM - 10) Carbon monoxide (CO) Nitrogen dioxide (NO2) Wind speed and direction Yellow Line Total Suspended Particulate (TSP) Particulate Matter less than 10 microns (PM - 10) Particulate Matter less than 2.5 microns (PM - 2.5) Carbon monoxide (CO)	Pink Line Station A1: Central Chest Institute of Thailand Station A2: Chonprathansongkhro School Station A3: Khlong Kluea School Station A4: Phranakhon Rajabhat University Station A5: Synphaet General Hospital Station A6: Min Prasat Witthaya School Yellow Line Station : 1 Pibool Upphatham School Station : 2 Vejthani Hospital Station : 3 Klongkalantan School Station : 4 Darul Amin Mosque Station : 5 Si Lam Temple Station : 6 Chulavej Hospital Station : 7 Under Phawana station (YL - 02)	Pink Line Every 3 months (4 times/year) by 5-day consecutive measurement (covering working days and holidays) for 5 years. After that, in the case that the value does not exceed the standard, measurement will be carried out twice a year. Yellow Line Twice a year, each covering five consecutive days, which include working days and public holidays for five consecutive years. After that, the air quality monitoring will occur once a year, each covering five consecutive days, which include working days and public holidays (during the southwest and northeast monsoons).	Operator or Concessionaire	MRTA	Pink Line 63,000 baht/station, total of 1,512,000 baht/year Yellow Line 77,000 baht/point, total 770,000 baht/time

Item	Monitoring Parameter	Monitoring Location	Frequency and Duration	Implementing Entity	Supervising Entity	Cost
	Nitrogen dioxide (NO2) Wind speed and direction	Station : 8 Under Chok Chai 4 station (YL - 03) Station : 9 Under Lat Phrao 101 station (YL - 07) Station : 10 Under Samrong station (YL - 23)				
Noise	Pink Line Leq 24 hr Ldn Lmax L90 Yellow Line Leq 24 hr Ldn Lmax L10, L90	Pink Line Station A1: Central Chest Institute of Thailan Station A2: Chonprathansongkhro School Station A3: Khlong Kluea School Station A4: Phranakhon Rajabhat University Station A5: Synphaet General Hospital Station A6: Min Prasat Witthaya School Yellow Line Station : 1 Pibool Upphatham School Station : 2 Vejthani Hospital Station : 3 Klongkalantan School Station : 4 Darul Amin Mosque Station : 5 Si lam Temple Station : 6 Chulavej Hospital	Pink Line Every 3 months (4 times/year) by 5-day consecutive measurement (covering working days and holidays) for 5 years. After that, in the case that the value does not exceed the standard, measurement will be carried out twice a year. Yellow Line Twice a year, each covering five consecutive days, which include working days and public holidays for five consecutive years. After that, the noise monitoring will carried out once a year, each covering five consecutive days, which include working days and public holidays (during the southwest and northeast monsoons).	Operator or Concessionaire	MRTA	Pink Line 25,000 baht/day/station, total of 600,000 baht/year Yellow Line 6,000 baht/point, total 36,000 baht/time
Vibration	Peak Particle Velocity (PPV) in mm/sec Frequency in Hz	Pink Line Station A1: Central Chest Institute of Thailan Station A2: Chonprathansongkhro School Station A3: Khlong Kluea School Station A4: Phranakhon Rajabhat University Station A5: Synphaet General Hospital Station A6: Min Prasat Witthaya School Yellow Line Station : 1 Pibool Upphatham School Station : 2 Vejthani Hospital Station : 3 Klongkalantan School Station : 4 Darul Amin Mosque Station : 5 Si lam Temple Station : 6 Chulavej Hospital	Pink Line Every 3 months (4 times/year) by 5-day consecutive measurement (covering working days and holidays) for 5 years. After that, in the case that the value does not exceed the standard, measurement will be carried out twice a year. Yellow Line Twice a year, each covering five consecutive days, which include working days and public holidays, for five consecutive years. After that, the monitoring will be carried out once a year, each covering five consecutive days: both working days and public holidays	Operator or Concessionaire	MRTA	Pink Line 30,000 baht/day/station, total of 720,000 baht/year Yellow Line 18,000 baht/point, total 108,000 baht/time
Transportation and accidents	Number, types and directions of vehicles at the measurement points at different intersections. Statistics of accidents. Causes and levels of severity of accidents	Pink Line Khae Rai intersection Sanambin Nam intersection Pak Kret intersection Vibhavadi Rangsit Interchange Siam Park intersection Min Buri intersection Yellow Line Phatthanakan Intersection On Nut Intersection Udom Suk Intersection Si lam Interchange Thepharak Intersection Samrong Intersection	Pink Line Monitoring of accident statistics every 3 months (4 times/year) for 5 consecutive years. After that, in the case that the traffic volume in 24 months has a trend to decline more than 40% in comparison to those in the pre-project development period, traffic survey will be carried out once a year Yellow Line Twice a year, each covering three consecutive days: working days and holidays during morning peak hours	Operator or Concessionaire	MRTA	Pink Line 10,000 baht/time, total of 240,000 baht/year Yellow Line 10,000 baht/point, total 60,000 baht/time

