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)

Revised Pink Line: Khae Rai – Min Buri Environmental Management Plan (Part 3 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-0.

(Logo)

No NBM.MRTA.00022.PK1042.07.11.2017

7 November 2017

Subject: Submission of the Environmental Management Plan (Revised) for MRT Pink Line Project (Khae Rai – Min Buri)

Dear Mr. Surachet Laopoonsuk
Director of Phase I Project
MRT Pink Line Project (Khae Rai – Min Buri)
Mass Rapid Transit Authority of Thailand

Reference The Company's Letter No. NBM/GEN/0031/2560 dated 21 August 2017

Attachment The Environmental Management Plan (Revised) 1 Set (A4)
MRT Pink Line Project (Khae Rai – Min Buri)

Northern Bangkok Monorail Company Limited has received the concession by the Mass Rapid Transit Authority of Thailand (MRTA) to perform the construction of MRT Pink Line Project (Khae Rai – Min Buri) Project.

With reference to the aforementioned company's letter, submitting the Environmental Management Plan for MRT Pink Line Project (Khae Rai – Min Buri) to MRTA for consideration and approval before commencing the construction, the company was coordinated by MRTA Consultant and was requested to revise some contacts.

The company therefore would like to submit the Environmental Management Plan (Revised) for MRT Pink Line Project (Khae Rai – Min Buri) to MRTA for consideration and approval before commencing the construction, in terms of the Environmental Impact Prevention and Correction Measures and the Environmental Impact Inspection Follow-up Measures for MRT Pink Line Project (Khae Rai – Min Buri), as details attached herewith.

For your consideration.

Sincerely Yours,
(Signature)
(Mr. Surapong Laohaaunya)
Committee

(Received stamp on 8 Nov 2017)
(Signature) MRTFILE No.: 060/2.1 (51)
(Signature)

155/kk/NBM0061.1042

Northern Bangkok Monorail Company Limited 21 Soi Choei Phuang, Vibhavadi Rangsit Road, Chomphol Sub-district, Chatuchak District, Bangkok

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Tel. 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com Email: uae@uaeconsultant.com

No UAE3138/2017

2 November 2017

Subject: Submission of the Environmental Management Plan in accordance with the Report Requesting the Change in Project Details in the Environmental Impact Assessment for MRT Pink Line Project (Khae Rai – Min Buri) (Revised)

Dear Ms. Kanchana Warunchotikul
Sino-Thai Engineering and Construction Public Company Limited

Reference Quotation from United Analyst and Engineering Consultant Company Limited
No. EMA4005/2017 dated 16 August 2018

Attachment Report on the Environmental Management Plan in accordance with the Report Requesting the Change in Project Details in the Environmental Impact Assessment for MRT Pink Line Project (Khae Rai – Min Buri) (Revised) 2 Sets (Thai version) – 1 Original and 1 Copy

United Analyst and Engineering Consultant Company Limited has been assigned by Sino-Thai Engineering and Construction Public Company Limited to conduct the Report on the Environmental Management Plan for MRT Pink Line Project (Khae Rai – Min Buri) (Revised).

In this regard, United Analyst and Engineering Consultant Company Limited now completed the Report on the Environmental Management Plan for MRT Pink Line Project (Khae Rai – Min Buri) (Revised) and would like to submit the aforementioned report to Sino-Thai Engineering and Construction Public Company Limited for considereation.

For your consideration.

Sincerely Yours,
(Signature)
(Miss Nopphawan Urarak)
Vice Director of Environmental Quality Inspection Division

(Received stamp on 2 Nov 2017)
(Signature)

FILE No.: 060/1.5 (21)

Environmental Management Plan
in accordance with the Report Requesting the Change in Project Details in
the Environmental Impact Assessment
for MRT Pink Line Project (Khae Rai – Min Buri)
(Revised)

Presented by
Sino-Thai Engineering and Construction Public Company Limited

United Analyst and Engineering Consultant Co., Ltd.
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Environmental Management Plan
in accordance with the Report Requesting the Change in Project Details in the Environmental Impact Assessment for MRT Pink Line Project (Khae Rai – Min Buri) (Revised)

Presented by
Sino-Thai Engineering and Construction Public Company Limited

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**CHAPTER 1
WORK SCOPE IN ACCORDANCE WITH ENVIRONMENTAL IMPACT PREVENTION AND CORRECTION MEASURES AND ENVIRONMENTAL IMPACK INSPECTION FOLLOW-UP MEASURES**

1.2 Introduction

The government has declared the policy on the coverage extension of the electric railway system in Bangkok Metropolitan Region, with aims to provide the more convenient mean of transportation and to allow mass transit for a high volume of passengers in order to resolve traffic congestion issues on the limited availability of roads. The key objective is to reduce the use of personal vehicles in order to cut down national budgets on import and fuel reserves that have been affected by the increase in oil price in the global market.

In accordance with the meeting held on 9 March 2010, the cabinet acknowledged the outcomes from the Commission for the Management of Land Traffic (CMLT) meeting on 8 February 2010, endorsing the Mass Rapid Transit Master Plan in Bangkok Metropolitan Region that designated relevant agencies to implement relevant plans of action within the first 10 years (operation by 2019) for 7 transit lines, amounting to 154 kilometers in total. The MRT Pink Line from Khae Rai – Pak Kret – Min Buri is one of the 7 transit lines in the aforementioned master plan.

Regarding the Mass Rapid Transit Master Plan, the MRT Pink Line from Khae Rai – Pak Kret – Min Buri was planned as a secondary mass transit, typed all-route overpassing straddle monorail. The origin of this line is close to Khae Rai Junction, then goes along Tiwanon Road, Chaeng Wattana Road, Laksi Junction, Ram Inthra Road, Min Buri Junction, and ends at Ramkhamhaeng – Romklao Junction. This route is planned to support mass transit system between Nonthaburi province and Min Buri District in Bangkok, or to connect the mass transit between the northeastern side and the eastern side of Bangkok Metropolitan region. This line will be connected to 5 other lines. The 3 lines are under the Mass Rapid Transit Authority of Thailand (MRTA), including MRT Purple Line from Bang Sue to Bang Yai (Nonthaburi Civic Center Station), MRT Dark Green Line from Mo Chit to Saphan Mai (Wat Phra Si Maha That Station), MRT Orange Line from Bang Kapi to Min Buri (Min Buri Station). One line is under the State Railway of Thailand (SRT), which is SRT Dark Red Line from Bang Sue to Rangsit (Laksi Station). The last line is under the Office of Transport and Traffic Policy and Planning (OTP), which is BMA Grey Line from Vatcharapol to Rama IX Bridge (Vatcharapol Station).

According to the feasibility study of this project routing conducted by the Office of Transport and Traffic Policy and Planning (OTP), the MRT Pink Line was planned to be an all-route overpassing straddle monorail with approximately 34.5 kilometers in total, comprising of 24 stations and 2 locations of Park & Ride facility and the depot. This study with details regarding project feasibility, potential environmental impacts, and the MRT Pink Line (Khae Rai – Min buri) project design was presented to the National

Environment Board of Thailand for endorsement in terms of the Environmental Impact Assessment at the 2/2554 Meeting on 23 March 2011 and at the 2/2555 Meeting on 16 March 2012 (the Notification of the Environment Board, *Office* of Natural Resources and Environmental Policy and Planning, No. TS (KKWL) 1008/W5742 dated 18 June 2012).

Later, the Mass Rapid Transit Authority of Thailand (MRTA) requested the changes to project details in accordance with the review of the feasibility study for the improvement of MRT Pink Line Project (Khae Rai – Min buri). The change details were requested in 5 areas, including (1) eliminate the location of Park & Ride facility and the depot at Sanambin Nam and maintain only 1 location at Rom Klao Junction, (2) rearrange originally-planned stations and add new stations to the total of 30 stations, (3) adjust the environment impact prevention, correction, and elimination measures, (4) adjust the environment impact inspection follow-up measures, and (5) add the health and economic environment impact assessment. The type of project still remained an all-route overpassing straddle monorail of 34.5 kilometers, comprising of 30 stations and 1 location of Park & Ride facility and the depot. The review with details regarding project feasibility, potential environmental impacts, and the revision on the MRT Pink Line (Khae Rai – Min buri) project design was presented to the National Environment Board of Thailand for endorsement in terms of the Environment Impact Assessment at the 18/2557 Meeting on 15 July 2014 and the National Environment Board of Thailand agreed to acknowledge the review at the 1/2558 Meeting on 18 March 2015, in accordance with the Notification of the Environment Board, *Office* of Natural Resources and Environmental Policy and Planning, No. TS (KKWL) 1005/W7091 dated 22 June 2015.

1.2 Changes to Project Details of the MRT Pink Line Project (Khae Rai – Min buri)

1.2.1 Location

The location of the MRT Pink Line Project (Khae Rai – Min buri) is located in Nonthaburi Province and Bangkok Metropolitan, starting from Nonthaburi Civic Center Station (connecting to the MRT Purple Line from Bang Sue to Bang Yai) to Min Buri Station. There are 30 stations, as follows.

(1) Nonthaburi Civic Center Station
(2) Khae Rai Station
(3) Sanambin Nam Station
(4) Samakkhi Station
(5) Royal Irrigation Department Station
(6) Pak Kret Station
(7) Pak Kret Bypass Station
(8) Chaeng Wattana – Pak Kret 28 Station
(9) Muang Thong Thani Station
(10) Si Rat Station
(11) Chaeng Wattana 14 Station
(12) Government Complex Station
(13) TOT Station
(14) Lak Si Station
(15) Rajabhat Phranakhon Station
(16) Wat Phra Si Maha That Station
(17) Ram Inthra 3 Station
(18) Lat Pla Khao Station
(19) Ram Inthra 31 Station
(20) Maiyalap Station
(21) Vacharaphon Station
(22) Ram Inthra 40 Station
(23) Khubon Station
(24) Ram Inthra 83 Station
(25) East Outer Ring Road Station
(26) Nopparat Rajathanee Station
(27) Bang Chan Station
(28) Setthbutbamphen Station
(29) Min Buri Market Station
(30) Min Buri Station

1.2.2 Project Routing

The MRT Pink Line Project (Khae Rai – Min buri) starts from Rattanathibet Road in front of the Nonthaburi Civic Center, with a connection to the MRT Purple Line (Bang Sue - Bang Yai) at the Nonthaburi Civic Center Station, then the route turns left at Khae Rai Junction towards Tiwanon Road and goes along Tiwanon Road passing the Central Chest Institute of Thailand, Sanambin Nam Junction, and Wat Chonlaprathan Rang Srit, to Pak Kret Junction. The route then turns right towards Chaeng Wattana Road, passing Impact Exhibition and Convention Center, Muang Thong Thani, Si Rat Expressway, the Government Complex, Lak Si Junction, then goes under Don Muang Toll Way, whereas there is a connection to the SRT Dark Red Line (Bang Sue – Rangsit) as Lak Si Station. The route continues passing through Anusawari Lak Si Circle whereas there is Wat Phra Si Maha That Station as an interchange station to the MRT Dark Green Line (Mo Chit - Saphan Mai), then continues along Ram Inthra Road and overpass Chalong Rat Expressway at Vatcharaphon Junction, whereas there is Vatcharaphon Station, an interchange station to the BMA Grey Line (Vatcharapol to Rama IX Bridge). The route continues towards Min Buri Junction and then enters Min Buri Town along Sihaburanukit Road, across Khlong Sam Wa Canal, and turns right across Khlong San Saep Canal, passing empty space and enters Ramkhamhaeng Road (Sukhapiban 3), to the ending point at Rom Klao Junction around Soi Ramkhamhaeng 192, with an interchange station to the MRT Orange Line (Bang Kapi to Min Buri), amounting to total distance of 34.5 kilometers.

In terms of changes made to Project Details of the MRT Pink Line Project (Khae Rai – Min buri), there are few changes made, including eliminating the location of Park & Ride facility and the depot at Sanambin Nam to maintain only 1 location at Rom Klao Junction, as well as rearranging originally-planned stations and adding 6 new stations. As a result, the project consists of 30 stations and 1 location of Park & Ride facility and the depot. The type of project still remained an all-route overpassing straddle monorail, as shown in Picture 1-1.

1.2.3 Construction Plan of the Station, the Park & Ride Facility and the Depot

The details of the construction plan of the stations, the Park & Ride facility and the depot for The MRT Pink Line Project (Khae Rai – Min buri) are as follows.

1) The rail is all-way overpassing with top of rail 15 meters above the road (level +16.00 MSL) on the traffic island, except for some areas with barriers where the route goes along the side of the road and for some areas the rail can be only 9 meters above the road (level +10.00 MSL).

2) Stations are designed in the form of sided platform. The station buildings are 2-leveled and 3-leveled. The height of concourse level and platform level are as follows.

- Muang Thong Thani Station and Lak Si Station : Platform Level +9.5 meters and concourse level +1.5 meters
- Wat Phra Si Maha That Station : Platform Level and concourse level on the same level +11.16 meters
- Other 27 stations : Platform Level +15.5 meters and concourse level +7.5 meters.

3) Park & Ride facility is a reinforced concrete 3-leveled building, in the form of garage parking. It is planned to locate at Min Buri Station (Rom Klao Junction), to the side of Ramkhamhaeng Road, covering 50.57 Rai. This facility has capacity to park 3,000 vehicles (1,000 vehicles/level). This is built for people to park their personal vehicles and use the electric railway system, as shown in Picture 1-2.

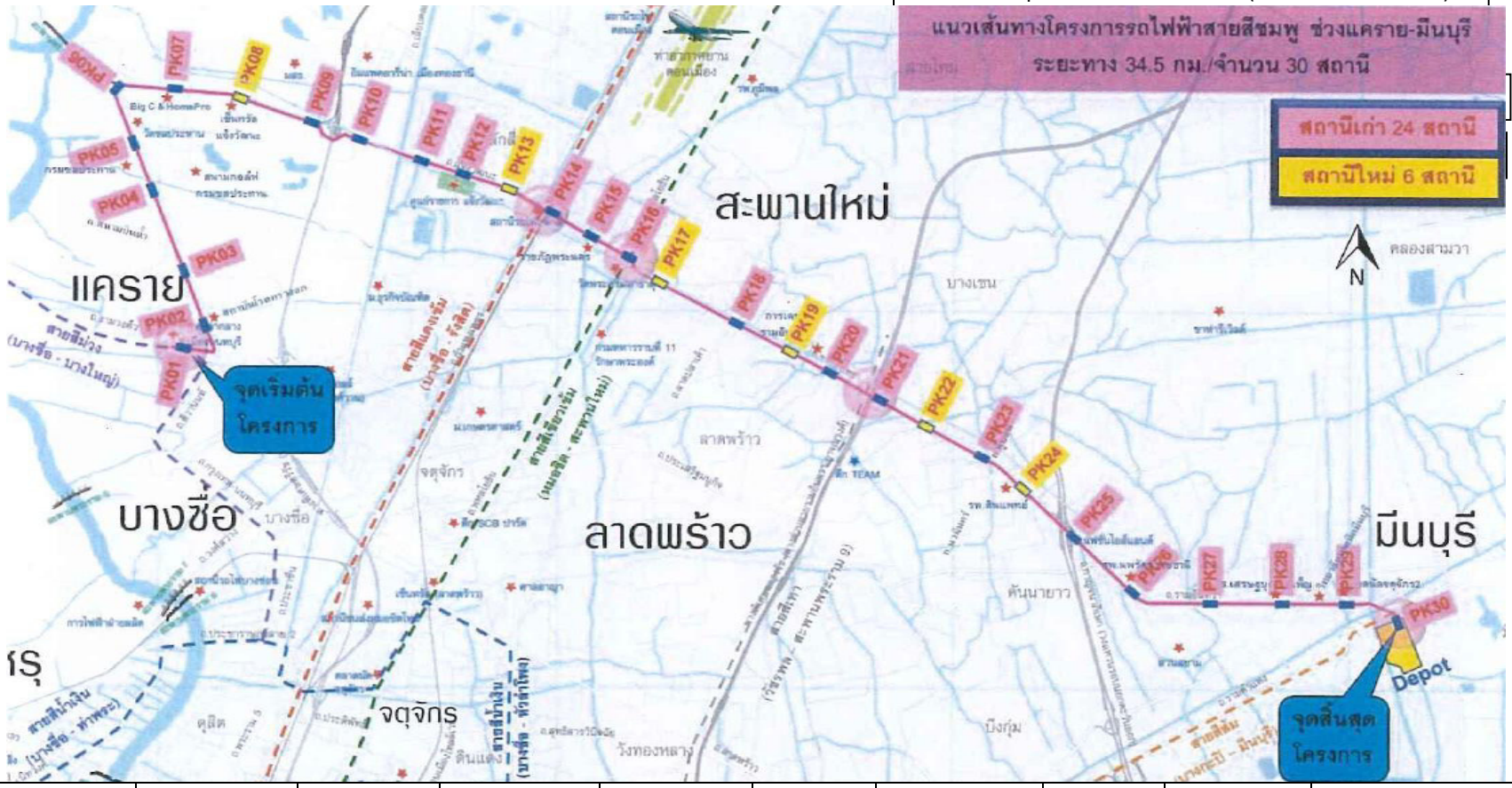
4) Depot is a building behind the Park & Ride facility, covering 178.43 Rai, with capacity to serve all 56 trains under this project, as shown in Picture 1-3. Inside the depot, there are building and amenities as follows.

- Administration and OCC Building : The inside of this structure includes conference room, electric control room, electric transformer room, water cooling machine and water pump room, battery room, electric backup reserve room, low-pressure electric room, traffic control room, and SCADA system that is the hub for controlling and monitoring overall electric system.
- Main workshop : The inside of this structure includes light maintenance workshop and heavy maintenance workshop, office, minor workshop, storage room, litter repair shop, wheel changing workshop, under wheel workshop, and paint repair workshop.
- Bulk substation
- Hazardous building
- Waste storage
- Storm Water Pump House
- Wastewater Treatment Plant
- Guard House
- Stabling Yard
- Washing Garage
- Canteen
- Employee dormitory
- Traffic Control Office
- Driver's School

The Design and Construction Office of Overpassing Railway, Stations, Park & Ride Facility and Depot is under the responsibility of Sino-Thai Engineering & Consultant Public Company Limited. The project duration is approximately 39 months. The company that received concessionary from the Mass Rapid Transit Authority of Thailand (MRTA) assigned United Analyst & Engineering Consultant Company Limited to prepare details and plan on the inspection of the implementation under the Environmental Impact Prevention and Correction Measures and the Environmental Impact Inspection Follow-up Measures in the construction phase of The MRT Pink Line Project (Khae Rai – Min buri), as well as to prepare a report regarding implementation outcomes under the Environmental Impact Prevention and Correction Measures and the Environmental Impact Inspection Follow-up Measures in the construction phase of this project, to propose to Sino-Thai Engineering & Consultant Public Company Limited and the Mass Rapid Transit Authority of Thailand (MRTA) for further consideration.

PICTURE 1-1 : ROUTE MAP OF MRT PINK LINE (KHAE RAI – MIN BURI) PROJECT

Route Map of the MRT Pink Line (Khae Rai – Min Buri)



PK01 Nonthaburi Civic Center Station	PK04 Samakkhi Station	PK07 Pak Kret Bypass Station	PK10 Si Rat Station	PK13 TOT Station	PK16 Wat Phra Si Maha	PK19 Ram Inthra 31 Station	PK22 Ram Inthra 40 Station	PK25 East Outer Ring Road Station	PK28 Setthbutbamphen Station

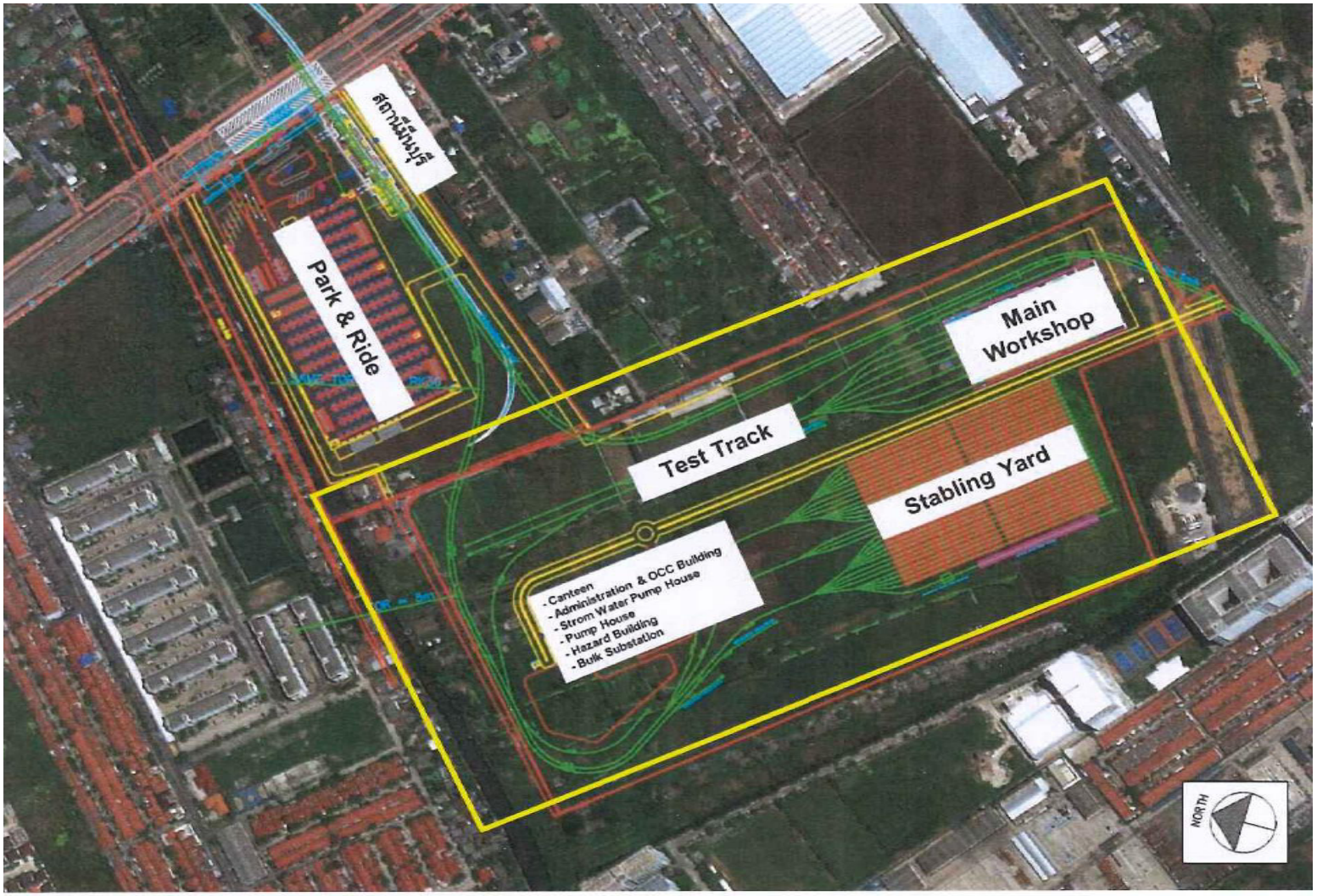
					That Station				
PK02 Khae Rai Station	PK05 Royal Irrigation Department Station	PK08 Chaeng Wattana – Pak Kret 28 Station	PK11 Chaeng Wattana 14 Station	PK14 Laksi Station	PK17 Ram Inthra 3 Station	PK20 Maiyalap Station	PK23 Khubon Station	PK26 Nopparat Rajathanee Station	PK29 Min Buri Market Station
PK03 Sanambin Nam Station	PK06 Pak Kret Station	PK09 Muang Thong Thani Station	PK12 Government Complex Station	PK15 Rajabhat Phranakhon Station	PK18 Lat Pla Khao Station	PK21 Vacharaphon Station	PK24 Ram Inthra 83 Station	PK27 Bang Chan Station	PK30 Min Buri Station

Source : Complete Report (Report on Changes to Enviroment Impact Assessment of the Project), 2015

PICTURE 1-2 : PARK & RIDE FACILITY OF MRT PINK LINE (KHAE RAI – MIN BURI) PROJECT

Source : Complete Report (Report on Changes to Enviroment Impact Assessment of the Project), 2015

PICTURE 1-3 : DEPOT OF MRT PINK LINE (KHAE RAI – MIN BURI) PROJECT



Source : Complete Report (Report on Changes to Enviroment Impact Assessment of the Project), 2015

1.3 Potential Environmental Impacts in Pre-construction and Construction Phase

1.3.1 Potential Environmental Impacts in Pre-construction Phase

The potential environmental impacts in pre-construction phase of the MRT Pink Line (Khae Rai – Min Buri) Project are impacts relating to migration and land expropriation.

1) Quality of Life Value

(a) Impacts in terms of migration and land expropriation

Migration and land expropriation may affect mental health of migrants and the owner of the expropriated lands and properties, in particular the area along the mass transit route that has to be diverted out of the traffic island on Rattanathibet – Tiwanon Road (KM.0+300 – KM.1-180), Tiwanon - Chaeng Wattana Road (KM.6+230 – KM.6-656), Chaeng Wattana Road (KM.9+500 – KM.11-150, KM.14+750 – KM.15+950, KM.16+400 – KM.18+000, KM32+135 -) and Ram Inthra – Sihaburanukit Road (KM.33+800 – KM.34+300).

1.3.2 Potential Environmental Impacts in Construction Phase

The potential environmental impacts from activities done during pre-construction phase of the MRT Pink Line (Khae Rai – Min Buri) Project to vulnerable surrounding areas include 4 aspects as follows.

1) Physical Environmental Resources : This includes impacts to geographical landscape, soil resources, geological conditions and earthquake, hydrological conditions and land settlement, Ground Water quality, air quality, noise pollution and vibration.
2) Biological Resources : This includes impacts to aquatic ecology and terrestrial ecology,
3) Human Utilization Value : This includes impacts to land utilization pattern, transportation, infrastructures and utilities.
4) Quality of Life Value : This includes impacts to economy, society, migration and land expropriation, public health and safety, historic and archaeological resources, as well as aesthetic landscape.

The details are as follows.

1) Physical Environmental Resources

(a) Geographical Landscape Impacts

Along Mass Transit Route and Stations

Since the construction of the mass transit system will use the traffic island area of Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road that have floodable low plain land geographical landscape and the level of traffic island is less than 3 meters above mean sea level, the construction requires only digging and leveling before building overpassing rail and stations that may slightly or hardly impact in changing geographical landscape both in increasing or decreasing direction.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

Since the construction area of the Park & Ride facility and the depot at Rom Klao Junction also has floodable low plain land geographical landscape and the level of the construction area is less than 3 meters above mean sea level, the construction of the 3-level Park & Ride facility and the depot at Rom Klao Junction may slightly or hardly impact in changing geographical landscape both in increasing or decreasing direction.

(b) Soil Resources Impacts

Along Mass Transit Route and Stations

Since the construction of the mass transit system requires digging and opening of some areas and then removing some soil to build overpassing structure base for the distance of 34.50 kilometers and 30 stations, it may inevitably disturb the conditions/structures and properties of original soil. In addition, some areas, including land under overpassing rail on Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road, except for the area of the bridge across Sanambin Nam Junction and the crossing of Chaeng Wattana Road – Phahonyothin Road – Ram Inthra Road (Anusawari Lak Si Circle) or the part that the mass transit route is diverted out of the traffic island (e.g. the area nearby Lak Si Plaza Department Store, Pak Kret Junction, Si Rat Expressway Crossing, Khlong Kluea School, Rajabhat Phranakhon University, etc.), may need leveling and need to be replaced with abundant soil resources that are nourished and appropriate for planting bushes and mid-sized trees. Consequently, this may significantly lead to negative impacts on soil resources properties and may cause significant change from the originals.

Digging and leveling activities for the construction of overpassing rail and stations, in particular during the rainy season, may cause a massive amount of soil from pillar drilling to fall down on to the construction areas or on road surfaces during the time of moving out of the construction areas. This massive amount of soil may be drained by rain to flow along the sloping area or road surface to the lower plain land or public water resources. This may lead to moderate impacts of piling soil and shallow public water resources.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

The construction in this area will cause impact to soil structure and properties since it is floodable low plain land and was previously used for agricultural purpose (rice field). Consequently, land leveling is needed to at least be as high as the road surface of Ramkhamhaeng Road. The construction may bring in some soils gained from the digging to construct the base of overpassing rail and stations and soils from other places to level this construction area, which may inevitably disturb the conditions/structures and properties of original soil. This may be moderate negative impact. Since the original land hasn't been used and previously was used for agriculture, there is moderate chance of soil drainage and land slide in the area on south-western side along Khlong Song Ton Noon Canal in parallel with the area of the Park & Ride facility and the depot construction. During the rainy season, a massive amount of soil may be drained by rain to flow along the sloping area into Khlong Song Ton Noon Canal, causing moderate impacts of piling soil and shallowness of Khlong Song Ton Noon canal.

(c) Geological Conditions and Earthquake Impacts

Along Mass Transit Route and Stations

There is a chance of impacts to geological conditions/base geology in terms of the movement of soft clay layer. Since along the construction route is located on soft to moderate soft clay layer to approximately 18 meters depth, round-face pillar drilling, if needed, may easily cause the movement of soft clay layer. This is moderate impact to the soil around pillar drilling area, particularly in the station construction areas close to surface water resources, including PK-01, PK-10, PK-11, PK-14, PK-15, PK-20, PK-21, PK-23, PK-29 and PK-30.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

There is a chance of impacts to geological conditions/base geology in terms of the movement of soft clay layer. Since along the construction route is located on soft to moderate soft clay layer to approximately 18 meters depth, round-face pillar drilling, if needed, may easily cause the movement of soft clay layer and the calculated amount of soft clay that is ready to move is also high.

The impacts for earthquake is presumably low or none since the construction area is located in 2A zone that has low risk and the possibility of damages is low to moderate.

(d) Surface Water Hydrological Conditions and Drainage Impacts

Along Mass Transit Route and Stations

It is assumed that the natural water flow remains unchanged since there is no structures laid along the surface water resources. However, there might be some barriers to water flow since the construction of overpassing rail and stations requires the construction area with width about 8 meters on traffic island on Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road, except for the area of the bridge across Sanambin Nam Junction and the crossing of Chaeng Wattana Road – Phahonyothin Road – Ram Inthra Road (Anusawari Lak Si Circle) or the part that the mass transit route is diverted out of the traffic island (e.g. the area nearby Lak Si Plaza Department Store, Pak Kret Junction, Si Rat Expressway Crossing, Khlong Kluea School, Rajabhat Phranakhon University, etc.). Consequently, this may significantly lead to moderate impact to water that flows into public drainage system on both sideways due to small pieces from construction (e.g. cement pieces, rocks, soils, sand, etc.) and the piling of construction materials or the line of non-transparent cement wall for construction zoning. The aforementioned factors may impede the flow of rain water on traffic surface before flowing into public drainage system, causing slower flow and flooding on traffic surface along the mass transit route. In addition, there was an experience of the occurrence on traffic island on Vibhavadi Rangsit Road, caused by the construction of Don Muang Toll Way Phase I (KM.5+000 to KM.21+000). It was found that the remains from construction impeded the water flow and filled the public drainage along both sides of VIbhavadi Rangsit Road, causing extremely severe traffic issue on both outbound and inbound of VIbhavadi Rangsit Road.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

The construction in this area may not cause any impact to hydrological conditions of surface water and water drainage even though the land was abandoned and previously used for agricultural purpose (rice field), or even the construction of the 3-level Park & Ride facility and the depot may bring in a number of machines, equipment and construction materials. The unorganized layover of things may impede water flow sometimes during heavy rain periods but it may not cause flooding because

there is Khlong Song Ton Noon Canal on south-western side of the construction area that may act as natural resource for water collection and drainage to help prevent flooding issue.

(e) Surface Water Quality Impacts

Along Mass Transit Route and Stations

The impacts from construction, particularly from surface cultivation, land filling, base digging to support the structure of overpassing rail and stations, or construction tools and materials moving (e.g. sand, rocks, cements, soils, etc.) may be low since the pier construction of the structure of overpassing rail and stations has no intrusive part to surface water resources and there is no activity that can disturb the quality of surface water, except for 10 stations that are located less than 50 meters from the surface water resources, namely PK-01, PK-10, PK-11, PK-14, PK-15, Pk-20, PK-21, PK-23, PK-29 and PK-30, that may be affected by the increase in water turbidity from soil surface drains only during the period of base digging and land filling, or by the contamination of oils from machines and tools used for construction. However, they will be low impacts since the construction areas are limited on traffic island. In addition, surface water quality inspection found that the quality was poor due to wastewater from urban communities.

Impacts from activities done in the project office and the living communities of employees may happen in 2 cases.

- If there is a project office

- Wastewater and wastes may come from the use of toilet or dishwashing during daily work routine of the employees working at the project office, so there must be the good design and preparation of sufficient toilets that match with sanitary standard (10 employees/ toilet) and the wastewater management system must be installed to manage wastewater from all activities occurring in the project office.
- Garbage and wastes may also come from daily activities of the employees working at the project office, approximately 200 employees. This may cause the blockage and may impact surface water resources in the close vicinity so there is a need for garbage containers.

- If there is a project office and employees' living community

- Wastewater and wastes may come from the use of toilet, dishwashing, washing, bathing during daily work routine of the employees working at the project office, construction workers, officers, and labors.
- Garbage and wastes may also come from daily activities of the employees working at the project office and construction workers living in the community, approximately 1,200 employees. This may cause the blockage and may impact surface water resources in the close vicinity.

Impacts from continuous activities during the construction, such as equipment washing and cleaning and the use of vehicles, from the project office may come from the use of water up to 12 cubic meters per day. Therefore, the instant wastewater management system must be installed to manage this amount of wastewater.

For the Park & Ride facility and the depot, the construction activities, particularly soil surface cultivation, land filling, base digging to support the 3-level Park & Ride facility and the depot, or

the moving of construction tools and materials (e.g. cement pieces, rocks, sand, soils etc.), may lead to low impact from turbidity increase from the use of machines and oil-related tools. Although the construction area is close to the surface water resource (Khlong Song Ton Noon Canal) but there is no intrusive parts into the canal and there is no activity that may disturb the quality of surface water resource. In addition, during the construction, there must be temporary water drainages around the area to receive wastewater from construction activities before flowing into Khlong Song Ton Noon Canal.

Consequently, the workers are required to properly follow the Environmental Impact Prevention and Correction Measures, and the Environmental Impact Inspection Follow-up Measures in order to prevent impacts to surface water quality from construction activities, in particular at the 5 specific stations, including W1 Khlong Bang Talad canal Station, W2 Khlong Prapa canal Station, W3 Khlong Prem Prachakorn canal Station, W4 Khlong Lam Chala canal Station, and W5 Khlong Song Ton Noon canal Station.

(f) Hydrological Conditions and Land Settlement Impacts/ Ground Water Quality Impacts

It is assumed no impact to hydrological conditions and land settlement of the construction area since there is no development or digging or pumping of ground water for construction. Impacts to ground water quality due to wastewater and other contamination from construction, however, can be detailed as follows.

- Construction, in particular the base digging to support overpassing rail and stations requires digging massive amount of soils from holes, causing a large-sized concrete structure to intrude ground water resource, in particular Bangkok ground water layer (50 meters depth in average). Therefore, there is a chance that concrete mixtures and lubricants from tools and equipment may contaminate with ground water. However, the construction must input polymers to mix with Bentonite solutions in the holes to avoid soil erosion and to maintain the hole stability. This method helps reduce absorption through sand layer and to help adhere soil or sand particles to accelerate the sedimentation process. It is hence assumed that the disturbance of ground water quality from concrete mixture or lubricants will lead to impact at low level.

- Activities done at the project office will cause wastewater and waste from the use of toilet or dishwashing during daily work routine of the employees working at the project office, so there must be the good design and preparation of sufficient toilets that match with sanitary standard (10 employees/ toilet) and the instant wastewater management system must be installed. Therefore, it can be seen that the flow of water into ground water resources may have no impact to ground water quality and may not cause any contamination from waste and garbage.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

Activities from the construction of the Park & Ride facility and the depot at Rom Klao Junction, particularly soil surface cultivation, land filling, base digging to support the 3-level Park & Ride facility and the depot, may not lead to any impact to hydrological conditions and land settlement of the construction area. There may be low impact from contamination on the non-depth level of soil due to an entire amount of Coliform Bacteria/ Fecal Coliform Bacteria, or chemicals used in the toilets, the use of machines, oil-relevant tools and equipment, or wastewater from machine cleaning during the construction period, etc.

(g) Air Quality Impacts

Impacts from dust particles spreading in the air depend on several factors. The density of dust particles from construction activities around overpassing rail are expected to see dust particles equal to 0.0019 milligrams/ cubic meter during the construction period, complying to the Air Quality Standard under the National Environment Board of Thailand's Notification No. 24 (2004) on "the Determination of Air Quality Standard in the General Atmosphere," that determine the density of dust particles in general atmosphere up to 0.330 milligrams/ cubic meter. In this regard, the dust particle amount is varied throughout the day, variable to construction activities. Therefore, this may create low impact.

The density of dust particles from construction activities around stations may be equal to 0.0005 milligram/ cubic meter, complying to the Air Quality Standard under the National Environment Board of Thailand's Notification No. 24 (2004) on "the Determination of Air Quality Standard in the General Atmosphere," that determine the density of dust particles in general atmosphere up to 0.330 milligrams/ cubic meter. In this regard, the dust particle amount is varied throughout the day, variable to construction activities. Therefore, this may create low impact.

Impacts from vehicles, machines, tools and equipment used for construction in the overpassing rail construction area (up to 1,000 meter per phase) may have Carbon Monoxide (CO_2) 0.0002 per 1 million, Hydro Carbon (HC) 0.0001 per 1 million, Nitrogen Dioxide (NO_2) 0.0002 per 1 million, and Total Suspended Particulate (TSP) 0.0002 milligram per cubic meter, complying to the Air Quality Standard under the National Environment Board of Thailand's Notification No. 24 (2004) on "the Determination of Air Quality Standard in the General Atmosphere". In addition, since the use of machines may not occur concurrently and may not be done continuously all day, the accumulation of pollution from vehicles and machines may be low. Also, the construction duration in each period time frame is short up to 30 days and then moves to the new area along the rail route. The impact will then be low.

Nevertheless, the workers are required to properly follow the Environmental Impact Prevention and Correction Measures, and the Environmental Impact Inspection Follow-up Measures in order to prevent impacts to surface water quality from construction activities, in particular at the 6 vulnerable areas, including A1 the Central Chest Institute of Thailand Station, A2 Chonprathan Songkhro School Station, A3 Khlong Kleur School Station, A4 Rajabhat Phranakhon University Station, A5 Sinpat Hospital Station, and A6 Min Prasart Wittaya Station.

(h) Noise Pollution Impacts

<u>Along Mass Transit Route and Stations</u>

Impacts from construction noise to the communities and vulnerable areas in general ay occur to the environment within the 150 meter radius from the noise origin, as follows.

1. Siam Business Administration College (SBAC)
2. Darulmuttakeen Mosque
3. Sri Sangwan School
4. Khlong Kluea School
5. Chit Chamrun Witthaya School
6. Aphakon Kindergarten
7. Charoenphon Wittaya School
8. Wat Phra Si Mahathat Demonstration Secondary School
9. Anusawari Lak Si Circle

10. Prachaphiban School
11. Pramoch Wittaya School
12. Sinpat Hospital

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

Around Rom Klao Junction, there are local communities and vulnerable areas that may have environmental impacts. The closest areas are Rung Napa Place Village (200 meters), Ramkhamhaeng Housing (180 meters), Min Prasart Wittaya School (200 meters), and Ramkhamhaeng Housing Children Development Center (180 meters).

Consequently, the workers are required to properly follow the Environmental Impact Prevention and Correction Measures, and the Environmental Impact Inspection Follow-up Measures in order to prevent impacts to surface water quality from construction activities, in particular at the 5 vulnerable areas, including A1 the Central Chest Institute of Thailand Station, A2 Chonprathan Songkhro School Station, A3 Khlong Kleur School Station, A4 Rajabhat Phranakhon University Station, A5 Sinpat Hospital Station, and A6 Min Prasart Wittaya Station.

(i) Vibration Impacts

Along Mass Transit Route and Stations

Impacts from pillar drill activities to build the base to support the structures of overpassing rail, stations/ the Park & Ride facility and the depot that may cause PPV_{max} may occur for a short period of time and may not be continuous. Only construction areas will be moderately impacted. However, the workers are required to properly follow the Environmental Impact Prevention and Correction Measures, and the Environmental Impact Inspection Follow-up Measures in order to prevent impacts to surface water quality from construction activities, in particular at the 5 vulnerable areas, including A1 the Central Chest Institute of Thailand Station, A2 Chonprathan Songkhro School Station, A3 Khlong Kleur School Station, A4 Rajabhat Phranakhon University Station, A5 Sinpat Hospital Station, and A6 Min Prasart Wittaya Station.

2) Biological Resources

(a) Aquatic Ecological Impacts

Along Mass Transit Route and Stations

The impacts from construction, particularly from surface cultivation, land filling, base digging to support the structure of overpassing rail and stations, or construction tools and materials moving (e.g. sand, rocks, cements, soils, etc.) may not occur to aquatic ecological conditions of surface water even though the mass transit line will cut through 20 surface water resources. The pier construction of the structure of overpassing rail and stations has no intrusive part to surface water resources and there is no activity that can disturb the quality of surface water or can pose any direct impact to the aquatic surface water conditions, except for 10 stations that are located less than 50 meters from the surface water resources, namely PK-01, PK-10, PK-11, PK-14, PK-15, Pk-20, PK-21, PK-23, PK-29 and PK-30, that may be affected by the increase in water turbidity from soil surface drains only during the period of base digging and land filling, or by the contamination of oils from machines and tools used for construction.

The turbidity and oil stains may impede sunshine from shining through water at some level, and then may reduce the rate of planktons' photosynthesis and the amount of dissolved oxygen from planktons in the water. This may lead to temporary impact during the construction phase only since the construction areas are limited only the traffic island area.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

Rom Klao Junction area is close to the surface water resource (Khlong Song Ton Noon Canal) but there is no intrusive parts into the canal. There may be some impacts from the turbidity of surface drainage only during the period of base digging and land filling.

Consequently, the workers are required to properly follow the Environmental Impact Prevention and Correction Measures, and the Environmental Impact Inspection Follow-up Measures in order to prevent impacts to surface water quality from construction activities, in particular at the 5 specific stations, including W1 Khlong Bang Talad canal Station, W2 Khlong Prapa canal Station, W3 Khlong Prem Prachakorn canal Station, W4 Khlong Lam Chala canal Station, and W5 Khlong Song Ton Noon canal Station.

(b) Terrestrial Ecological Impacts

(1) Forestry Resources

Along Mass Transit Route and Stations

The construction of overpassing rail (distance 34.50 kilometers) and stations (30 stations) is implemented on the construction area with width about 8 meters on traffic island on Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road, except for the area of the bridge across Sanambin Nam Junction and the crossing of Chaeng Wattana Road – Phahonyothin Road – Ram Inthra Road (Anusawari Lak Si Circle) or the part that the mass transit route is diverted out of the traffic island (e.g. the area nearby Lak Si Plaza Department Store, Pak Kret Junction, Si Rat Expressway Crossing, Khlong Kluea School, Rajabhat Phranakhon University, etc.). Consequently, there is a need to cut or remove trees that are taller than 10 meters that may impede the construction, in particular the location of pier areas to support the overpassing rail and stations. This may impact to the loss of ecology and plant society at the low level.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

Rom Klao Junction has 28 tress (8 types) and it is assumed that only some of them may need to be removed or cut for construction area. The removal may pose no or low impact to the ecology balance and the economic value.

(2) Wildlife Resources

Along Mass Transit Route and Stations

The construction of overpassing rail (distance 34.50 kilometers) and stations (30 stations) may require to cut or remove trees that are taller than 10 meters that may impede the construction, in particular the location of pier areas to support the overpassing rail and stations. This may impact to the habitats and activities areas of wildlife in terms of birds. However, birds are usually able to move fast and can migrate to trees along both sides of the roads. In addition, they are very familiar with urban environment and can adapt themselves to changing environment. Therefore, the impact may be low.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

The construction may impact wildlife in terms of birds that live in the bushes or are hidden. However, they can migrate to neighboring areas quickly.