Item	Monitoring Parameter	Monitoring Location	Frequency and Duration	Implementing Entity	Supervising Entity	Cost
			(07:00-09:00 hrs) and evening peak hours (16:00-19:00 hrs, for five consecutive years. The, the frequency of the monitoring will reduce to once a year if the 24-month traffic volume tends to reduce by over 40%			
Socio-economic impacts	Basic data of households Socio-economic data, opinions about the project development, problems, impacts during the operation phase, as well as other suggestions, data on accidents and complaints.	<p>Pink Line People residing within a 500-m radius from the right-of-way and around the depot and park & ride building (community leaders and indirectly affected people)</p> <p>Yellow Line People living within the right-of-ways who have to relocate, establishments located near right-of-ways, community leaders, as well as the representatives of educational institutions and religious places.</p>	<p>Pink Line Once a year throughout the operation phase</p> <p>Yellow Line Once a year, each at least 500 sets of questionnaires, throughout the 40-year project implementation phase.</p>		MRTA	<p>Pink Line 515 baht/sample total of 257,500 baht/year</p> <p>Yellow Line 300,000 baht/time</p>

Figure EMP - 3. Information and Complaints Management Structure



VIII. EMP Capacity Building and Training Plan

Construction Phase. Contractors will provide training to staff and construction workers on the use and maintenance of tools, machinery and equipment. Contractors will also provide training and a guidebook on Occupational Health and Operational Safety for all construction workers.

Operation Phase. The Ministerial Regulations Prescribing the Standards for Administration and Management of Occupational Safety, Health, and Environment in Relation to Fire Prevention and Control, B.E.2555, requires the preparation of Fire Prevention and Control Plan Training for workplaces with 10 or more employees. Training will equip employees with fire prevention knowledge and response to fire emergencies. Examples of training courses will include basic firefighting training and first aid training, among others.

IX. Information Disclosure, Consultation and Participation

The project outline will be publicized through the Bangkok Metropolitan Administration local agencies (District offices) or municipalities that are area owners at least 30 days in advance. The local agencies will further publicize this through community leaders, who will inform this to their people members.

The MRTA will establish a Public Relations Unit to create a positive understanding between the Contractor and local communities near construction areas. The unit will publicize information and conduct meetings to present and clarify the characteristics and phases of the construction process, the disaster prevention system, and the monitoring system. The unit will also conduct public hearings once a month to obtain public input into the construction process and the effectiveness of mitigation and management measures.

Public hearings, publication/broadcast of project activities, press conferences, and advertising through exhibition boards and print media were conducted since 2012. Websites with information on the Pink⁴ and Yellow⁵ Lines are also available.

X. Mechanism for Feedback and Adjustment

In case of any change in the project description or measures not affecting the essential issues of EIA and with positive impact on the environment, either better than or equivalent to the measures specified in the EIA report that was approved by the Expert Review Committee, MRTA will submit documentation of the changes to local regulatory agencies, with a copy to ONEP for information. In case changes to the project description or measures will affect the essential issues of the EIA report, MRTA will commission the preparation of an addendum to the EIA report assessing the

⁴ https://www.mrta.co.th/pinkline/index_en.html

⁵ <https://www.mrta.co.th/th/projectelectrictrain/yellowline/>

impacts associated with the change which will be submitted to ONEP for consideration of the Expert Review Committee prior to project commencement. MRTA will ensure the contractor's strict compliance with the impact monitoring plans specified in the report.

Appendixes