3) Human Utilization Value

(a) Impacts on Land Use

Along Mass Transit Route and Stations

The construction of overpassing rail (distance 34.50 kilometers) on the construction area with width about 8 meters on traffic island on Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road, except for the area of the bridge across Sanambin Nam Junction and the crossing of Chaeng Wattana Road – Phahonyothin Road – Ram Inthra Road (Anusawari Lak Si Circle) or the part that the mass transit route is diverted out of the traffic island (e.g. the area nearby Lak Si Plaza Department Store, Pak Kret Junction, Si Rat Expressway Crossing, Khlong Kluea School, Rajabhat Phranakhon University, etc.), and the construction of stations (30 stations) may require permanent change in land use pattern from empty sideways (PK-30 Min Buri Station, Si Rat Expressway area, and Khlong Kluea School) or existing commercial buildings (PK-15 Rajabhat Phranakhon Station) to be overpassing rail and stations. The impact may be low.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

The Park & Ride facility and the Depot at Rom Klao Junction covers the area of approximately 229 Rai. The land use may be partially changed from empty space (rice field in the past) with Khlong Song Ton Noon Canal and moats around the project to the 3-level building of the Park & Ride facility and the Depot. It is assumed that the impact may be low since the area of land use pattern change is small, comparing with the change from the land use around non-crowded residential areas/semi-commercial areas/commercial areas.

(b) Impacts to Transportation

Along Mass Transit Route and Stations

Impacts to capacity to serve traffic on the existing roads may be moderate to high since most construction activities may use traffic island on Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road.

Impacts to the usage life of the existing roads may occur since the transporting and moving of construction materials or tools-machines to use at the construction sites may be mainly on the existing roads (Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road). This may cause the existing roads to have some damages or deteriorated before the normal usage life.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

The construction of the Park & Ride facility and the Depot at Rom Klao Junction needs the existing roads for transporting and moving of construction materials or tools-machines to use at the construction sites, which may become significant factor causing the existing roads to have some damages or deteriorated before the normal usage life. In terms of capacity to serve traffic on the existing roads, there may be no impact since the construction of the Park & Ride facility and the Depot is limited and is not located on the traffic island of the existing roads.

However, the workers are required to properly follow the Environmental Impact Prevention and Correction Measures, and the Environmental Impact Inspection Follow-up Measures in order to prevent impacts to surface water quality from construction activities, in particular at the 6 specific sites, including Khae Rai Junction, Sanambin Nam Junction, Pak Kret Junction, Vibhavadi Rangsit Ramp, Suan Siam Junction, and Min Buri Junction.

(c) Impacts to Infrastructures and Utilities

Along Mass Transit Route and Stations

There may be impacts to infrastructures and utilities as follows.

Remove waterworks system (Metropolitan Waterworks Authority of Thailand), 300-mm PVC and 300-mm AC pipes along traffic island and sideways of Rattanathibet Road (300 meters), Tiwanon Road (1,200 meters), Chaeng Wattana Road (3,089 meters), Ram Inthra Road (15,975 meters), and Sihaburanukit Road (300 meters)

Remove high voltage posts/cables/electric devices (Metropolitan Electricity Authority) along both sides of Rattanathibet Road (156 posts), TiwanonRoad (179 posts), Chaeng Wattana Road (312 posts), Ram Inthra Road (525 posts), and Sihaburanukit Road (38 posts)

Remove infrastructure (the Highways Department) along both sides and on the traffic island of Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road

Remove telephone lines – aerials, sized 9-d4", 12-D4", 16-D4" (TOT Public Company Limited) along both sides of Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road

Remove cable media – fiber optic, cable media – bronze cable and wiring harness (CAT Telecom Public Company Limited) along both sides of Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road

Remove cable media – fiber optic, cable media – bronze cable and wiring harness (True Corporation Public Company Limited) along both sides of Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, and Ram Inthra Road

Remove cable media –bronze cable and wiring harness (Total Access Communication Public Company Limited) along both sides of Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road

4) Quality of Life Value

(a) Economic and Social Impacts

Impacts to overall economic change of the communities may be low positive.

Impacts to conflicts among trespassers using existing roads or local people with officers and workers due to the construction may be rare or none.

Mostly the construction implemented in the traffic island of Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and Sihaburanukit Road is in the clear zoned area.

Impacts to annoyance and inconvenience of trespassers using existing roads or local people living nearby the construction sites are required immediate solutions and alleviation.

Impacts to existing commercial activities in the construction areas, in particular station construction sites, may happen since the construction may impede entrance and exit of the commercial buldings.

Impacts to overall economy of the communities are the increase of skilled labor employment.

Impacts to land value due to the mass transit system may be positive due to the convenience and speedy transit that may welcome and stimulate more investments, in particular the areas around all 30 stations, and the Park & Ride facility and the depot at Rom Klao Junction. This may significantly impact in the change of land use pattern.

The workers are required to properly follow the Environmental Impact Prevention and Correction Measures, and the Environmental Impact Inspection Follow-up Measures to prevent complaint from impacted public. In addition, the informational sessions and public hearing are requisite, and the feedbacks from the relevant public must be addressed in a timely manner.

(b) Migration and Land Expropriation Impacts

Migration and land expropriation may affect mental health of migrants and the owner of the expropriated lands and properties, in particular the area along the mass transit route that has to be diverted out of the traffic island on Rattanathibet – Tiwanon Road (KM.0+300 – KM.1-180), Tiwanon - Chaeng Wattana Road (KM.6+230 – KM.6-656), Chaeng Wattana Road (KM.9+500 – KM.11-150, KM.14+750 – KM.15+950, KM.16+400 – KM.18+000, KM32+135 -) and Ram Inthra – Sihaburanukit Road (KM.33+800 – KM.34+300).

(c) Public Health and Safety Impacts

Local people or trespassers may be impacted by receiving or exposing to total suspended particulate (TSP), or dust particles that are smaller than 10 micron (PM-10) spreading in the atmosphere, e.g. eye irritation or respiratory system issues.

Residential areas – commercial buildings and areas that are vulnerable to noise (religious venues, educational institutes, and medical centers) may be considerably impacted from the construction activities if they are within 100 meters away from the noise origin.

If people who work within the construction sites are lack of carefulness and if the machines, tools and equipment that are used have some damages or are broken, this may easily pose impacts to health, life and properties.

The sufficient number of public health center and medical staff may help decrease impacts to the low level of severity. Currently health service system in the construction areas and neighboring areas has throughout coverage since the areas are big urban areas with complete infrastructures.

There may also be impacts to mental health of people due to the lack of adaptability. These impacts are persistent impacts and may be increasingly severe. However, the chance of this impact to happen is low since the problems related to traffic and pollution from construction works and vehicles on the existing roads are already common.

(d) Historic and Archaeological Site Impacts

Along Mass Transit Route and Stations

There is no direct impact to the loss or the destruction of historic or archaeological site because the construction areas are mostly on the traffic island of the existing roads. However, there may be indirect impact to 12 significant historic or archaeological sites that are related to the communities within 500-meter radius from the mass transit line.

Noise from the use of a more than 1, or 2-3 heavy-duty machines or large-sized machines at the same time will impact people along the existing roads within 20 meter. The maximum noise is 86.22 Decibel(A), that does not exceed the maximum noise standard (115 Decibel(A)) but exceeds the general noise standard (70 Decibel(A)) in accordance with the National Environment Board's Notification No. 15 (1997). This therefore may lead to moderate impact that may annoy or disturb people who visits or learns from the historic or archaeological sites or significant venues related to the communities within 500-meter radius from the mass transit line.

Vibration originated for pillar drill activities to build the base to support the structure of overpassing rail and stations within 30-meter radius from the origin has PPV_{max} equal to 2.387 millimeter/second. When comparing with the Regulations on Vibration to Structures/Buildings of DIN 4150 (Nelson, 1987), it is found that there is no risk to cause any damages to general building or architectural structures but measures for monitoring of vibration from such activities are required.

The impact to learners and visitors who want to visit or conduct any religious practices or ceremonies is the convenience to enter the religious venues, or the historic or archaeological sites, or significant venues related to the communities due to some physical obstacles.

(e) Aesthetic Landscape Impacts

Along Mass Transit Route and Stations

Along the mass transit line, there are 5 significant historic – cultural venues or unique structures with value and distinctive characteristics, located in the influenced areas that may have aesthetic landscape impacts, or within 50 meters from the mass transit line, including Nonthaburi City Pillar Shrine (New), Makut Ramayasara Park, Darulmuttakeen Mosque, Wat Chonlaprathan Rang Srit Temple, and Anusawari Lak Si Circle. Therefore, this is a moderate impact that may hide the distinctive venues by its height or the contrast of characteristics within the landscape components.

CHAPTER 2

ACTION PLAN IN ACCORDANCE WITH ENVIRONMENTAL IMPACT PREVENTION AND CORRECTION MEASURES AND ENVIRONMENTAL IMPACK INSPECTION FOLLOW-UP MEASURES

CHAPTER 2
ACTION PLAN IN ACCORDANCE WITH ENVIRONMENTAL IMPACT PREVENTION AND CORRECTION MEASURES AND ENVIRONMENTAL IMPACK INSPECTION FOLLOW-UP MEASURES

2.1 Guidelines on the Implementation Inspection under Environmental Impact Prevention and Correction Measures

Guidelines on the implementation inspection under Environmental Impact Prevention and Correction Measures were determined in the Environmental Impact Assessment. Such report was endorsed by the National Environment Board of Thailand at the Meeting 1/2558 on 18 March 2015, in accordance with the *Office* of Natural Resources and Environmental Policy and Planning's Notification No. TS (KKWL) 1005/W 7091 dated 22 June 2015). The report aims to promote the implementation under the measures, under the working concept focusing on encouraging inspection by providing recommendations for projects leading to proper actions in accordance with requirements and academic theories on the basis of practical implementation. Consequently, inspection processes in each specific area along the construction line must be implemented as follows.

1) Organize a joint meeting between the inspector team, including consulting company, contractor, project owner, and project owner's consultant in order to inform of key purposed of the implementation under the measures and contents of the measures that determine processes to inspect the implementation in accordance with the measures.

2) Inspect construction areas to jointly inspect actual implementation in accordance with the measures in terms of potential impacts from implementing activities, as well as vulnerable points determined in the measures, whereas during the inspection, the team is required to inquire details from the workers to know problems and, if the implementation cannot be performed or can be partially performed, the limitations must be addressed to support the proposal of recommendations to solve problems or to correct the implementation on the basis of reasonable academic theories.

3) Record inspection outcomes during the inspection by using the Inspection Report Form for the Implementation in accordance with the Measures, as shown in Table 2-1.

4) At the end of each inspection, assess and summarize the inspection outcomes for contractor and project owner's information and, if there is any urgent environmental impacts, such as damaged road that may cause accidents, requiring prevention/solution, UAE must provide immediate guidelines to solve and to cease impacts first before proposing long-term solutions to eliminate the impacts further. In this regard, the summary needs to provide details with supporting pictures to create clear understanding on inspected issues.

5) Prepare inspection summary and provide to contractor and project owner for their reference within 5 days from the day of inspection.

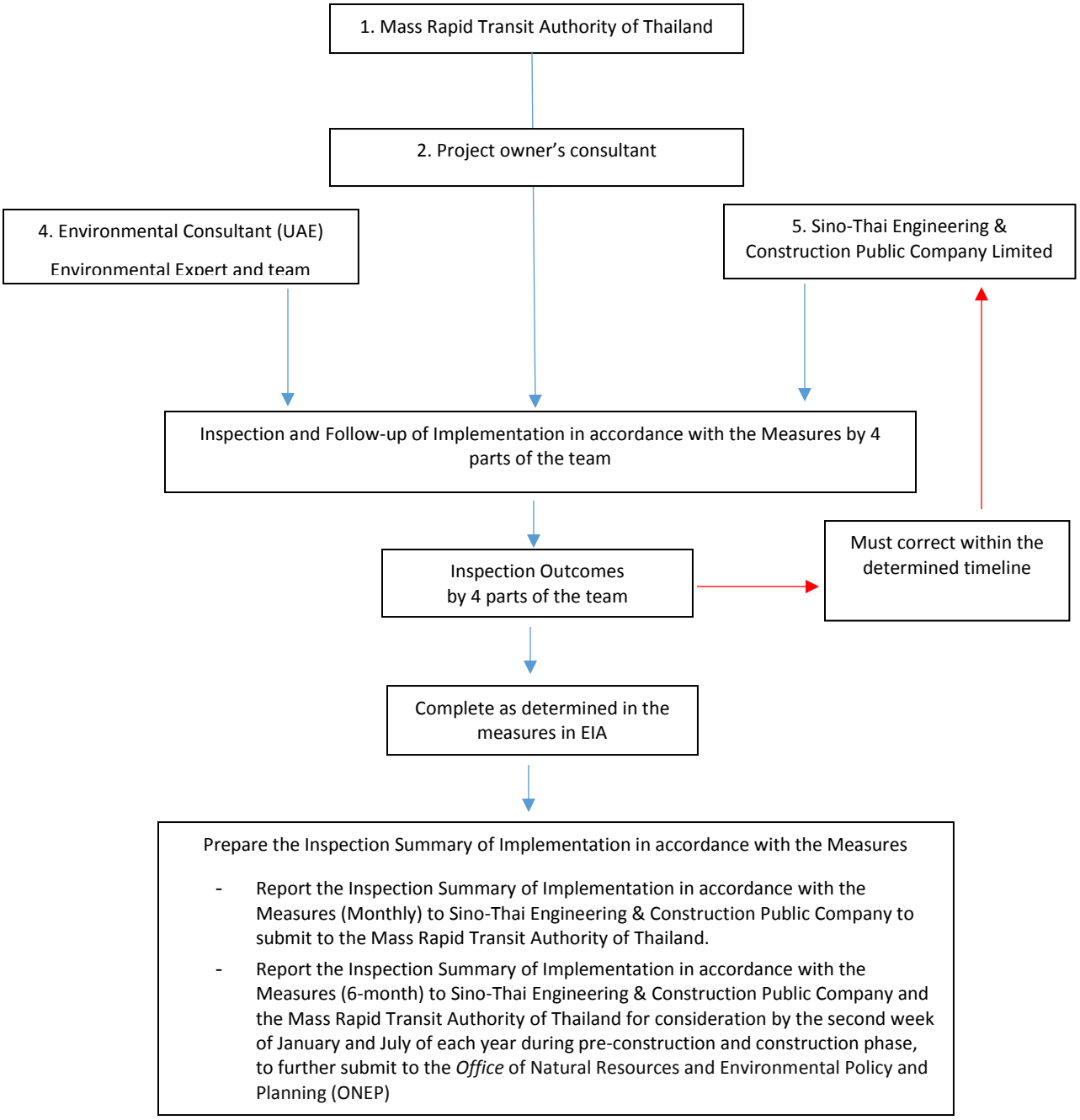
Table 2-1 Sample of the Inspection Report Form for the Implementation in accordance with the Measures

Environmental Impact Prevention and Correction Measures	Implementation			Details of Implementation in accordance with the measures
	Implemented	Not implemented	Partially Implemented	
Nonthaburi Civic Center Station (Pier No. A – Pier No. B)				
Rail route between Nonthaburi Civic Center Station – Khae Rai Station (Pier No. B - Pier No. C)				
Khae Rai Station (Pier No. C - Pier No. D)				

6) Prepare inspection summary and provide to contractor and project owner for their review and consideration by

- Submit the Inspection Summary of Implementation in accordance with the Environmental Impact Prevention and Correction Measures and the Environmental Impact Inspection Follow-up Measures for pre-construction period within 30 days from the last days of inspection follow-up of pre-construction environmental impacts to Sino-Thai Engineering & Construction Public Company Limited in order to further submit to the Mass Rapid Transit Authority of Thailand (MRTA) (6 sets of summary in Thai language).
- Submit monthly the Inspection Summary of Implementation in accordance with the Environmental Impact Prevention and Correction Measures and the Environmental Impact Inspection Follow-up Measures within 30 days from the last days of inspection follow-up of pre-construction environmental impacts to Sino-Thai Engineering & Construction Public Company Limited in order to further submit to the Mass Rapid Transit Authority of Thailand (MRTA) (6 sets of summary in Thai language).
- Submit the Inspection Summary of Implementation in accordance with the Environmental Impact Prevention and Correction Measures and the Environmental Impact Inspection Follow-up Measures in accordance with conditions to submit report every 6 months (in January and July of every year during pre-construction phase and construction phase) to Sino-Thai Engineering & Construction Public Company Limited in order to further submit to the Mass Rapid Transit Authority of Thailand (MRTA) and the *Office* of Natural Resources and Environmental Policy and Planning (6 sets of summary in Thai language).

In this connection, the inspection of the implementation in accordance with the measures can be described in chart to show the linkage of the 4 parts of the team, including 1) project owner, 2) project owner's consultant, 3) contractor and 4) environmental consultant company of the contractor (UAE). The reporting guidelines for correcting and improving implementation in accordance with the measures of this project to generate outcomes and to achieve objectives presented in EIA are shown in the chart picture (Picture 2-1) below.



Picture 2-1 : Chart presenting Linkage between the Team and Reporting Structure to correct the implementation in accordance with the Environmental Impact Prevention and Correction Measures of the Project

2.2 Environmental Impact Prevention and Correction Measures

2.2.1 General Measures

1) Environmental Measures and Action Plan for Implementation
   1.1) Follow all of the Environmental Impact Prevention, Correction, and Elimination Measures and the Environmental Impact Inspection Follow-up Measures of the project in order to implement the project as presented in the Environmental Impact Assessment of the MRT Pink Line (Khae Rai – Min Buri) Project, and as additionally suggested by the expert committee, whereas this must be included in terms and conditions of contract made with the design contractor and/or the construction and project administration contractor.
   1.2) Monitor and supervise the design contractor and/or the construction and administration contractor to comply with the Environmental Impact Prevention, Correction, and Elimination Measures and the Environmental Impact Inspection Follow-up Measures as presented in the MRT Pink Line Project's Environmental Impact Assessment.
   1.3) Recruit third party to follow up the inspection of the implementation in accordance with the Environmental Impact Prevention, Correction, and Elimination Measures and the Environmental Impact Inspection Follow-up Measures as presented in the report, by setting total budget as part of the expenses related to the MRT Pink Line (Khae Rai – Min Buri) Project, under the supervision of the Mass Rapid Transit Authority of Thailand (MRTA), and designate the Committee to follow up the Inspection and the Implementation of the Environmental Measures, consisting of the *Office* of Natural Resources and Environmental Policy and Planning, the State Railway of Thailand, the Highways Department, the Pollution Control Department, Nonthaburi Province, Bangkok Metropolitan, the Office of the Consumer Protection Board, private development organizations, experts, etc., to monitor and follow up the environmental measure compliance for the entire project.
2) MRTA will prepare the summary on the implementation outcomes of the Environmental Impact Prevention, Correction, and Elimination Measures and the Environmental Impact Inspection Follow-up Measures as determined in the report, and will report the implementation outcomes of such measures every 6 month to the *Office* of Natural Resources and Environmental Policy and Planning and relevant bodies for reference.
3) MRTA complies with the Environmental Impact Prevention, Correction, and Elimination Measures and the Environmental Impact Inspection Follow-up Measures as presented in the report and approved by the expert committee on the consideration of the Environmental Impact Assessment in terms of transport of the government agencies, the state-owned enterprises, or project cooperating with private sector. Should there be any changes to project details or measures that do not impact the significant contents of the environmental impact assessment outcomes in the report and are measures that benefit to environments more than or as same as measures provided in the Environmental Impact Assessment Report approved by the expert committee, it must be presented to legal enforcement bodies in the area, copying the *Office* of Natural Resources and Environmental Policy and Planning for acknowledgement. If the change or correction of the measures impact to the significant contents of the environmental impact assessment outcomes in the report, the revised report and the changes to the Environmental Impact Assessment must be presented to the *Office* of Natural Resources and Environmental Policy and Planning for further approval by the expert committee before implementation.

4) For construction and implementation of the project, should there be any environmental impacts or any complaints, the Mass Rapid Transit Authority of Thailand, design contractor, construction contractor and administration contraction shall perform actions to urgently prevent and correct, as well as inform to the *Office* of Natural Resources and Environmental Policy and Planning and relevant bodies for acknowledgement in order to cooperatively seek for solutions and recommendations to the issues further.

2.2.2 Physical Environmental Resources

(a) Geographical Conditions

Construction Period

Along Mass Transit Route and Stations

- The construction of the depot and the Park & Ride facility around Rom Klao Junction may not potentially impact to the change of geographical condition. Therefore, there is no need to determine the prevention, correction, and elimination measures.

(b) Soil Resources

Construction Period

Along Mass Transit Route and Stations

1) Determine clear construction zone by building non-transparent fence around the area that will be used for construction, at least 2.0 meters higher from the ground to prevent soil erosion and collapse to flow into the public water resources, or lower plain land, or surface water resources.
2) Perform activities, land digging/filling, removing infrastructures such as waterworks pipes, water drainage, electric posts, digging for base building, in the draught season to prevent soil erosion.
3) Soil piling and the laying of tools and materials used for construction must be as far away from the surface water resources as possible and must avoid the area that can easily collapse, in particulate the areas close to the surface water resources, such as Khlong Bang Talad canal, Khlong Prapa canal, Khlong Prem Prachakorn canal, Khlong Thanon canal/Khlong Bua canal, and Khlong Song Ton Noon canal.
4) The construction area that is empty and has no cover must be treated to have more stability by using small rocks, or canvas, or plants to cover temporarily.
5) Use soil gained for the digging of base for land filling in the area of the depot around Rom Klao Junction, or to trash in the area authorized by MRTA; whereas soil shall not be piled in the construction area for too long.
6) The construction area of the depot and the Park & Ride facility at Rom Klao Junction must have temporary water drainage size 0.60 x 0.60 meters around the construction area and 2 sediment traps size 1.00 x 1.00 x 1.00 meter each at the end of temporary water drainage to filter sediments flowing together with water/rainwater before flowing into the surface water resources, public water drainage, or low plain land.
7) For activities of land digging and surface cultivation in the construction area of overpassing rail, stations, the depot, and the Park & Ride facility at Rom Klao Junction, after the land use finishes, the soil must be compressed and has smooth surface, or must be covered with plants immediately to avoid erosion, in particular during the rainy season.

(c) Geological Conditions and Earthquake

Construction Period

Along Mass Transit Route and Stations

1) There must be steel sheet pile around the construction areas that have pillar drill; whereas the steel sheet pile must be as deep as the moderate soft clay layer, which is approximately 18 meters in depth from the original ground level.
2) There must be steel sheet pile around the construction areas that are close to surface water resources, e.g. Khlong Bang Talad canal, Khlong Prapa canal, Khlong Prem Prachakorn canal, Khlong Lam Chala canal, and Khlong Song Ton Noon canal, or the area of loose soil, in order to avoid soil erosion.
3) In the case of pillar drill, polymer slurry must be used to avoid erosion and to maintain stability of the holes; whereas the polymer slurry can help reduce the absorption through sand layer and to adhere small soil and sand particles together to accelerate the sedimentation process.
4) There must be a design for land settlement adjustment structure that is built on top of the base of overpassing rail that overlaps with the traffic surface of the plain road; whereas the land settlement adjustment structure must have scape that is designed for the various levels of settlement that may take place from the vertical movement of plain road and the piers of the overpassing rail. This may help reduce the damage to traffic surface and prevent settlement issue of road surface and pier base of the overpassing rail structure on the traffic island.
5) For structures that have potential vibration, in general they must be held to be in the position that can resist to the horizontal force from earthquake, whereas the project engineers are required to bring in seismic buffers or stopper to use with the structure above the bridge poles to prevent that structure above the poles or the bridge structure from slipping out. The seismic buffers must be securely held to the concrete shear key box above the pole top. Polymer slurry must be used to avoid erosion and to maintain stability of the holes; whereas the polymer slurry can help reduce the absorption through sand layer and to adhere small soil and sand particles together to accelerate the sedimentation process. If the base of piers of the overpassing rail and stations is close to the traffic surface, the unequally settlement of the traffic surface may take place so there must be a design for land settlement adjustment structure that is built between the base of piers of the overpassing rail and the stations, and the plain road to avoid damages to the traffic surface; whereas the land settlement adjustment structure must be built on top of the base of piers of the overpassing rail and the stations that overlaps with the traffic surface of the plain road and must have scape for the case of unequal settlement from the vertical movement of plain road and the piers of the overpassing rail to help reduce the damage to traffic surface.

(d) Surface Water Hydrological Conditions and Drainage e

Pre-construction Period

- There must be 2 retention ponds in the areas of the depot and the Park & Ride facility at Rom Klao Junction, whereas the minimum capacity of a retention pond in zone A must be 5,541.66 cubic meter, and the minimum capacity of a retention pond in zone B must be 9,775.91 cubic meter. There must also be 3 sets of pump installed (2 Duty 1 Standby).

Construction Period

Along Mass Transit Route and Stations

1) Keep construction materials, tools and machines used for construction in an organized manner to avoid soil particles, sand, clay from falling and contaminating to the water resources.

2) There must be embankment line to prevent soil erosion from land surface cultivation during the construction.
3) The land surface cultivation must be done before rainy season. If there is a need to implement during the rainy season, the soil layers must be compressed and must be smooth, as well as the moving of materials, in particular soils and concrete, must be done carefully to avoid soil erosion, particularly in rainy season (May – November).
4) Do not trash wastes and garbage, as well as leftovers of construction materials in to the public water resources or public water drainage in the areas close to the construction.
5) Construction materials leftovers must be kept properly with canvas cover to avoid soil erosion from rain into the water resources.
6) Perform activities, land digging/filling, removing infrastructures such as waterworks pipes, water drainage, electric posts, digging for base building, in the draught season to prevent soil erosion from rain into the water resources.
7) Build temporary drainage or small ponds to prevent flooding in the construction and neighboring areas.
8) Soil from the base construction must be piled specifically and must be closed or covered or kept in the close areas and there must be trucks to pick them up for trashing in the designated areas within 24 hours.
9) Prevent construction activities from contaminating oil into the water resources.
10) Pollution from construction, such as maintenance tools involving oil, must be discarded by using methods that meet with the sanitation.
11) Inspect pipe/drainage condition along all of construction line. Should there be any blockage, filling with soil and sand, or having obstacles, it must be removed as soon as possible to avoid blocking water flow.
12) If there is flooding in the surrounding area due to the project, the contractor must bring in pump to drain water out in a timely manner.
13) There must be a line to prevent rainwater contaminated with construction materials from flowing into the surface water resources nearby, whereas there must be a system to collect water direct to the drainage.
14) In the case of soil digging in the construction area leading to the pile of soil, the pole must be far away from the water resources and must be piled specifically and kept in the securely close area.
15) There must be sufficient drainage system, gutter, and sedimentation tank to receive rainwater, particularly in the areas that will be used for stations extension and building before flowing into public drainage, and they must be maintained and cleaned on a regular basis to be efficiently used at all time.
16) There must be sufficient sanitation toilets at the temporary built office and employee's residential area.
17) The maintenance and repair of construction tools and equipment must be done within the repair shop only.
18) There must be a wastewater pond to receive wastewater from activities, such as machine and tool washing.
19) There must be sufficient sanitation toilets at the rate of 10 employees/ toilet.

(e) Surface Water Quality

Construction Period

Along Mass Transit Route and Stations

1) The contractor must establish "Project Office" close to the construction area, where as "Employees' Residential Community" must be separate from the project office. In addition, the contractor must seek for/build the employees' residential community away from mass transit line at least 5 kilometers and must be approved by MRT first, and complied with laws/regulations of local authorities regarding the construction, or in accordance with the Building Control Act B.E. 2522 (1979), or Ministry of Interior's Regulation No. 55 B.E. 2543 (2000) strictly.
2) There must be a net or a canvas covering the structure under the overpassing rail and stations to receive construction materials, e.g. soil particles/ rocks/ sand/ cement, that may fall off or fall down to the surface water resources that will increase water turbidity to the surface water resources, in particular the construction areas that are close to the surface water resources less than 50 meters.
3) Construction activities, land digging/filling, removing infrastructures such as waterworks pipes, water drainage, electric posts, digging for base building, must be finished before rainy season. If there is a need to implement during the rainy season, the soil layers must be compressed and must be smooth, as well as the moving of concrete must be done carefully to avoid increasing water turbidity from land erosion, draining, or the contamination of oil/lubricants from machines and tools used for construction.
4) There must be sufficient sanitation bathrooms/toilets at the rate of 10 employees/ toilet.
5) There must be the installation of 5 instant wastewater management systems with capacity of 2 cubic meter/ system to be able to treat waste water 10.0 cubic meter/ day. This will be used for treating wastewater and wastes from activities involving the use of bathrooms/toilets or dish washing during daily work routine of the 200 employees working at the project office.
6) There must be trashes size 240 liters with close lid for dry garbage, wet garbage, dangerous waste, and recycle, spreading around the area in group, 4 trashes per group, within the project office, and the project must coordinate with the Bangkok Metropolitan or other local authorities in Nonthaburi Province to pick up garbage and wastes for disposal in accordance with the sanitation measures.
7) Wastewater from construction activities, such as lubricant transfer, construction tool and equipment washing and cleaning, vehicle washing, must be compiled in the area of project office, away from surface water resources at the minimum of 100 meters; whereas it must be treated before flowing into the natural water resources. It Is required to install 2 instant wastewater management systems with capacity of 6 cubic meter/ system to be able to treat waste water 12.0 cubic meter/ day.
8) The construction area of the depot and the Park & Ride facility at Rom Klao Junction must have temporary water drainage size 0.60 x 0.60 meters around the construction area and 2 sediment traps size 1.00 x 1.00 x 1.00 meter each at the end of temporary water drainage to receive wastewater from construction activities, such as construction tool and equipment washing and cleaning, and vehicle washing, or to filter soil mixing with water/rainwater from directing into the surface water resources, public water drainage or low plain land.

(f) Air Quality

Construction Period

1) The contractor is required to comply with regulations and practices on pollution control for each specific type of construction of the Pollution Correction Committee for Bangkok metropolitan and communities in Thailand.
2) Along construction line, light signal must be installed every 30 meters. The installation must be finished before starting construction and must be destroyed or removed immediately when the construction is finished.
3) It is required to use the ready mixed concrete or the concrete that is made and mixed from outside the construction areas to avoid and eliminate impacts to the communities around the construction areas.
4) It is required to spray water on existing road structures at least 3-4 times a day or as appropriate to reduce floating dust.
5) It is required to remove construction material leftovers or dg soil pile out of the construction areas as fast as possible within 24 hours.
6) It is required to have staff to clear up and clean up the construction areas daily, as well as there must be the organization of material and tool laying to avoid floating dust throughout the construction period.
7) It is required to have a unit to control, maintain and inspect vehicles and machines used for construction at least 1 time a week to avoid blowing dust (TSP and PM_{10}) and pollution (e.g. CO, NO_x, SO_2). Should there be any problems, it must be corrected immediately.
8) It is required to sweep and clean, or remove soil sediments/clay adhering to the vehicle tires before leaving the construction areas anytime in the area of overpassing rail and stations construction.
9) It is required to have a place for tire/truck and vehicle washing and cleaning at every exit to avoid soil and clay from falling on to the traffic surface outside of the construction area of the depot and the Park & Ride facility.
10) There must be speed limit for all truckers coming in and out for material transportation that pass the residential communities and vulnerable areas that may be impacted in terms of environment, such as religious places, medical centers, and educational institute, etc. The speed limit is up to 30 km/hour. This is to reduce floating dust and for traffic safety.
11) Construction materials pile in the construction area and the truck that transports construction materials into the construction area must have cover material to avoid floating dust and materials falling off.
12) Employees/workers are required to wear equipment to prevent dusts and other pollution (e.g. CO, NO_x, SO_2) when entering into the construction area that has floating dust or pollution from the use of machines and equipment for construction, in particular land surface cultivation, base digging, removing or moving construction materials, mixing concrete, etc.
13) There must be a net or a canvas covering the structure under the overpassing rail and stations to receive construction materials, e.g. soil particles/ rocks/ sand/ cement, that may fall off, or to avoid floating dusts 10 meters above the ground.
14) It is required to have traffic surface washing on the existing road structures along the line of the construction of overpassing rail and stations at night at least 4 days a week, during the operation hours starting from 24:00 hours but no later than 03:00 hours of the following day.

15) It is required to have a unit to control, maintain and inspect vehicles and machines used for construction at least 1 time a week to avoid blowing dust (TSP and PM_{10}) and pollution (e.g. CO, NO_x, SO_2). Should there be any problems, it must be corrected immediately.
16) For the case of the construction areas of overpassing rail and stations on the traffic island of the existing road structure, the space may not be sufficient to build tire washing area. Therefore, it is required to have 3-4 employees/ construction area to sweep and clean, or remove soil sediments/clay adhering to the vehicle tires before leaving the construction areas anytime. As for the construction area of the depot and the Park & Ride facility at Rom Klao Junction, there must be a place for tire and vehicle cleaning and washing to get rid of soil, clay or cement or sand since these materials when adheres to the vehicle tires may fall on to the traffic surface outside of the construction area.
17) The employees who drive vehicles for transporting construction materials or soil are required to drive with carefulness and comply with the speed limit up to 30 km/hour.
18) There must be a measure determining the use of cover materials for covering the trucks used for transporting construction materials/equipment to prevent falling down/falling off of the construction equipment or material leftovers from the construction on to the existing road surface or waterways along the route that the vehicles that transport construction materials/equipment move along.
19) Employees/workers are required to wear equipment to prevent dusts and other pollution, e.g. CO, NO_x, SO_2, when entering into the construction area that has floating dust or pollution from the use of machines and equipment for construction, in particular land surface cultivation, base digging, removing or moving construction materials, mixing concrete, etc.
20) It is required to have a sign showing route diversion/bypass for people who transport on the existing road structure to know alternative routes, and it is required to coordinate with the responsible police offices of each avoidable route.

(g) Noise Pollution

Construction Period

Along Mass Transit Route and Stations

1) It is required to use tools, equipment and machines that may not create noise, or to use noise reduction equipment or control noise from machines, such as noise reduction pipe or cover in the case that the noise pollution is over 90 Decibel (A) at the noise origin continuously more than 1 hour.
2) It is required to have concrete barrier and metal sheet high 2 meters at the construction areas on the existing road structures to show boundary of the construction area. It is also required to have non-transparent fence high 2 meters around the construction area of the depot and the Park & Ride facility at Rom Klao Junction to reduce impacts from noise pollution from the construction.
3) Check the conditions of machines and tools, or vehicles used for construction to be in good condition at all time throughout the construction to avoid noise pollution over the standard limit determined by relevant bodies, such as the Department of Land Transport, the *Office* of Natural Resources and Environmental Policy and Planning (ONEP), the Department of Pollution Control, or Bangkok Metropolitan, etc.
4) There must be speed limit for all truckers coming in and out for material transportation that pass the residential communities and vulnerable areas that may be impacted in terms of environment,

such as religious places, medical centers, and educational institute, etc. The speed limit is up to 30 km/hour. This is to prevent noise pollution.

5) Construction operation hours are determined in 2 periods as follows.
   - Period 1 Daytime: This starts from 8:00 hours and ends no later than 18:00 hours for main structure construction, such as overpassing rail and stations, including base digging for base to support overpassing rail and stations, concrete filling for piers of the overpassing rail/station floor.
   - Period 2 Night time: This starts from 21:00 hours and ends no later than 05:00 hours of the following day for construction that may not cause noise, or cause low noise ($_{Leq\ 24\ hrs}$ < 70 Decibel (A), or l_{max} < 115 Decibel (A)) to reduce noise during resting hours of the communities on the existing road structure, such as removing concrete mold/concrete pole/ready mixed concrete floor, or moving/removing excessive material or unused construction equipment outside of the construction area.

Areas Surrounding Depot and Park & Ride facility at Rom Klao Junction

1) Since the construction area of the deport and the Park & Ride facility at Rom Klao Station is conducted on the empty space with clear fence, the operation hours may start from 8:00 hours and end no later than 18:00 hours. No construction is allowed during other time, except for removing concrete mold/concrete pole/ready mixed concrete floor, or moving/removing excessive material or unused construction equipment outside of the construction area, which can be done during 19:00 – 21:00 hours.

2) The employees/contractor that have to work in the construction areas or the areas that have noise above 90 Decibel (A) for the continuous period of 8-10 hours are required to wear noise reduction equipment or devices, such as ear muffs, or ear plugs. In addition, the employees/workers that have to work in the construction areas or the areas that have continuous noise must be rotated at least 15 days/ team.
3) The contractor must install sound absorption materials under the 2 stations, including pK04 Samakkhi Station, and PK15 Rajabhat Phra Nakhon Station to reduce impacts from noise. In this regard, the contractor must consider using glass fiber aluminum sheet sound absorption materials to reduce echo from traffic. The ceiling under stations that will be used in the project must have Sound Absorption Coefficient at the minimum of 70 percent at frequency 400 hertz and 80 percent at frequency 1,000 hertz.
4) The construction activities that may create noise must be informed to public occasionally, particularly to the nearby communities.
5) It is required to use rubber floor instead of metal sheet for constructing temporary road to reduce noise from passing vehicles and temporary metal sheets can be used only when needed. Should there be any complaints about noise from public, the issue must be addressed immediately.
6) It is required to use pillar drill in the construction area that is a city or a community to avoid noise impacts.

(h) Vibration

Construction Period

Along Mass Transit Route and Stations

1) The design details for the construction of overpassing rail, stations, depot and Park & Ride facility at Rom Klao Junction must be able to tolerate vibration from earthquake or geo-hazard with safety and in accordance with the Ministry of Interior's Regulation on "the Determination of Weight

Capacity, Resistance, Building Durability, and Building Base Land for Tolerating Earthquake Force B.E. 2550 (2007)" under the Building Control Act B.E. 2522 (1979).

2) The construction of the base of building structure of overpassing rail, stations, depot and Park & Ride facility must use circular bored pile or barrette pile to reduce vibration to vulnerable areas that may be environmentally impacted less than 30 meters from existing road structures, including 14 places, namely Siam Business Administration College (SBAC), Boromarajonani College of Nursing, Central Chest Institute of Thailand, Saman Pichakorn School, Army Quartermaster Department, Chonprathan Songkhro School, Sri Sangwan School, Khlong Kluea School, Aphakon Kindergarten, Charoenphon Wittaya School, Rajabhat Phranakhon University, Wat Phra Si Mahathat Demonstration Secondary School, Anusawari Lak Si Circle, and Sinpat Hospital.
3) The installation of steel sheet pile during the base construction for overpassing rail and stations must be as deep as the moderate soft clay layer, which is approximately 18 meters in depth from the original ground level that may prevent and reduce vibration at depth to not disturb areas along the existing road structure, in particular vulnerable areas that may be environmentally impacted less than 30 meters from existing road structures, including 14 places, namely Siam Business Administration College (SBAC), Boromarajonani College of Nursing, Central Chest Institute of Thailand, Saman Pichakorn School, Army Quartermaster Department, Chonprathan Songkhro School, Sri Sangwan School, Khlong Kluea School, Aphakon Kindergarten, Charoenphon Wittaya School, Rajabhat Phranakhon University, Wat Phra Si Mahathat Demonstration Secondary School, Anusawari Lak Si Circle, and Sinpat Hospital.
4) The construction that may cause vibration must be conducted during 08:00 -18:00 hours, including base digging for overpassing rail and stations, or the depot and the Park & Ride facility, to avoid disturbing normal community activities in the neighbor communities and vulnerable areas to the environmental impacts.
5) Should there be any activity that may cause persistent vibration, in particular digging work for the base construction, the force use for each pillar drill must be adjusted but increasing number of digging times to reduce vibration.
6) All vehicles coming in and out for material transportation must strictly comply with traffic regulations, as well as limit their speed up to 30 km/hour, with weight up to 25 tons when passing residential communities or commercial areas or the environmental impact vulnerable areas, such as medical centers, educational institutes, and religious venues, etc.
7) Should there be any complaint, there must be an action to inspect and analyze damages. If it is found that the damage is caused by the construction, the damage must be assessed and the solutions must be came up with to provide immediate assistance.
8) Should there be any construction activities close to the environmental impact vulnerable areas, such as medical centers, educational institutes, and religious venues, etc., it must be informed to public in advance and on a continuous basis.
9) Before each construction that may cause vibration to houses, buildings or structures, employees/ civil engineers/ structural engineers must inspect and record current pictures before every time of implementation to avoid damages to people.

2.2.3 Biological Resources

(a) Hydro Ecology System

Construction Period

Along Mass Transit Route and Stations

1) Keep construction materials, tools and machines used for construction in an organized manner to avoid soil particles, sand, clay from falling and contaminating to the water resources.
2) There must be embankment line to prevent soil erosion from land surface cultivation during the construction.
3) The land surface cultivation must be done before rainy season. If there is a need to implement during the rainy season, the soil layers must be compressed and must be smooth, as well as the moving of materials, in particular soils and concrete, must be done carefully to avoid soil erosion, particularly in rainy season (May – November).
4) Do not trash wastes and garbage, as well as leftovers of construction materials in to the public water resources or public water drainage in the areas close to the construction.
5) Construction materials leftovers must be kept properly with canvas cover to avoid soil erosion from rain into the water resources.
6) Perform activities, land digging/filling, removing infrastructures such as waterworks pipes, water drainage, electric posts, digging for base building, in the draught season to prevent soil erosion from rain into the water resources.
7) Build temporary drainage or small ponds to prevent flooding in the construction and neighboring areas.
8) Soil from the base construction must be piled specifically and must be closed or covered or kept in the close areas and there must be trucks to pick them up for trashing in the designated areas within 24 hours.
9) Prevent construction activities from contaminating oil into the water resources.
10) Pollution from construction, such as maintenance tools involving oil, must be discarded by using methods that meet with the sanitation.
11) Inspect pipe/drainage condition along all of construction line. Should there be any blockage, filling with soil and sand, or having obstacles, it must be removed as soon as possible to avoid blocking water flow.
12) If there is flooding in the surrounding area due to the project, the contractor must bring in pump to drain water out in a timely manner.
13) There must be a line to prevent rainwater contaminated with construction materials from flowing into the surface water resources nearby, whereas there must be a system to collect water direct to the drainage.
14) In the case of soil digging in the construction area leading to the pile of soil, the pole must be far away from the water resources and must be piled specifically and kept in the securely close area.
15) There must be sufficient drainage system, gutter, and sedimentation tank to receive rainwater, particularly in the areas that will be used for stations extension and building before flowing into public drainage, and they must be maintained and cleaned on a regular basis to be efficiently used at all time.
16) There must be sufficient sanitation toilets at the temporary built office and employee's residential area.
17) The maintenance and repair of construction tools and equipment must be done within the repair shop only.

18) There must be a wastewater pond to receive wastewater from activities, such as machine and tool washing. In addition, there must be sufficient sanitation toilets at the rate of 10 employees/ toilet.

(a) Hydro Ecology System

- Forestry

Construction Period

Along Mass Transit Route and Stations

1) Remove trees that impede the construction outside the construction areas by using tie and dig out (no cut) method and replant in the area determined by MRTA. The specie and amount of trees that were removed must be recorded.
2) The moving of soil from base digging or materials, equipment and machines by mid- to large-sized trucks must be especially careful to avoid damages to trees in the close vicinity.
3) After the completion of the mass transit system, the following actions must be implemented.
   - Bring back trees that were tied and removed before the construction period to replant in the empty space along the mass transit line, or the area inside the depot and the Park & Ride facility as appropriate.
   - Plant ivies typed medium vines and heavy vines, such as liang-liang, Orapim Bougainvillea, Conbretum, Passion Flower, jasmine ivy, and Allamanda, etc. to reduce the contrast of piers of the overpassing rail and stations.
   - Increase green areas or plant small garden in the area under the stations (if there is any space) or along the mass transit line to increase ecological balance, enhance scenic landscape, or reduce air pollution, noise pollution and others by planting low bushes, such as Kalamona, yellow elder, Chinese Rice flower, Golden Dewdrop, and White Cheesewood, etc., or building pergola with wood or metal or other materials for growing medium vines and heavy vines, such as liang-liang, Orapim Bougainvillea, Conbretum, Passion Flower, jasmine ivy, and Allamanda, etc.

- Wildlife

Construction Period

Along Mass Transit Route and Stations

- The construction and the operation of the mass transit system, the depot and the Park & Ride facility at Rom Klao Junction may impact to wildlife in terms of the loss of food resources, habitats or hidden area but in a low level, since they are very familiar with urban environment and can adapt themselves to changing environment. Therefore, there is no need to determine prevention, correction, and elimination measures.

2.2.4 Human Utilization Value

(a) Transportation System

Construction Period

Along Mass Transit Route and Stations

1) Provide transportation alternatives for trespassers to reduce the number of vehicles passing by the existing road structure that is under construction, in particular determining bypasses on the existing road structure, as follows.
2) Tiwanon Road (Nagm Wong Wan Junction – Pak Kret Junction) and Chaeng Wattana Road (Pak Kret Junction – Anusawari Lak Si Circle)
   - Pass Prachachuen Road and turn to Samakkhi Road, pass Pak Kret Bypass and merge into Tiwanon Road before Amporn Paisarn School
   - Pass Bond Street (Chaeng Wattana 33 Lane) and merge to Tiwanon Road before the Ordnance Ammunition Depot Division, the Royal Thai Army Ordnance Department
   - Pass Prachachuen Road and turn to Chinnakhet Lane, pass Chitchon Road, Rajapruk Golf Course, and merge to Kamphaeng Phet 6 Road before Thung Song Hong Municipality Police Office
   - Pass Chaeng Wattana 14 Lane through the crossing with Kaset Road, pass Kosum Ruamjai Lane and merge to Kamphaeng Phet 6 Road at Kosum Ruamjai 5 Lane, through Bang Bua Housing Lane, then merge to Phahon Yothin Road at the entrance of Bang Bua Lane
3) Ram Inthra Road (Anusawari Lak Si Circle – Project End Point)
   - Pass Ram Inthra 19 Lane (Sukhapiban 2) and merge to Phahon Yothin Road at the entrance of Phahon Yothin 48 Lane
   - Pass Wat Lat Pla Khao Lane through Kaset-Navamin Road and merge to Phahon Yothin Road at Kaset Junction
   - Pass Ram Inthra 14 Lane and merge to Kaser-Navamin Road at the entrance of Maiyalap Lane
   - Pass Ram Inthra 23 Lane (Sukhapiban 4) through Sukhapiban 5 (Or Ngern) through Ram Inthra 65 Lane, pass Raminthra 40 Lane, through Nuan Chan Lane, Nuan Chan Road, and merge to Pradit Manutham Road around Chalong Rat Expressway (Ram Inthra-Arj Narong)
   - Pass Koo Bon through Navamin Road, merge to Kaset-Navamin Road at the entrance of Chanachon 2 Lane
   - Pass Ram Inthra Lane to merge to Kaset 62 – Navamin Road at the entrance of Suvanprasit Lane
   - Pass Panya-Natural Park Road through Surao Khlong Nung, merge to Hatai Rat Road at the area across to Sammakorn Village
   - Pass Phraya Suren Road through Surao Khlong Nung, merge to Hatai Rat Road at the area across to Sammakorn Village
   - Pass Seri Thai Road (Sukhapiban 2) through the meeting point between Min Pattana, pass the meeting point between Suan Siam Park and the Outer Ring (East) Road at the area of Chuen SIuk 1 Village.

4) If there is a need to improve physical conditions of the bypasses (details in (a)) to support more traffic and to continuously flow traffic without congestion, the bypasses that need to be maintained in good conditions at all time include Chinnakhet Lane, Bond Street Road (Chaeng Wattana 33 Lane), Chaeng Wattana 14 Lane, Bang Bua Housing Lane, Wat Lat Pla Khao Road, and Maiyalap Lane, etc. In addition, the physical management must consider the size of traffic lanes and the width of turning radius that are safe and meet with the turning radius standard of each type of vehicle in accordance with AASHTO and the Japanese standard. At least 1 kilometer before the mass transit construction, there must be the installation of clear traffic sign and signal boards, such as warning sign and bypass information, traffic guide sign, warning light or flashing light, construction zoning barriers, traffic lane lining, or traffic cones, etc., in accordance with the standard of traffic safety of the Office of Transport and Traffic Policy and Planning (OTP). This is to ensure of the safety, reduce confusion, or reduce the delay of outbound-inbound transportation.
5) Since the commuters from outside of the city to the east – the west have high demand to commute into the city through the existing road structures, in particular during morning rush hours (07:00 – 09:00 hours). Therefore, there is a need to provide reversible lanes to flow vehicles into the city as much as the capacity before construction. However, there may be bottle neck issue at the merging way, causing the elimination of traffic lane at the end of traffic current, the end of reversible lane. It is therefore required to provide sufficient length (40-150 meters), depending on driving speed. This will help provide less congestion through the construction area, or help merge vehicles into traffic safely without accident. It is required to coordinate with police officers to help facilitate traffic in that area for safety and flowing traffic conditions.
6) MRTA and the contractor must provide information or encourage people and commuters to know relevant information through media, such as brochures, newspapers, radio, news, website, and television, etc. In addition, it is required to coordinate information – news and seek for opinions and recommendations from relevant organizations. The information includes the following details.
   - To avoid the use of the existing road structures and to opt for bypasses, or to ask for cooperation or to encourage the commuters to follow the designed traffic plan;
   - To avoid the use of the existing road structures during rush hours if there is no need to so that the alternative routes are capable to receive traffic flowing from the existing road structures.
7) Encouraging the commuters to mainly use public transportation and focusing on the promotion of public transportation for Bangkok- or Nonthaburi-inbound and outbound route, i.e. people who live on Tiwanon or Chaeng Wattana Road around Pak Kret Junction can use Chao Phraya Express boats, or people who live in Min Buri District can use Khlong San Saep Canal Express Boat instead.
8) Promoting and encouraging on traffic regulation compliance and etiquette, as well as the legal enforcement on or collecting fines from people who violate it, in particular in the area that turning or U-Turn is prohibited. This is to flow traffic and to eliminate congestion.
9) The contractor is required to prepare traffic management plan in accordance with the mass transit system construction plan and present to MRTA and other relevant organizations, such as Bangkok Metropolitan, Nonthaburi Province, or local police offices before starting the construction in each area. In this regard, the guidelines on the management of traffic on the existing road structures are as follows.
10) Rattanathibet Road, Chaeng Wattna Road (from Pak Kret Junction to Lak Si Junction) and Ram Inthra Road (including Sihaburanukit Road) are wide 40 meters, 8 lanes (inbound-outbound) with 3.50 meter in width/direction, lifted traffic island with 4.20 meter width. During the construction, the construction area must be zoned at least 7 meters, divided into part, 500 meters/part. Should

there be the moving of construction materials or soil, 1 lane must be zoned out. In this regard, the traffic management may remain the same number of lanes and will decrease the width of traffic surface. After construction, it is required to resume traffic conditions on Rattanathibet Road, Chaeng Wattna Road and Ram Inthra Road to normal.

11) Chaeng Wattna Road from Lak Si Junction to Anusawari Lak Si Circle is wide 32 meters, with the lanes with 3.50 meter in width/direction. There is a concrete wall to separate the direction. The number of lanes may reduce from 4 to 3 lanes/direction without width adjustment. After construction, it is required to resume traffic conditions on Chaeng Wattna Road from Lak Si Junction to Anusawari Lak Si Circle to normal.
12) Tiwanon Road is wide 33 meters, with 6 lanes (inbound-outbound) with 3.50 meter in width/direction, lifted traffic island with 4.20 meter width. During the construction, the construction area must be zoned at least 8.40 meters, divided into part, 500 meters/part. Should there be the moving of construction materials or soil, 1 lane/direction must be zoned out, and only 2 lanes/direction remain with the same traffic surface width. After construction, it is required to resume traffic conditions on Tiwanon Road to normal.
13) All vehicles coming in and out for material transportation must strictly comply with traffic regulations, as well as limit their speed up to 30 km/hour, with weight up to 25 tons when passing residential communities or commercial areas or the environmental impact vulnerable areas, such as medical centers, educational institutes, and religious venues, etc.
14) Speed limit for trucks that move construction materials through the communities, educational institutes, medical centers, and religious venues is up to 30 kilometer/hour.
15) It is required to improve the traffic surface conditions on the existing road structures under overpassing rail and stations structures and nearby area to be smooth and there must be the clear line showing traffic routes around in each lane based on the lane size after the construction area returns to normal.
16) It is required to have lights under the station are and on the sideways of the existing road structure to light up on the traffic surface, in accordance with the regulation of relevant bodies, such as the Highways Department, Bangkok Metropolitan.

(b) Infrastructure and Utility System

Pre-construction Period

Contractor is required to perform works before the construction of the mass transit system as follows.

1) Survey details regarding infrastructures and utilities and prepare a form showing details regarding the removal of infrastructures and utilities, such as highway area, the existing road structure, expropriating areas, current position of infrastructures and utilities that need removal, and the layout of infrastructures and utilities that will be built or replaced, etc.
2) Prepare plan on the removal of infrastructures and utilities that may be impacted in accordance with the construction plan of the mass transit system to present to MRTA and relevant bodies, such as Bangkok Metropolitan, the Highways Department, the Metropolitan Waterworks Authority of Thailand, the Metropolitan Electricity Authority, CAT Telecom Public Company Limited, or local police offices for approval at least 30 days before removing infrastructures and facilities.

Construction Period

Along Mass Transit Route and Stations

1) Coordinate and jointly plan with local organizations who are in charge of the removing infrastructures and utilities, such as the Metropolitan Waterworks Authority of Thailand, the Metropolitan Electricity Authority, the Highways Department, TOT Public Company Limited, and CAT Telecom Public Company Limited, in order to prepare promotion plan to public/commuters for acknowledgment at least 30 days in advance.
2) Install non-transparent fence with height at least 2 meter or equivalent to zone out the areas of infrastructure and utility removal.
3) The removal of infrastructures and utilities, such as waterworks pipes, drainage, high voltage posts, electrical devices,/cables, wiring harness and traffic signs must be done at night from 21:00 hours but no later than 5:00 hours of the following day, or must be done during holidays. In this connection, it is required to have brochure, radio, traffic news, announcement sign in the removal area for public/commuters' acknowledgment at least 15 days in advance.
4) The vehicles that may be used to move infrastructures and utilities are required to have net or canvas to cover the loading area closely to avoid falling down objects on to the traffic surface. The speed limit of driving the vehicle to materials piling areas must be up to 30 km/hour.
5) Should there be any complaint that "the removal of infrastructures and utilities" disturbs and annoys to people or commuters, or creates damages to the infrastructures and utilities themselves, the issue must be addresses and solve in a timely manner.

2.2.5 Life Quality Value

(a) Economic and Social Conditions

Construction Period

1) The access to work in the area must be informed to the local bodies of Bangkok Metropolitan or Nonthaburi Province/Pak Kret Municipality Office, who are in charge of the area, at least 30 days in advance. This is to inform the community leaders to pass information to people in the local communities directly.
2) The contractor must strictly monitor and control its employees and workers to no behave and practice in the way that may cause problems or arguments with people in the local communities or trespassers who use the existing road structures along the construction line.
3) It is required to have an informational and complaint center at the project office to receive news or complaints from public, as well as to have informational signs suggesting channel for communication, such as Call Center number/ E-mail address. It is also required to have a staff stationed at the center 24 hours. The contractor is also required to compile and evaluate information regarding complains and recommendations, as well as the outcomes of resolution, and present to the Mass Rapid Transit Authority of Thailand (MRTA) once a month to assist and to alleviate problems and difficulties that people may be impacted from the construction.
4) The contractor must perform construction with carefulness to avoid damages to life and properties of people living in the local communities in the construction areas, such as causing damages to traffic surface that may become obstacles to transportation or connecting routes between

communities. If it is inevitable, the contractor is required to solve the problem to minimize impacts or to solve problems within 3 days.

5) It is required to have announcement to people or trespassers who use the existing road structure to know information at least 7 days in advance before road close for construction, or before moving large-sized construction materials and equipment. In this regard, the information must be made public through media, such as PR board, brochures, newspapers, radio, website, television, etc.
6) It is required to have a security guard to monitor and maintain security in the construction areas, as well as to facilitate traffic during construction period.
7) 70% of workers must have original address or have evidence that they have lived in Bangkok Metropolitan and its suburbs at the minimum of 5 years.
8) Should there be any complaints from commercial sector in the existing road structures along the construction line, there must be an open opportunity for them to voice for solution or problem alleviation under the concept of "public participation" in accordance with rights under the Constitution of Thailand B.E. 2550 (2007), as well as it is required to recognize the importance in seriously and urgently solving and alleviating problems, such as mental remedies for impacted people, or improve and correct construction design if the position of escalator, stairs, or elevator, or disabilities' accessibility impede the commercial venues, etc.
9) There must occasionally be public relations and event to create good understanding between the contractor and people in the local communities nearby the construction locations, by organizing a meeting to explain types and processes of security and inspection system establishment to avoid impacts, as well as to be informed of and to hear public opinions at least once a month. This is to acquire information for improvement or for alleviation impacts that may arise during the construction, or for determined construction plan that is clear and matches with the actual need of local people.
10) It is required to recognize the importance and to attend activities in the local communities along the construction line to create familiarity and to receive good acceptance from local communities, such as social development or career enhancement, provision of scholarships to students or schools in local communities, sports contest with the communities, participation in social development activities during special occasions, such as the King's Anniversary Celebration or religious holidays, etc.

(b) Migration and Expropriation

Pre-construction and Construction Period

MRTA is in urgent to complete actions regarding immigration and expropriation before starting the mass transit system, the depot, and the Park & Ride facility construction, as follows.

1) Organize a meeting to provide information to impacted people, such as project details, expected benefits, processes/expropriation processes, rights and duties of expropriator, etc. This must be completed at least 18 months before the construction.
2) Enact the Decree on the Determination of Land for Expropriation, by locating start point to end point, as well as the width of the expropriation area in the decree.
3) Exhibit the decree at government agencies along the construction line, such as Nonthaburi Civic Center, Bangkok Metropolitan Administration Building, Nonthaburi Provincial Land Office, Provincial Land Office branches, Bangkok Metropolitan Land Office or Nonthaburi Provincial Land Office, Nonthaburi City Hall, Pak Kret District Office, Lak Si District Land Office, Bang Khen District Land Office, Bung Koom District Land Office, Kannayao District Land Office, Min Buri District Land Office, Nonthaburi Municipality Office, Pak Kret Municipality Office, etc.

4) For the inspection of expropriation properties, such as land, structures, plantation, the officers must submit a letter informing inspection schedule to the property owner at least 15 days in advance. It is also required to conduct a survey on the number of impacted people thoroughly to know how much assistance may be in need from the government, as well as methods/ guidelines/ durations to pay compensation or recommendations on migration, which can lead to practical guidelines that best match with the needs of the impacted people.
5) It is required to designate a committee to determine compensation value of the lands, structures, and plantations. Preliminarily, the committee body must be represented by the representatives of impacted people, local community leaders from expropriated areas. This committee may cooperatively consider and determine criteria on the determination of property compensation, estimation methods, and payment procedure, etc.
6) The preliminary determination of compensation of properties will be considered to be given to the followings.
   - Owner or legitimate occupant of the land that is expropriated
   - Owner of other buildings or structures that cannot be removed on the expropriated land on the effective date of decree, or that are built afterwards with official approval
   - Tenant of the land, other buildings or structures on the expropriated land but the rent must have written evidence made before the decree effective date of the decree, or that are made afterwards with official approval, and the rent must not be suspended on the day that an officer or a person assigned by an officer enter to such land, building or structure; whereas the compensation for rental will be paid to actual impacted persons for the cause of leaving out of the land, building or structure before the suspension of the rental agreement
   - Owner of trees on the land on the effective date of decree
   - Owner of other buildings or structures that can be removed on the expropriated land on the effective date of decree but is not a person who was asked to remove the building or structure by the land owner; whereas the compensation will be paid for removal, moving, and rebuild (in the same conditions) expenses.
   - A person who loses entitlement in laying waterworks pipe, drainage, cables, or other things in the same manner through the expropriated land in accordance with Section 1349 or Section 1352 of the Civil and Commercial Code (in the case that such person has paid for the compensation of such entitlement to the owner of the expropriated land)
7) It is required to consider and to pay compensation for the properties at the fair rate that is accepted by the impacted people, by considering fairness, mental remedy value (opportunity cost), mental loss, as well as the payment duration of the compensation must comply with project construction action plan, and the payment must be made before starting the construction. For the evaluation of compensation that may be paid to impacted people, it shall concern actual expenses from the loss of incomes that gained in the past, as well as special compensation to help stable living until the condition is back to normal.
8) Enact the Property Expropriation Act to give ownership of properties to the government.
9) The criteria for determining compensation for the expropriated properties and the amount of compensation payment for the extended electric rail project and the new electric rail project of MRTA must strictly comply with the MRTA regulations.

(c) Public Health and Safety

Construction Period

1) It is required that the contractor must strictly comply with the Environmental Impact Prevention, Correction, and Elimination Measures in terms of air quality and noise during the construction period.
2) During construction, there may be some accidents from works if the workers are lack of carefulness and are neglect. In order to prevent accidents from leading to severe outcomes, the contractor is required as follows.

   - Designate the Safety Committee to set policies on work safety in the construction areas, such as determine construction plan and safety control measures, control and monitor employees and workers to comply with regulations or laws related to safety, inspect causes of dangerous incidents, and provide recommendations and training to employees and workers to work with carefulness, etc.
   - Train employees and workers on how to use and maintain tools, machines and equipment properly and appropriately for different types of works. It is also required to have employees who take care of tools, machines and equipment maintenance and the repair must be performed immediately in case of any damage to prevent accidents from work at all time.
   - Employees and workers are strictly required to wear personal protective equipment (PPE) at all time during working hours in the construction areas to prevent dangers and accidents from work, in accordance with the Ministerial Regulations of the Determination of Administration and Management of Safety, Occupational Health and Work Environment related to Construction Works B.E. 2551 (2008), and the Personal Safety Protection.
   - Control and monitor workers and truckers who transport construction tools and materials to not use drugs or stimulating substances, or consume any alcoholic beverages during work; whereas severe penalty for the violators must be in place, such as unlimited work suspension, 50% salary cut, or fire.
   - Control and monitor truckers who transport construction tools and materials to strictly comply with traffic rules and regulations when passing the residential communities and vulnerable areas that may be impacted in terms of environment, such as religious places, medical centers, and educational institute, etc. The speed limit is up to 30 km/hour.
   - It is required to have concrete barrier and metal sheet high 2 meters at the construction areas on the existing road structures to show boundary of the construction area. It is also required to have non-transparent fence high 2 meters around the construction area of the depot and the Park & Ride facility at Rom Klao Junction to reduce impacts from noise pollution from the construction.
   - It is required to have announcement to media, such as PR board, brochures, newspapers, radio, television, and website to people or trespassers who use the existing road structure to know if there is a closure of normal road used, including Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road, and SIhaburanukit Road, for removing infrastructures and utilities, or for moving large-sized construction materials and equipment, or for concrete laying works.
   - It is required to determine measures to control every construction area by having security guard to watch and prevent unauthorized people and irrelevant people to enter the construction area. This is to prevent danger and to prevent the loss of properties.

- It is required that the contractor must have a net or a canvas to cover the structure under the overpassing rail and stations, and other structures to prevent accident that may arise from falling down object or materials from the construction. In the case that public or any damaged person files a complaint, there must be an officer visit to inspect damage and that person must be paid for compensation from such damage as appropriated or based on the actual costs.
- Lights must be sufficiently and appropriately installed within the construction areas based on construction activities for work safety purpose. Also, light signal or flashing light must also be installed to clearly zone the construction area, in particular during nigh time, for the safety of trespassers.

1) The contractor is required to arrange to have nursing unit in the project office with at least 1 professional nurse to provide preliminary treatment, such as perform first-aid practices for sick employees and workers. In the case of severe accidents during work time, the injuries must be transferred to the nearest hospital, such as Panyananthaphikkhu Chonprathan Medical Center, Mongkut Wattana Hospital, Sinpat Hospital, Nopparat Rajathanee Hospital, Navaminthra Hospital, Wetchakarunrasm Hospital, Lat Krabang Hospital Bangkok Metropolitan, etc.
2) It is required to have environment sanitation management in the construction areas or in the project office in accordance with the recommendations of the Engineering Institute of Thailand and the Ministry of Public Health, as follows.
   - Provide sufficient clean water for drinking (5 liter/person/day) and utilization (50 liter/person/day) for employees
   - For workers working in the construction areas or the project office and the employees' residential area, there must be sufficient bathroom-toilet (10 persons/room) and the instant wastewater management system must be installed inside the project office before flowing water into the public pipes.
   - There must be sufficient garbage bins that meet with sanitation standards in the construction areas and the project office, size 240 liters with close lid, separating into wet garbage, dry garbage, dangerous garbage, and recycle. Also, it is required to coordinate with local in-charge organizations to pick up garbage for proper disposal at least 3 times a week.
3) Contractor is required to prepare measures for construction workers as follows: -

1. Measures for Construction Workers

Public Health Measures

- Provide first-aid unit with ambulance for workers, as well as coordinate with hospital in the close vicinity of the construction areas in advance for services in the case of emergency from the project
- Train and provide education on safety in the construction areas and employees' residential areas, as well as on how to use personal preventive equipment
- Strictly control and regulate rules relating to vehicle driving
- Measures on Occupational Health and Safety in Working Areas for Construction Workers

Measures on Safety Relating to the Use of Tools and Machines for Construction

For safety purpose when using the construction tools and machines, the contractor is required to strictly encourage and monitor the workers to follow measures relating to the safety in using construction tools and machines, as follows.

- When holding tools with sharp end, the end must point to the ground or there must be a cover, such as compasses, metal pen. Do not keep these tools in the shirt or pants pocket.
- Do not use damaged tools, such as bending or broken hammer, because it may lead to mistakes when hammering or hitting works.

- When working in the high place, the tools must be properly tied or securely kept to avoid falling down to the ground.
- When operating machines in the construction, the user must know how to stop the machines.
- When changing engine speed or changing conveyers or gears, the machine must be stopped or the switch must be cut every time.
- Do not try to stop the machine by hands or any part of the body.
- Be careful for the dangerous parts of the machine, such as gears, conveyers, blades, that are required to have cover or protection.
- Inspect works or blades to be stickily adhered to or to be located in the proper position before working.
- After finishing works, the switch must be cut before leaving the room every time.

Measures on Safety when Lifting or Carrying Heavy Objects

For safety purpose when lifting or carrying heavy objects, the contractor is required to strictly encourage and monitor the workers to follow measures relating to the safety in lifting or carrying heavy objects, as follows.

- Holding too heavy object may lead to severe danger so the helper is required or it is required to use labor-saving tools. When lifting heavy objects from the ground, do not use back but try to use leg muscles instead.
- Lifting object should use thigh muscle by standing with good balance, which is bending knees, straight back, bending down head, holding tight and stretching legs.
- Avoid carrying sharp objects.
- When lifting object up, before walking, ensure the visibility of forward way and surrounding area.

Measures on Safety when Performing Electrical Works

For safety purpose when performing electrical works, the contractor is required to strictly encourage and monitor the workers to follow measures relating to the safety in performing electrical works, as follows.

General cautions when performing electrical works

- If the lid or the switch box is broken or damaged, it must be replaced and repaired immediately.
- Keep the area close to electrical switched clean.
- Frequently inspect inside electrical switch console, electrical control box to not have bronze piece or conductive metal inside the box. Do no bring equipment inside the control box, such as fuse, out.
- When changing fuse, it is must be specific fuse for that specific work and switch must be properly off to open the circuit.
- Do not use lid that made from inflammable materials.
- Each lid must have sign showing below details.
    - Use with direct or alternating current
    - Electric voltage (electromotive force/ or pressure)
    - Electric current
    - Tools and equipment connecting to the switch
    - Receiver name

- The switch must be off to open circuit when performing inspection or repairing machines, with a signal or sign at the switch showing “under repair”.
- Before turning on the switch to close the circuit, it must be ensured that everything is in place and there is a correction signal. Before testing the machine operation, it must also be ensured that the machine does not have other struggled materials or objects inside.
- Signaling for on-off switch must be performed carefully.
- Do not turn switch on-off with wet hands.
- When turning on the switch to close the circuit, it must be ensured that the signal shows correctly.
- When screwing to close the electric circuit, it must be tight.
- Do not use any broken electric equipment since it may lead to danger.

Cautions relating to the Use of Circuit Breaker

- Circuit breaker is used with the highly dangerous part so the person in charge must frequently inspect and have clear identifying sign in place.
- When performing inspection or repairing machines, with a signal or sign at the switch showing “under repair”. The sign can be removed when the repair is finished.
- Machine control switch used during construction by many people so there must be rules or signals for practice as a common standard.
- The collaboration between 2 groups of workers sharing machines must be careful, in particular if there is an inspection and repair. This requires good coordination with technician before opening-closing circuit.

Cautions relating to the Use of Electric Tools, Machines, and Equipment

- Inspect cables. If damage found, use tape to cover damage properly and recheck cable connection area.
- For moveable electric equipment, inspect the connecting joints, terminal attaching to the equipment and cables carefully. If any damage found, replace or repair to be in good condition.
- When changing/repairing electric equipment, even minor damage, it must be performed by the technician.
- Do not turn off the cables when there is electric current flowing in.
- Do not hang or cling cables on sharp objects, such as blades, saws, and propellers.
- The use of some specific electric equipment, such as motor and transformer, must have person in charge of turning on and off.
- Electric equipment that may cause dangers must have clear sign, such as light signal, red flag, red tape, etc.
- If there is any abnormality with electric equipment, the switch must be off to open the circuit and this must be informed to the person in charge.
- Do not remove electric protective equipment, except being authorized.
- When finishing work, turn off the switch and make sure the circuit is open.
- Do not wrap lamp with paper or fabric.
- Do not bring inflammable substances or materials nearby the switches or electric outlets.
- Do not use electric tools or equipment with wet hands.
- When there is any injury due to electric-related accident, the switch must be off to open the circuit immediately.

Cautions relating to the Installation of Electric Equipment

- The installation of electric equipment must be monitored by the technician or electric expert, except for work that has electric pressure less than 50 volts with ground wire.
- The installation of electric equipment can be perform only after consulting with the expert, in particular on the communication on protection when working during electric current flow or if there is any disruption.
- Avoid working during electric current flow except when it is truly necessary.
- The installation of electric equipment is not only required to comply with laws and electric standard, but also has to follow the following details.
    - Do not turn on any part of electric equipment that will run current flow or will have electric charge. There must be a cover or insulation, or if it cannot be covered, there must be a caution sign in place.
    - Equipment or cables that are installed in a high place must have good insulation and must be frequently inspected.
    - Frequently inspect insulation of electric equipment in that touchable or working areas.
    - When lining cables on the road (even for temporary), there must be danger preventive system in place for each specific type of work/
- When working with electric, there may be a disruption that needs higher level of carefulness as follows.
    - Some machines cannot switch back to default after operation, there must be a sign for it.
    - All machines need good ground wire.
    - When there is any problem, it must be addressed to the electric technician or expert.
    - Before turning on the switch for working, it must be ensured that there will be no electrical short and the ground wire is already in place.

Measures on Assistance and First-aid Treatment

- The contractor must organize a training on the assistance and first-aid treatment if there is any accident when working in the project areas for the workers before construction takes place, with following details.

  If stop breathing

  The details of assistance and first-aid treatment in the case that the workers stop breathing while working in the construction areas

  If receiving dangers from electrical shock

  - Do not use bare hands when providing assistance
  - Switch off the electric current (switch/outlet)
  - Use insulation to remove the cable, but in the case of no insulation, dry wood stick can be used
  - Once electric is off, switch must also be off to open the circuit
  - In the case of electric short that causes fire, turn off the switch to open the circuit, then extinguish fire with fire extinguisher type C only, such as fire extinguish tank with dry chemical substances, CO_2, etc.
  - Do not use water or water-based fire extinguisher to extinguish fire since it may cause dangers.
  - In the case of water accident, do not jump into the water to help unless making sure that the electric current is fully cut.
  - In the case of passing-out, massage the patient chest and perform CPR immediately.

Stop Bleeding

Details of the processes to stop bleeding can be summarized as follows.

- Use clean fabric piece to wrap around the legs or arms 2 rounds
- Tie the knot
- Put a wood piece on top of the know and retie the knot twice more
- Rotate or twisting the robe until bleeding stops
- Tightly tie the end of wood piece to a stable position with small robe
- Record the time of robe twisting

Measures on Organizing Working Areas

- The working areas must have nothing that may cause dangers or may become an obstacle to working, and there must be no wastes, oil and lubricant.
- The walkway must be empty to access to the working area safely.
- Bathroom and vanity sink must be clean and meet sanitation standards.
- Foods must not be kept within working areas.
- Wastes and leftovers must be removed out of the working areas on a daily basis.
- Do not place inflammable materials close to lamps or heated or fire sparking objects.
- Oil and grease that spilled on the floor must be properly clean.
- Keep materials on the smooth level area in an organized and secured manner.
- Make a chuck to support round-shaped materials to prevent rotation.

Measures on the Use of Materials for Warning and Blocking the Dangerous Areas during Work

- There must be fence surrounding construction areas with a sign showing “Construction Area. Employees Only.”
- There must be fence surrounding dangerous areas with a sign showing “Dangerous Area for Construction” and there must be clear red light signal showing at night.
- High area and hole areas must have rail to prevent falling down.
- Irrelevant and no-duty people are not allowed to enter the construction areas and the dangerous areas for construction.
- Do not allow the workers to live in the construction areas

Measures on Safety when Working in the High Place

- Anti-falling rail must be durable and secured with the height at least 90 centimeters from ground.
- Inspect all types of equipment relating to work, such as crane, sling, robe, hook, shackles to ensure that they are in good condition before start working. Do not use if there is any damage.
- During storm or raining, the workers must stop working and come down.
- When there is a risk of falling down from the height and working more than 4 meters above, the controller of the construction must consider to order the use of safe belts and life line throughout the entire working period.

Measures on Safety when Using Heavy Machines and Crane for Moving Objects

- There must be only one expertise person who can provide signals.
- Do not get closer to the rotating machines.
- If there is any digging, the area must be fenced around.

- Do not stay under the lifted objects without exception.
- Working at night must have sufficient light throughout the working duration.
- Do not adjust or change any part of the crane.
- Arrange to have sound signal and flashing light for warning of moving vehicles.
- Arrange to have handbook regarding the crane in Thai language for the driver to study and properly follow the instructions.

Measures on Safety when Using Ladders

- It is recommended to use ladders made by a manufacturer typed durable stairs.
- Do not use damaged or broken ladders, and there should be a sign showing “DO NOT USE”.
- Do not tie 2 ladders together to make longer distance.
- Do not place ladders in the slippery areas or the areas that have wastes on the ground.
- The end of the ladder must higher above the laying point 3 feet.
- When climbing up and down, face towards the ladder.
- Do not lift or carry object when climbing up the ladder.
- Do not use metal ladder with electric works without exception.

Measures on Safety on Scaffolding

- When working in the area higher than 2 meters, scaffolding is required.
- Metal scaffolding must capable to receive weight at least 4 times of usage weight.
- Scaffold must have width at the minimum of 35centimeters.
- It is required to have a ladder to climb up and down to and from the scaffold.
- It is required to have canvas or safety net to cover the areas outside of the scaffold.
- Scaffold structure must have holding sticks to prevent unstable legs or falling down. When working close to electric cables that have no insulation, it must have distance as determined, or it is required to contact the Electricity Authority to install insulation to cover the cables temporarily.
- There must be an anti-falling rail with height at least 90 centimeters and up to 1.10 meters, except the areas that there is object transfer.
- If there is overlapping working, there must be an object to prevent falling down that may harm the person who works in the lower level.
- When working on scaffolding high over 4 meters, team leader must suggest workers to wear safe belt.

Measures of Safety when Choosing Hooks, Chain Sling and Holder to Attach Tightly to the Structure

- Use hooks with single attachment for lifting, and use chain sling with at least 2 attachments for lifting.
- Hooks must have safety bolts attached (except for some types of hook).
- Hooks are used to lift weight whereas the object weight will fall into the hook slit.
- It is required to request approval from the supervisor first before tying materials with other structures to ensure that it may not exceed the capacity of such structure.

- Do not use metal sheet holder, pliers or pipe holder to replace the holders that can be used with the structure.
- It is required to inspect and approve for hooks, chain sling, and holder that are used with the structure before every usage to not exceed the determined weight capacity.
- Weight capacity for lifting must clearly show on the equipment.
- Do not leave objects that will be lifted in the loose condition or without watching clinging on the chain sling.
- Do not leave or let any part of the body under the object that is lifted by chain sling.
- Do not use chain to measure objects for lifting.
- Inspect chain before lifting objects. As for visual inspection, the inspection must cover the hooks that may be abnormal, as well as other damages from the improper use of equipment.

Measures on Safety of Digging

- The digging of ground or canal that has depth more than 1.5 meters must be held or must have slope, as well as must be inspected by the workers every day before working. The inspection must be recorded.
- It is required to have obstacles and signs around the digging areas.
- The workers must wear safety helmet and safety boots or heel-covered shoes.
- Do not allow any person to get close to the top of the dig holes or any other operating machines.
- Arrange to have ladders when digging ground for entrance and exit and there must have exist provided.
- Dirty objects or digging objects or other materials must be collected at least 1 meter from the top of the hole.
- The digging area must be inspected after raining and the action must be performed to prevent flooding.

Measures on Safety of Traffic in the Construction Areas and Parking

- Allow only people with valid driver license to drive around the construction areas.
- Limit speed in the construction areas up to 20 km/hour. Drivers must comply with rules on the traffic signs.
- Do not allow driving in a risky manner that may cause dangers.
- The safe getting over of the vehicles is allowed as long as it’s under the set speed limit.
- All drivers must turn light on before dark.
- While driving, the drivers are required to wear safety belt and safety belts must be installed in all vehicle.
- Employees must walk on the right hand of the constructing area roads while the car driving in different direction.
- The drivers must comply with rules on the traffic signs and must give a way to street walkers.
- The employees’ vehicles and the visitors’ vehicles can be parked in front of buildings that parking lots are allocated, or can be parked in the designated parking area with traffic signs allowing parking.

- General traffic rules shall be effective in the construction areas as well.

Measures on Safety for Fire Prevention and Fire Extinguisher

The contractor must be organize a training on the fire prevention and emergency plan for the workers.

- The workers are required to know the position of fire warning signal and know usage instructions.
- The workers are required to know meaning of warning signals, such as fire, evacuation or other threats, and must know fire evacuation route and the meeting point.
- The workers are required to know the position of the closes fire extinguisher tank and know usage instructions.
- Inflammable objects must be kept away from the origin of fire sparkles.
- When refilling oil to the machines and other equipment, it must be done when it is turned off and the engine must already cool down.
- Trash stubs in the designated places. Do not trash in the basket or general garbage.
- Position and location of warning signal installation must be exhibited on the PR board for safety.
- The first responder must try to eliminate the fire by using fire extinguishers installed at specific points.

Measures on Safety for Welding and Grinding

- Before using electric or gas for welding every time, the workers are required to inspect surrounding areas to have no inflammable objects in the radius that fire sparkle from working can reach, as well as when welding in the high place that fire sparkle can fall down. Should there be any inflammable object, it must be removed or covered with fire proof blanket.
- Inflammable substances mist be removed out of the sparkling area from welding.
- Non-inflammable materials must be used to cover the working areas to prevent fire sparkle or fire from falling on the inflammable objects or people in the close vicinity.
- When welding or cutting of inflammable substance container at every time, the substance and the gas must be removed and cleaned, and then ventilating air inside the container to make sure that there is no inflammable substance remain in the container, or it must be 0% of lower explosive limit only before welding.
- In the welding area, there must be sufficient fire extinguishers installed in place to be able to use in case of emergency.
- Gas tanks must be placed straight up away from the welding areas to prevent them from fire sparkle and they must be attached securely to prevent them from falling down.
- Inspect every equipment to prevent leaking holes and to ensure the good condition before working.
- Welding tools must have no damage or must not be broken.
- The removal of welding stick for temporary pause or for finishing work, the switch must be turned off every time.
- The fuse of electric welder must have appropriate size and must be fit perfectly.
- Do not switch air duct and gas duct without exception.
- Inspect air duct and gas duct, as well as flashback arrestors to be in ready condition for work.

- The workers are required to wear gloves, glasses, and mask every time and all the time during work.
- After finishing work, it is required to inspect the working areas to ensure there is no fire.

Measures on Personal Protective Equipment

- All workers have been informed of the place for the storage of personal protective equipment and the usages.
- It is required to arrange to have sufficient safety helmets for every workers.
- Eye and face protective equipment (e.g. full face cover on top of the safety glasses for scratching and cutting works) must be used for the work that may harm eyes and face.
- All workers are required to wear leather safety shoes and strong boots, as well as to wear safety helmets all the time during working period.
- The contractor is required to provide personal protective equipment, such as ear muff or ear plug to the workers who work in the noisy areas or to rotate project employees or workers who work in a continuously noisy areas every 30 days.

Measures on Occupational Health and Work Safety for Construction Workers or Contractor Company

- The contractor company/the contractor must educate and advise workers on health protection.
- The contractor company/the contractor must arrange good working environment, such as good temperature, light, noise, and equipment standard as appropriate in accordance with the Ministry of Interior's Notification on Work Safety in Terms of Environment.
- The contractor company/the contractor must provide a handbook on occupational health and work safety for construction workers with details determined in the measures on occupational health and work safety for construction workers at the minimum, as well as must organize a training and an educational session on safety and the proper use of machines and equipment for the workers as details shown in the handbook before starting actual work. The handbooks must be placed close to the workers and must be sufficiently provided based on the number of workers in the project.
- The contractor company/the contractor must prepare the personal protective equipment, such as safety helmet, gloves, glasses, mask, noise protector, heel-covered rubber shoes, or other personal preventive equipment sufficiently for all workers.
- The contractor company/the contractor is required to ensure that the workers wear personal protective equipment in accordance with the condition and type of work, as well as wear proper, fit, good condition clothes. In the case of electric-related works, the worker must wear dry clothes. Appropriate outfits for works relating to machines during construction is one-piece suit in the proper conditions with all buttons in place, without accessories, such as necklace, watch, ring, etc. The workers are required to wear hell-covered shoes or boots to prevent dangers from construction materials. In addition, the workers must not have long hair. Or if long hair, they are required to wear hats to cover hair. In this regard, this is in accordance with the form of appropriate outfits for working in the construction areas for construction workers.
- The contractor company/the contractor is required to have an employee in charge of the inspection on occupational health and safety to station at each construction area.
- The contractor company/the contractor is required to have sufficient first-aid units in the construction areas.

- The contractor company/the contractor must comply with the environmental impact elimination measures in accordance with the impact elimination measures on noise, air quality, and traffic control to enhance work safety during the construction period.

Measures on Environmental Quality Maintenance in the Construction Workers' Residential Areas

- For the selection of the location for construction workers' residential areas, the contractor company/the contractor is required to have a plan on the construction worker's residential areas administration, design, locations of infrastructures and utilities, as well as other details, and it must be proposed to MRTA who is the project owner for consideration and approval before starting the project. In this regard, the location of the construction workers' residential areas, including the construction control office, must be away from underground water ponds at least 50 meters to avoid the contamination of dirty materials to the underground water resources.
- The preparation for entrance-exit, and the construction control office, as well as parking areas and other empty spaces must make the areas stable, such as using rocks on top of the ground, laying materials that help eliminate dusts, eliminate erosion and collapse, as well as plant some plants on the ground, if possible.
- The management of water utilization and wastewater management, MRTA as the project owner is required to supervise the contractor company/the contractor to perform the followings.
    - Prepare sufficient clean water for drinking and prepare at least 72 cubic meter/day/1 residential household of water for utilization, for construction workers on a daily basis.
    - Arrange to have sufficient and sanitary bathrooms-toilets for the construction workers in the construction workers' residential areas, as well as install instant wastewater management system, septic tank/ anaerobic filter tank for treating wastewater before releasing outside.
    - Always monitor and maintain the wastewater management system in highest efficiency and pump sediments from the system on a regular basis every 3 months.
- The contractor is required to perform the management of wastes, as follows.
    - Provide containers for regular garbage along the construction line with close cover. In this regard, the contractor must compile garbage arisen in the construction areas to trash at the project office every day.
    - Provide containers for regular garbage arisen from daily routines of construction workers in the residential areas to compile with daily garbage. These containers must place all over the areas with close cover, separating to wet garbage, dry garbage, dangerous wastes, and recycle.
    - Contact the municipality or the Sub-district Administrative Organization (SAO) that provides waste services in the close vicinity to pick up garbage for disposal every week.

2. Measures for Local Communities People Around the Construction Areas of Stations and Rail Line

Measures on Safety to Commuters and Nearby Communities

- The contractor company/the contractor must provide signal sign, identifying the construction area in 50-100 meters distance.
- The contractor company/the contractor must monitor the drivers to strictly comply with traffic rules.
- The contractor company/the contractor must have life and properties insurance for third party who may be damaged/harmed due to the construction project.

Measures on Prevention and Elimination of Impacts from the Change of Environmental Quality

- The contractor company/the contractor must strictly comply with the measures on the environmental impact prevention, correction and elimination, in terms of air quality, noise, vibration, surface water quality, and transportation to prevent and to eliminate impacts from the construction project, that may cause deterioration to the environment, and may affect to health of public and construction workers further.

(d) Aesthetic Landscape

Pre-construction Period

During design process, the followings must be implemented

- The designing of station details must follow urban design concept, focusing on openness, light design, and matching with the surrounding environment. Engineering and architecture design must be modern but simple to help reduce impacts and to enhance aesthetic landscape around the stations to be more appropriate. In this regard, the details design in terms of architecture and landscape architecture of each station does not need to be similar. They can be different in accordance with the environment and the scene around each location of the stations so each station will be unique and have scenic design.
- It is required to design pole structure and overpassing rail to match with the original environment or surrounding landscape. The poles must be designed in curve shape, sleek, light, open, as well as gouging technique can be used to reduce the contrast.
- It is required to consider the use of light and bright color to ensure the matching of the overpassing rail structure and the stations with the environment, as well as to reduce the contrast with the original surroundings.

Construction Period

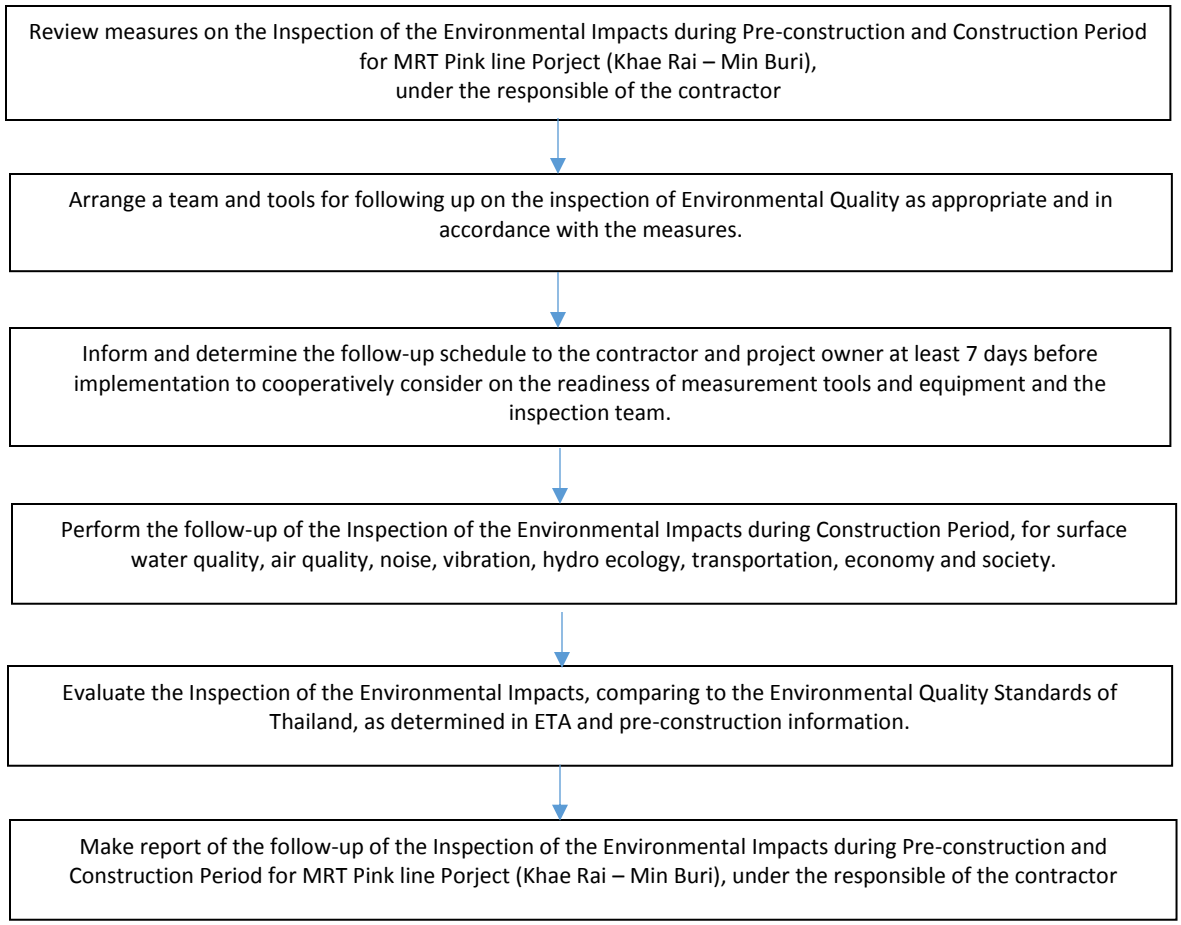
Along Mass Transit Route and Stations

1) Install non-transparent fence with height 2 meter to determine the construction area with clear sign, as well as to install sign board showing the project landscape of the future mass transit system to help reduce landscape impacts in the construction areas.
2) Avoid creating unpleasant or unfavorable landscape in the construction areas, such as leaving wastes and garbage outside the containers, or piling of materials and equipment left from the construction in an unorganized manner, or have no plastic or canvas cover, etc. After the completion of the mass transit system, the following actions must be implemented.
    - Plant ivies typed medium vines and heavy vines, such as liang-liang, Orapim Bougainvillea, Conbretum, Passion Flower, jasmine ivy, and Allamanda, etc. to enhance the landscape overlook and to reduce the contrast of piers of the overpassing rail and stations.
    - Increase green areas or plant small garden in the area under the stations (if there is any space) or along the mass transit line to increase ecological balance, enhance scenic landscape, or reduce air pollution, noise pollution and others by planting low bushes, such as Kalamona, yellow elder, Chinese Rice flower, Golden Dewdrop, and White Cheesewood, etc., or building pergola with wood or metal or other materials for growing medium vines and heavy vines, such as liang-liang, Orapim Bougainvillea, Conbretum, Passion Flower, jasmine ivy, and Allamanda, etc.

2.3 Guidelines for the Inspection of Environmental Impacts

The Environmental Impact Assessment requires this project to follow up on the inspection of impacts during the pre-construction and the construction period, including surface water quality, air quality, noise, vibration, hydro ecology, transportation, economy and society. The project is required to inspect environmental impacts at each determined point and follow up on the compliance in accordance with the Environmental Impact Prevention and Correction Measures, and the Inspection Follow-up on Environmental Impact Measures for Pre-construction and Construction Period of the Project, as well as is required to submit report every 6 months to the *Office* of Natural Resources and Environmental Policy and Planning.

In terms of the follow up on the inspection of the Environmental Impacts, this is required to be conducted by the consultant company (UAE) that is registered with the Department of Industrial Works, and possess prompt tools and measurements, and an inspection team to follow up and inspect the complete list of the environmental impacts as determined in the Environmental Impact Assessment. In this regard, the consultant company is required to perform actions shown in Picture 2-2, and the Follow-up Plan of the Inspection of the Environmental Impacts in Table 2-2.



PICTURE 2-2 IMPLEMENTATION PROCESS OF THE FOLLOW-UP OF THE INSPECTION OF THE ENVIRONMENTAL IMPACTS FOR MRT PINK LINE PROJECT (KHAE RAI – MIN BURI)

TABLE 2-2 THE FOLLOW-UP PLAN OF THE INSPECTION OF THE ENVIRONMENTAL IMPACTS FOR MRT PINK LINE PROJECT (KHAE RAI – MIN BURI) SINO-THAI ENGINEERING & CONSTRUCTION PUBLIC COMPANY LIMITED

Environmental Impacts	**Inspection Follow-up Indicators**	**Inspected Stations**	**Inspection Follow-up Frequency**
1. Surface water quality	<u>Physical Inspection</u> 1.Depth 2.Temperature 3.Transparency 4.Salinity 5.Conductivity 6.Velocity <u>Chemical Inspection</u> 1. Potential of hydrogen (pH) 2. Dissolved oxygen 3. Dirtiness in the form of biochemical oxygen demand (BOD_5) 4. Suspended solids 6. Oil & grease 7. Total iron <u>Biological Inspection</u> 1. Total coliform bacteria 2. Fecal coliform bacteria <u>Heavy Metal Inspection</u> 1. Lead (Pb) 2. Cadmium (Cd)	5 Stations, namely 5 Stations, namely 1. W1 Khlong Bang Talad canal Station 2. W2 Khlong Prapa canal Station 3. W3 Khlong Prem Prachakorn canal Station 4. W4 Khlong Lam Chala canal Station 5. W5 Khlong Song Ton Noon canal Station	Every 1 month throughout the construction period that cut through the water resource (1 time before construction)[1/]

TABLE 2-2 (CONT) THE FOLLOW-UP PLAN OF THE INSPECTION OF THE ENVIRONMENTAL IMPACTS FOR MRT PINK LINE PROJECT (KHAE RAI – MIN BURI)

Remark: [1/] Inspection follow-up 1 time during pre-construction period, addition to the conditions determined in the complete report of the report of requests to change details of the Environmental Impact Assessment approved by the National Environment Board of Thailand

SINO-THAI ENGINEERING & CONSTRUCTION PUBLIC COMPANY LIMITED

Environmental Impacts	**Inspection Follow-up Indicators**	**Inspected Stations**	**Inspection Follow-up Frequency**
2. Air Quality	1. Wind speed and direction 2. Total Suspended Particulates (TSP) 3. Particulate matter with 10 micrometers or less in diameter (PM-10) 4. Carbon Monoxide (CO) 5. Nitrogen Dioxide (NO_2)	6 Stations, namely 1. A1 Central Chest Institute of Thailand Station 2. A2 Chonprathan Songkhro School Station 3. A3 Khlong Kleur School Station 4. A4 Rajabhat Phranakhon University Station 5. A5 Sinpat Hospital Station 6. A6 Min Prasart Wittaya Station	- 1 time, 1 month before construction for baseline data - Every 3 month (4 times/year) by inspecting for 5 consecutive days (covering week days and holidays until the project completion)
3. Noise	1. Equivalent sound ($L_{eq\ 24\ hours}$) 2. 90% sound (L_{90}) 3. Daytime-Nighttime sound (L_{dn}) 4. Maximum sound (L_{max})	6 Stations, namely 1. N1 Central Chest Institute of Thailand Station 2. N2 Chonprathan Songkhro School Station 3. N3 Khlong Kleur School Station 4. N4 Rajabhat Phranakhon University Station 5. N5 Sinpat Hospital Station 6. N6 Min Prasart Wittaya Station	- 1 time, 1 month before construction for baseline data - Every 3 month (4 times/year) by inspecting for 5 consecutive days (covering week days and holidays until the project completion)
4. Vibration	- Peak Particle Velocity	6 Stations, namely 1. V1 Central Chest Institute of Thailand Station 2. V2 Chonprathan Songkhro School Station 3. V3 Khlong Kleur School Station 4. V4 Rajabhat Phranakhon University Station 5. V5 Sinpat Hospital Station 6. V6 Min Prasart Wittaya Station	- 1 time, 1 month before construction for baseline data - Every 3 month (4 times/year) by inspecting for 5 consecutive days (covering week days and holidays until the project completion)

Remark: 1/ Inspection follow-up 1 time during pre-construction period, addition to the conditions determined in the complete report of the report of requests to change details of the Environmental Impact Assessment approved by the National Environment Board of Thailand

TABLE 2-2 (CONT) THE FOLLOW-UP PLAN OF THE INSPECTION OF THE ENVIRONMENTAL IMPACTS FOR MRT PINK LINE PROJECT (KHAE RAI – MIN BURI)

SINO-THAI ENGINEERING & CONSTRUCTION PUBLIC COMPANY LIMITED

Environmental Impacts	**Inspection Follow-up Indicators**	**Inspected Stations**	**Inspection Follow-up Frequency**
5. Hydro geology	1. Biodiversity 2. Type and density of plant and animal planktons 3. Population of surface animals	5 Stations, namely 1. W1 Khlong Bang Talad canal Station 2. W2 Khlong Prapa canal Station 3. W3 Khlong Prem Prachakorn canal Station 4. W4 Khlong Lam Chala canal Station 5. W5 Khlong Song Ton Noon canal Station	Every 1 month throughout the construction period that cut through the water resource (1 time before construction)1/
6. Transportation	1. Traffic volume 2. Accident (location, severity, and causes of accident)	6 Stations, namely 1. Khae Rai Junction 2. Sanambin Nam Junction 3. Pak Kret Junction 4. Viphavadi Rangsit Overpassing Junction 5. Suan Siam Junctin 6. Min Buri Junction	- Inspect and record traffic volume 1 month before construction for 2 consecutive days (covering week days and holidays) for baseline data at traffic volume counting points. - Inspect and record traffic volume every month for 2 consecutive days (covering week days and holidays) until project completion.

Remark: 1/ Inspection follow-up 1 time during pre-construction period, addition to the conditions determined in the complete report of the report of requests to change details of the Environmental Impact Assessment approved by the National Environment Board of Thailand

			- Inspect accident statistics once a month throughout the construction period.

TABLE 2-2 (CONT) THE FOLLOW-UP PLAN OF THE INSPECTION OF THE ENVIRONMENTAL IMPACTS FOR MRT PINK LINE PROJECT (KHAE RAI – MIN BURI)

SINO-THAI ENGINEERING & CONSTRUCTION PUBLIC COMPANY LIMITED

Environmental Impacts	**Inspection Follow-up Indicators**	**Inspected Stations**	**Inspection Follow-up Frequency**
7. Socio-economic study and public opinions	1. Acknowledgement of project information 2. Impacts during construction and opinions towards the project 3. Problems from project, including opinions and recommendations for the project	<u>Pre-construction Period</u> 1. A group of direct impacted people (expropriation and migration) 2. A group of local communities living within 500 meters from the line and the depot and the Park & Ride facility location (community leaders and indirect impacted people) At least 500 households	1 time before construction
		<u>Construction Period</u> A group of local communities living within 500 meters from the line and the depot and the Park & Ride facility location (community leaders and indirect impacted people) At least 500 households	2 times per year throughout the construction period

The follow up of the section of the environmental impacts of MRT Pink Line Project (Khae Rai – Min Buri) will follow the following standards.

- The General Ambient Air Quality Standard under the Notification of the National Environment Board of Thailand No. 24 (2004), dated 9 August 2004, declared in the Government Gazette Vol. 121, Special Section 104d, dated 22 September 2004
- The General Sound Standard under the Notification of the National Environment Board of Thailand No. 15 (1997), dated 12 March 1997, declared in the Government Gazette Vol. 114, Special Section 27d, dated 3 April 1997
- The Vibration Standard for Preventing Impacts to Building under the Notification of the National Environment Board of Thailand No. 37 (2010), declared in the Government Gazette Vol. 127, Special Section 69d, dated 2 June 2010
- The Surface Water Quality Standard under the Notification of the National Environment Board of Thailand No. 8 (1994) in accordance with the National Environment Promotion and Protection Act B.E. 2535 (1992), declared in the Government Gazette Vol. 111, Special Section 16d, dated 24 February 1996

2.4 Methods for the Follow Up of the Environmental Impact Inspection

2.4.1 The follow up of the surface water quality inspection

Follow up on the inspection of the surface water quality during the pre-construction period 1 time for baseline

Data and every 1 month during the construction period throughout the construction period that cut through the water resource for 5 stations, including

1) W1 Khlong Bang Talad canal Station
2) W2 Khlong Prapa canal Station
3) W3 Khlong Prem Prachakorn canal Station
4) W4 Khlong Lam Chala canal Station
5) W5 Khlong Song Ton Noon canal Station

The details of inspection follow-up method are as follows.

1) Method for surface water sample collection

The collection of surface water sample must comply with the regulations under the notification of the National Environment Board of Thailand No. 8 (1994), in accordance with the National Environment Promotion and Protection Act B.E. 2535 (1992) on the determination of surface water resource quality, declared in the Government Gazette Vol. 111, Special Section 16d, dated 24 February 1996, regarding the Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2012 as determined by APHA, AWWA and WEF.

It is required to collect sample by using grab sampling method, with Kemmerer Sampler equipment that is cleaned from laboratory, then to use glass sampler collect the sample from the middle of the depth, except for total coliform bacteria that must be collected at the depth 30 centimeters at the inspection follow-up points.

When collecting water sample, it is required to record water depth, pH, conductivity, DO, and velocity immediately in the field, as well as record the water sample conditions that can be seen, such as color and smell, before storing water sample in to the specific container as shown in Table 2-3.

(a) For sample collection point in a canal without bridge **(b) For sample collection point in a canal with bridge**

PICTURE 2-3 Showing water sample collection from the flowing water resources by using Kemmerer Sampler

2) **Surface Water Sample Storage Method**

All surface water sample must be stored in accordance with standard method as determined on the Water Sample Collection Method and Water Quality Inspection, in accordance with the notification of the National Environment Board of Thailand No. 8 (1994), in accordance with the National Environment Promotion and Protection Act B.E. 2535 (1992), regarding the Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2012 as determined by APHA, AWWA and WEF. In the last process, all water sample must be frozen in the temperature approximately <6 degree Celsius and it is required to record data in the chain of custody and the sample must be sent to laboratory within 24 hours. The details of storage methods show in Table 2-3.

3) Surface Water Quality Inspection Method

The sample sent to the laboratory will enter into standard control system for inspection in the laboratory. After recoding data of water sample into Log Book system already, the sample must be stored in freezing room for further analysis., by using inspection method in accordance with the standard notified by the notification of the National Environment Board of Thailand No. 8 (1994), in accordance with the National Environment Promotion and Protection Act B.E. 2535 (1992) on the determination of surface water resource quality regarding the standard for water sample and wastewater inspection in the Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2012 as determined by APHA, AWWA and WEF, as shown in Table 2-3.

TABLE 2-3 Sample Container, Storage Method, Inspection, and Minimum Standard for Surface Water Quality Inspection

Inspection Indicator	Container	Surface Water Storage Method	Surface Water Inspection Method	Minimum Standard for Inspection	Unit
1. Physical					
1.1 Depth	-	Inspect immediately in the field	Depth Meter	-	m
1.2 Temperature	-	Inspect immediately in the field	Thermometer	-	˚C
1.3 Transparency	-	Inspect immediately in the field	Secchi Disc	0.1	M
1.4 Salinity	-	Inspect immediately in the field	Electrical Conductivity Salinity Temperature Meter	-	ppt
1.5 Conductivity	-	Inspect immediately in the field	Electrical Conductivity Method	-	Umho/cm
1.6 Velocity	-	Inspect immediately in the field	Flow Meter	-	m/s
2. Chemical					
2.1 pH	-	Inspect immediately in the field	Electrometric Method	-	-
2.2 Dissolved Oxygen	G	Freeze at temp > 0˚C, ≤ 6˚C	Azide Modification Method	0.5	mg/L
1.3 BOD_5	P	Freeze at temp > 0˚C, ≤ 6˚C	Azide Modification Method	1.0	mg/L
1.4 Suspended Solids	P	Add H_2SO_4 for pH < 2 Freeze at temp > 0˚C, ≤ 6˚C	TSS Dried at 103-105 Celsius Degree	5.0	mg/L
1.5 Oil & Grease	G, Wide Bore	Add HNO_3 for pH ≤ 2 Freeze at temp > 0˚C, ≤ 6˚C	Partition-Gravimetric Method	3	mg/L
1.6 Total irom	P(A)	Freeze at temp > 0˚C, ≤ 6˚C	Phenanthroline Method	0.010	mg/L Fe

TABLE 2-3 (CONT) Sample Container, Storage Method, Inspection, and Minimum Standard for Surface Water Quality Inspection

Inspection Indicator	Container	Surface Water Storage Method	Surface Water Inspection Method	Minimum Standard for Inspection	Unit
3. Biological					
3.1 Total coliform bacteria	G, Sterile	Put in zip lock bag Freeze at temp > 0˚C, < 8˚C	Multiple Tube Fermentation Technique	<1.8	MPN/100 mL
3.2 Fecal coliform bacteria	G, Sterile	Put in zip lock bag Freeze at temp > 0˚C, < 8˚C	Multiple Tube Fermentation Technique	<1.8	MPN/100 mL
4. Heavy Metal					
4.1 Pb	P(A)	Add HNO_3 for pH ≤ 2 Freeze at temp > 0˚C, ≤ 6˚C	Electrothermal Atomic Absorption Spectrometric Method	0.010	mg/L Pb
4.2 Cd	P(A)	Add HNO_3 for pH ≤ 2 Freeze at temp > 0˚C, ≤ 6˚C	Electrothermal Atomic Absorption Spectrometric Method	0.010	mg/L Cd

Remarks:
P means Poly Ethylene or equivalent
G means glass
P(A) means plastic (polyethylene or equivalent) that passes the scouring process of 1 + 1 Nitric Acid
G(A) means glass that passes the scouring process of 1 + 1 Nitric

2.4.2 Air Quality Inspection

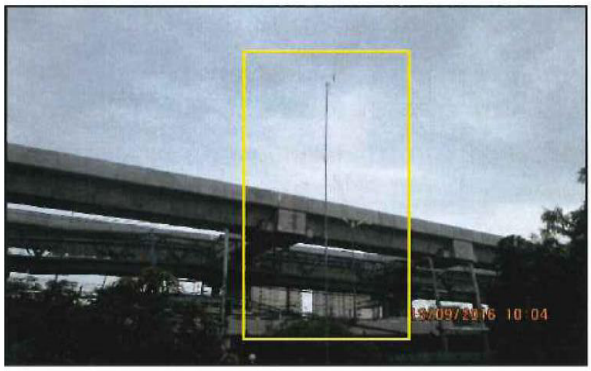
Perform the inspection of wind velocity and direction, total suspended particulates (TSP), Particulate matter with 10 micrometers or less in diameter (PM-10), Carbon Monoxide (CO) and Nitrogen Dioxide (NO_2) for 5 consecutive days (covering week days and holidays) 1 time, 1 month before the construction for baseline data, and every 3 months (4 times/ year) until the project completion in the vulnerable areas along the project line, 6 stations, namely

1) A1 Central Chest Institute of Thailand Station
2) A2 Chonprathan Songkhro School Station
3) A3 Khlong Kleur School Station
4) A4 Rajabhat Phranakhon University Station
5) A5 Sinpat Hospital Station
6) A6 Min Prasart Wittaya Station

For each process of implementation must follow the processes determined the certificate ISO/IEC 17025:2005, with the following inspection follow-up details

1) Wind velocity and direction

Record wind velocity and direction when following up general ambiance air quality inspection, using Cup Anemometer and Wind Vane branded Met One Model 034, that is an American product, manufactured by Met One Instrument Inc. and can signal to Data Logger, as well as can follow up the inspection and can convert inspection outcomes in the form of Wind Rose

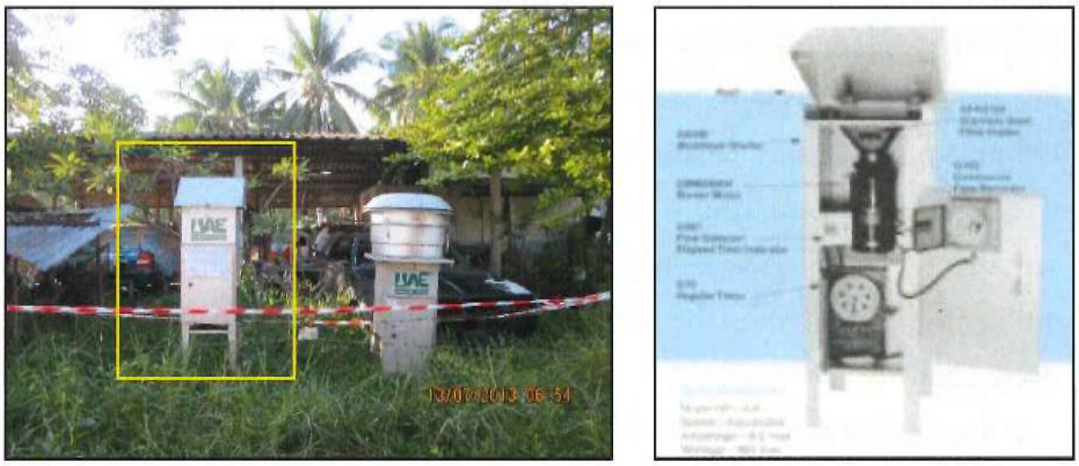


Picture 2-4 The Follow Up of Wind Velocity and Directio

2) Total Suspended Particulates (TSP)

The collection of total suspended particulates or particulate matter with 100 microns or less in diameter must apply Gravimetric, under the Notification of the National Environment Board of Thailand No. 10 (1995), dated 17 April 1995, declared in the Government Gazette Vol. 112, Special Section 42d, dated 22 May 1995, by using High Volume Air Sampler. The sample will be collected in the field and will be brought for analysis for total suspended particulates amount. Every step is required to comply with the processes determined in ISO/IEC 17025:2005 Certificate, as follows.

- Prepare the High Volume Air Sampler by checking it conditions and the conditions of the filter to select particulate size before using.
- Prepare glass fiber filter size 8 x 10 inches by stamping number on the rim of the filter and heat in desiccator for 24 hours, by controlling humidity in the desiccator to be between 30-50% RH at all time, then weight by using micro scale 4 positions that has been certified, record the result, and prepare a paper to record the flowing rate of the air (flow chart).
- Install the High Volume Air Sampler at the determined areas by picking based on U.S. EPA, such as a space to pull sample from the High Volume Air Sampler must be 1.5 meters but less than 6 meters higher from the ground in the 270 degree radius. The surrounding area of this space must has no obstacle that can impede the air flow, must be open, away from the wall or other structure more than 2 meters all around, as well as away from wind flow obstacles 20 meters or at least twice of the height of the obstacles. It must also be away from the road that is not coated with proper materials and away from agricultural area at least 400 meters, as well as away from pollution origins that may lead to error outcome, such as waste kiln, metal kiln, or areas that can cause dust, except for the case that the pollution origin is designated as a place for inspection. In the case of inability to locate the right point, it is recommended to pick the convenient point and record the point condition by making the plan of the inspection point and its surrounding areas in the form of TSP sample.
- Perform the comparative inspection of flowing rate of the High Volume Air sampler with certified Standard Orifice at the sample collection points to get 5 values before collecting sample and plot graph to calculate the correlation coefficient (r), that must be more than or equal to 0.995. If the value does not meet the determined value, the sampler must be tested and it must be re-inspected until r is more than or equal to 0.995, then record the outcome in the form of TSP sample.
- Collect sample by pumping air through paper filter at the pumping rate of 1.13 – 1.7 cubic meters per minute for 24 hours and then take the paper filter, paper for recording air flowing rate, and the form of TSP sample for further analysis of TSP.
- Dry the sample in desiccator for 24 hours for one more time by controlling humidity and they weight by using 4-position micro scale that is certified, the calculate particulate weight on the paper filter in accordance with Pre and Post Weight Different.
- Calculate the air volume flowing through the paper filter from the flow chart, together with the comparative outcome, and then adjust air volume to the standard temperature and pressure (25 Celsius degree and pressure 1 atm).
- Calculate and report the result of the follow up of the inspection of TSP in 24 hours in the unit of milligram per cubic meter, in accordance with Gravimetric method, and present the inspection follow-up result together with the evaluation by comparing the result with the standard TSP.



PICTURE 2-5 The Follow-up of the TSP Inspection By High Volume Air Sampler

3) Dust not more than 10 micron (PM-10)

Collection for dust sample, in which having the particle not more than 10 Micron will use Gravimetric method according the National Environment Board No.10 (1995) dated 17 April, 1995 announced in the government gazette No. 112: Special Edition 42 Ngor (42ง) dated 25 May, 1995 by High Volume Sampler, will sampling in the file and bring the sample for testing the density of dust. The method will follow the steps mentioned in Thai Industrial Standards Institute 17025-2548 (มอก.17025-2548) (ISO/IEC 17025-2005), the following steps can summarize as follows:

- Prepare High Volume Air Sampler, inspect the condition of sampler and condition of selecting head per type of dust before usage.
- Prepare Quartz Fiber Filter size 8 X 10 inches and mark the number on filer border, then bake in the Desiccator for 24 hours in which controlling the humidity all the times for the range of 30-50% RH, then weigh with the calibrated 4 digits dedicate weighing scale, then record and prepare record paper for the flow chart rate.
- Install the High Volume Air Sampler at the assigned location according to U.S.EPA such as channel for sample with the drawer of High Machine with at least 1.5 meters height from ground level but not more than 6 meters and 270 degree radius. The drawer of the Air Sampler must not have any obstruction to the air flow, open area far from fence, or wall or any surrounding construction more than 2 meters and far from the wind obstruction more than 20 meters or at least 2 times far from the height of obstruction, shall far from the unpaved road with material and the agricultural area not less than 400 meters, far from the polluted sources in which could cause any data error such as waste incinerator, metal incinerator or source of dust. Except that the polluted sources will be the part of the measurement. And In case of un-identify for the appropriate location, shall select the convenient location for installation and recording type of measure location by writing the measure location plot and surrounding area in the sampler record paper for the dust not more than 10 micron in the general atmosphere.
- To compare the air flow of High Volume Air Sampler with Standard Certified Orifice at the sampling location for 5 values before collecting samples for plotting graph in order to calculate the Correlation Coefficient, r. This must have the value more than or equivalent to 0.995. In case of the value is not comply with the requirement, shall inspect the High Volume Air Sampler and compare again until receive the value r more than or equivalent to 0.995. Then, to record on the dust sample record for not more than 10 micron in the general atmosphere.
- Collect sample by pumping through paper filter with the pumping rate of 1.13-1.17 cubic meters rate per minute for 24 hours, then bring the paper filter to record the air flow and record the dust not more than 10 micron in the general atmosphere in order to analyze the quantity of dust not more than 10 micron.

- Bring the sample to the Desiccator for 24 hours again by controlling the humidity, then weigh by calibrated 4 digits dedicate weighing scale, and then calculate the weight of dust on the filter paper according to Pre and Post Weight Different.

- Calculate the quantity of air flow in which flowing to paper filter from Flow Chart, together with the comparison result, then adjust the quantity of air flow to the standard temperature and Atmospheric pressure (25 degree Celsius and Pressure 1 atm.)
- Calculate and report result of monitoring quantity of dust not more than 10 micron in general atmosphere for 24 hours average in the milligram per cubic meter according to Gravimetric, then report eh monitoring result with the evaluation by comparing the inspection with the air quality standard in general atmosphere.

Figure 2-6: Monitoring the quantity of dust not more than 10 Micron (PM-10) and Standard Certified Orifice

4) Carbon Monoxide (CO)

Carbon Monoxide detection in the atmosphere by using Non-Dispersive Infrared or NDIR according to the National Environment Board is installed in the air quality measure mobile station in which having the temperature control in order to protect the equipment from any impact of changing temperature in natural. This detector is already certified, then can use for detecting with the following steps:

- Bring the air quality measure mobile station to the assigned location by selecting the location according to the criteria such as: shall open area without any obstruction for the radius of meters, far from other resources, etc., install the end collecting tube in the range of 3.0 -6.0 meters from ground level, record the environment of the sample location in Field Data Sheet
- Inspect the CO Analyzer
- Supply electricity to the Analyzer, then warm up the Analyzer for 1-2 hours, inspect the condition of equipment then starting to compare.
- Calibrate by adjusting Nitrogen Gas (Co Free) in the tank, then adjust span by input the Certified Standard Carbon Monoxide Gas (N_2 Balanced) to Analyzer by setting the span value between 80-85% of 80-85% of full scale measurement.
- Measure the quantity of Carbon Monoxide in atmosphere with the CO Analyzer in atmosphere (Thermo Brand, Series 48C) average 8 hours for 7 days continually. In between, also inspect the condition of Analyzer every 24 hours.
- Then shall record the result on Data Logger, and bring the result for analysis by comparing with the air quality standard in atmosphere, then further prepare the report.

Figure 2-7: Monitoring the quantity of Carbon Monoxide (CO)

and CO Analyzer (NDIR)

5) Nitrogen Dioxide (NO_2)

Nitrogen Dioxide (NO_2) detection in the atmosphere by using Nitrogen Dioxide (NO_2) Quantity Analyzer in atmosphere as per Chemiluminescense according to the National Environment Board and according to U.S. EPA, Code of Federal Regulations, Title 40, Part 53 is installed at the air quality measure mobile station in which having the temperature control in order to protect the equipment from any impact of changing temperature in natural. This detector is already inspected and calibrated by Multipoint Calibration, then can use for detecting with the following steps:

- Bring the air quality measure mobile station to the assigned location by selecting the location according to the criteria such as: shall open area without any obstruction for the radius of meters, far from other resources, etc., install the end collecting tube in the range of 3.0 -6.0 meters from ground level, record the environment of the sample location in Field Data Sheet
- Inspect the NO_2 Analyzer and other equipment in the station starting from Sampling Probe, air pump, air flow meter, and condition of Analyzer, etc.
- Supply electricity to the Analyzer, then warm up the Analyzer for 1-2 hours, inspect the condition especially for the Reaction Chamber and Photo-multiplier Tube. When it's found out that it's complied with requirement, then starting to modify.
- Calibrate by adjusting Zero Gas (NO, NO_2 Free) from Zero Gas Generator, and then adjust span by input the Certified Standard NO (NO_2 Balanced) to Standard Gas Generator in which the Dynamic Diluter for Mass Flow Controller to control the flow of Gas NO and Zero Gas by setting the span value between 80-85% of 80-85% of full scale measurement.
- Measure the quantity of Nitrogen Dioxide in atmosphere in atmosphere average 1 hour for 7 days continually. In between, also inspect the condition of Analyzer every 24 hours.

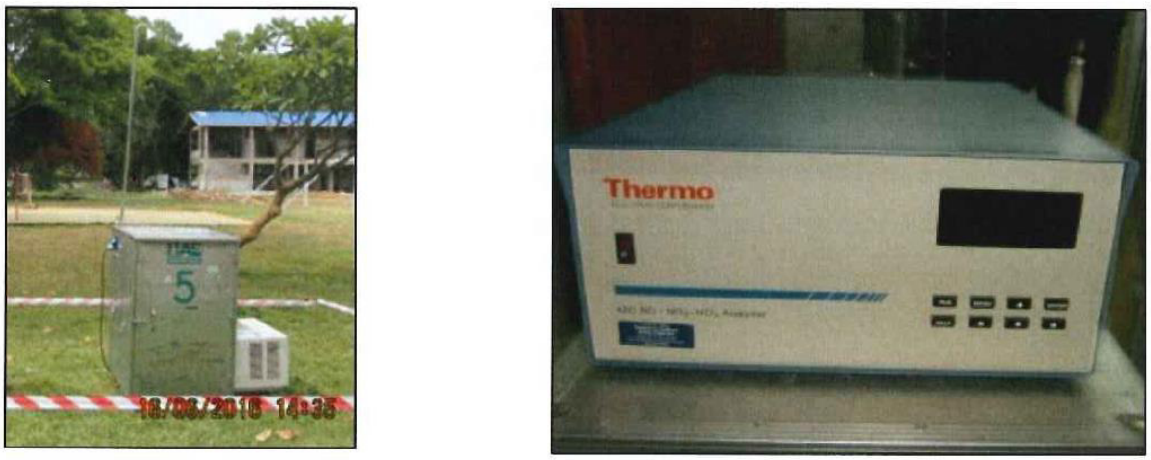


Figure 2-8: Monitoring the quantity of Nitrogen Dioxide (NO_2) and NO_2 Analyzer (Chemiluminescense)

2.4.3 Sound Level Monitoring

To monitor general sound level consists of average sound 24 hours ($L_{eq\ 24\ hrs}$), maximum sound level (L_{max}), sound level of 90 percentile (L_{90}) and sound level during day time and night time (L_{dn}) for 5 days continually (covers normal day and holidays) for 1 time, one month before starting the construction in order to use as Baseline Data and every 3 months (4 times/year) until the construction complete in the sensitive area along the route line of the project for 6 stations as follows:

Station N1: Central Chest Institute of Thailand

Station N2: Chonprathasongkhro School

Station N3: Khlong Kluea School

Station N4: Phranakhon Rajabhat University

Station N5: Synphaet General Hospital

Station N6: Min Prasat Witthaya School

The details of monitoring methos are as follows:

Monitoring the sound level will follow the general sound level standard according to the National Environment Board No.15 (1997) dated 9 August, 2004 announced in the government gazette No. 114: Special Edition 27 Ngor (27ง) dated 3 April, 1997 by monitoring the average sound level 1 hours ($L_{eq\ 1\ hrs}$), maximum sound level (L_{max}), sound level of 90 percentile (L_{90}). Then use the value of $L_{eq\ 24\ hrs}$ for 24 hours continually to calculate the average sound level of 24 hours ($L_{eq\ 24\ hrs}$) and the sound level during day time and night time (L_{dn}) in dB(A).

Monitoring the sound level for Integrated Sound Level Metre Type Rion, Series NL-21 or NL-42, in which the product of Japan produced by Rion Co.,Ltd. is the standard sound Type 2 complied with international standard IEC 61672, very accuracy, and the errors of monitoring is in ± 0.5 dBA. This type has Wind Screen attached with Microphone in order to cover and protect from wind that could be the factor for errors during monitoring. The installation of sound level meter is on stand by having microphone 1.2-1.5 meters height from ground and within 3.5 meters radius. In the horizone around microphone shall have no fence or any obstruction in which having the reflection. For sound goes into the sound level meter will go through the mutiflier and sound filter which having the center of gravity at A and C or F according to occurred sound. Before the monitoring shall inspect and calibrate equipment with the Sound Level Calibrator with the standrd sound at 94.0 dB, frequency 1,000 Hz at center of gravity of C, and then modify to center of gravity A before monitoring.

Figure 2-9: Monitoring the sound level by using Integrated Sound Level Meter and Acoustic Calibrator produced sound wave with frequency 100 Hz 94.0 dB.

2.4.4 Monitoring the Vibration

Monitor the vibration consisted of frequency and Peak Particle Velocity by continuous measure for 5 days (covers the normal work day and holidays) for 1 time one month before the construction in order to have Baseline Data and every 3 months (4 times/year) until the construction project complete in the sensitive area along the route line of the project for 6 stations as follows:

1. Station N1: Central Chest Institute of Thailand
2. Station N2: Chonprathasongkhro School
3. Station N3: Khlong Kluea School
4. Station N4: Phranakhon Rajabhat University
5. Station N5: Synphaet General Hospital
6. Station N6: Min Prasat Witthaya School

Monitoring vibration shall conduction according to the requirement in vibration standard in order to protect any impact to building according to National Environment Board No.37 (1995) announced in the government gazette No. 127: Special Edition 69 Ngor (69ง) dated 2 June, 2010 by using vibration meter; Instantel brand, Blastmate III series, Minimate series, or Minimate Plus series, installs the vibration meter at the foundation of building by turning the receiver to the source of vibration and tight the steel plate in order to protect from Resonance between ground and vibration meter, continues to measure for every vibration event, then bring the result to compare with the standard.

Figure 2-10: Monitoring the Vibration

2.4.5 Monitoring the Water Ecology System

To conduct the Water Ecology System monitoring consists of biodiversity for type and density of Phytoplankton and Zooplankton, and density of benthos during the construction preparation for 1 time in order to use for Baseline DATA and during construction by monitoring every month for the whole construction period for 5 stations as follows:

1) Station W1 Khlong Bang Talat

2) Station W2 Khlong Prapa

3) Station W3 Khlong Prem Prachakon

4) Station W4 Khlong Lam Chala

5) Station W5 Khlong Song Ton Nun

Details of monitoring are as follows:

1) Method for Collecting and Maintaining plankton sample

Sample of water biodiversity for analysis for species and quantity of plankton will sampling by Plankton Net as per conical standard with the diameter approx. 30 cm, made from 20 micron mesh for Phytoplankton and 70 micron mesh for Zooplankton. At the end of conical sheet will have bulb to keep plankton quantity during filter. The sampling will use vertical pulling method (according to the transparency). The filtered sample will put in the bottle with Formalin (40% Formaldehyde = 100 % Formalin) by adding water sample in the sample bottle until 190 millimeters, then add Formalin for 10 millimeters, slightly shakes for mixing, then freeze the temperature at 4 degree Celsius, then quickly send to Laboratory to analyze the species and quantity of Phytoplankton and Zooplankton according to the method of APHA AWWA and WEF “Standard Methods for the Examination of Water and Wastewater”, 22nd Edition, 2012.

Figure 2-11: Plankton Net Sampling

2) Method for Collecting and Maintaining Benthos Sample

Collecting the Benthos in order to analyse species and quantity of Benthos by seperating sediment soil collected from underground watersoil with Petersen Grab Sampler, grab the top soil by seperating the soil sample in which already filter with mesh. Then keep the sample in the concentrated Formalin solution approx. 10% in the soil sample, then completely seal the bag, then send the sample for analysis in order to find species and benthos quantity.

3) Method for analysis and evaluation the Phytoplankton and Zooplankton

Analysis the plankton and benthos samples classify by using microscope in order to classify species and quantity of Phytoplankton and Zooplankton according to "Standard Methods for the Examination of Water and Wastewater", 22nd Edition, 2012 by APHA AWWA and WEF. When classify species and quantity of plankton and benthos of each sampling location, then will bring species and quantity of plankton and benthos to evaluate the water resource by consideration the index of diversity of found plankton. The concern index for consideration will consist of Sum of Species, Diversity Index H and Evenness Index J according to Shannon-Weaver. The details are as follows:

- Sum of Species, S is the index to state the diversity of quantity and species of plankton in water resources by consideration the sum of species of found plankton.
- Diversity Index, H. Index is changed according to finding sum of species, including quantity of each species. If in any water resources is found that sum of species is high, and similar quantity of each species, then the calculation for diversity index will be high. The diversity index can calculate by the following equation:

$$H = -\sum_{i=1}^{n} Pi \times \ln Pi$$

H = Diversity Index
Pi = Proportion of living thing, i per total living thing of the population
N = total sum of species of living thing of population

The criteria to consider the Diversity Index refers to Shannon-Weaver Diversity Index

- Evenness Index, J is represented the dispersion of plankton in each survey location and no.of survey. If the value is close or equals to 1, presents that the survey location consisted of several species of plankton in which having similar quantities. And the same dispersion presents that survey location has similar quantity of living thing and regularly dispersion, can calculate from the following equation

$$J = \frac{H}{\ln n}$$

J = Evenness Index, J
H = Diversity Index, H

2.4.6 Mass Rapid Transit System Monitoring

During the construction of the project can impact to the transportation caused from the deletion of traffic lanes in the construction protect area or speed limit, therefore it is needed to survey the traffic quantity in order to use as data to increase the efficiency of traffic management and in order to prevent from any accident might have. The traffic quantity survey will consist of recording the traffic quantity per day by monitoring and recording the traffic quantity continues for 2 days (cover the normal day and holiday) one month prior to the construction for 1 time in order to use as Baseline Data and every month until the construction project is complete. The accident statistics for position, severity, and cause of accident shall conduct once per month during the construction period by selecting the inspection point station in order to count the traffic quantity of the project at intersection close to construction area along the route line of the project for 6 stations as follows:

1) Khae Rai Intersection
2) Sanambin Nam Intersection
3) Pak Kret Intersection
4) Vibhavadi Rangsi Intersection
5) Suan Siam Intersection
6) Min Buri Intersection

The details of monitoring are as follows:

1) Traffic Quantity Survey

Traffice Quantity Survey along the routeline of the project referred to several methods such as assign the road line for survey, collect the traffic quantity, and classiy the type of vehicle by survey for each side of traffic, classify the type of vehicle or this technique is called Mid-Block. The objective of the mentioned methods is in order to bring the analysis to compare with the changing of traffic quantity before the construction period and during the construction period. The details of each step are as follows:

1. Classify the vehicle into 7 types according to the gneral survey by Office of Land Traffic Management Board as details presented in table 2-4.
2. Prepare tools/equipment such as CCTV, traffic quantity survey data sheet, PPE including training and orientation for personnel working in the field.
3. Assign the survey location/CCTV position in which could clearly survey the number of each type of vehicle of each side of the road.
4. Set up time for collecting the number of vehicles and install CCTV size 40X40 centimeters, 3 meters height in order to survey traffic quantity by recording per required date and time; 7.00 -7.00 of the next day for 24 hours for 1 day and count the number of vehicles in and out from recorded pictures as presented in the sample of using CCTV to survey traffic quantity as per picture.
5. Count the number of vehicles from CCTV by 2 methods: recording by marking to represent the number of one vehicle or using Counter, and then summarizing the number of vehicles into the survey summary data sheet.
6. Verify data and use the survey result consisted of quantity of vehicle classified into each type per hour, record the survey result in the traffic quantity record table in electronic file.
7. Calculate the traffic quantity classified each hour per Passenger Car Unit/Hour by using Microsoft Excel to calculate and analyze.
8. Use the traffic quantity per hour of each type of vehicle to adjust to be the same unit of Passenger Car Unit/Hour (PCU/Hour) by using Passenger Car Equivalent (PCE) according to the United States of Transportation Research Board

Table 2-4 Classification of Vehicle for collecting the traffic quantity and adjust the traffic quantity of each type of vehicle to be the same unit for 4 wheels personnel vehicle (Passenger Car Unit: PCU)

Item	Type of Vehicle [1/]	Description of Vehicle	PCE [2/]
1.	4 wheels truck	• 4 wheels truck with 2 wheels drive (Pickup) – personnel • Truck with 4 wheels drive (personnel) • 4 wheels truck for carrying more than 7 persons • Van	1.0

2.	Bus	• 6 wheels bus (minibus and microbus) • 6 wheels bus without route. • Bus by Bangkok Mass Transit Authority • Bus by private organization	1.5
3.	6 wheels truck	• Carry truck with 6 wheels for carrying material	1.5
4.	More than 6 wheels truck	• More than 6 wheels Carry Truck	1.7
5.	4 wheels personnel vehicle	• 4 wheels personnel vehicle not more than 7 persons. • 4 wheels personnel vehicle not more than 7 persons. (Taxi)	1.0
6.	3 wheels vehicle	• Tuk – Tuk	0.3
7.	Motorcycle	• 2 wheels motorcycle	0.3

Sources: [1/] Office of Land Traffic Management Board (2003)
[2/] Passenger Car Equivalent: PCE, referred from the Engineering Division of Department of Highway, 2002

Figure 2-12: Traffic Quantity Survey

2) Collecting the accident statistics data

The consulting company will conduct and collect statistics data, position, time for accident, and cause of accident from related authorities such as: local police station**.**

2.4.7 Socioeconomic Condition Survey

The execution of the construction project may disturb life and the living of population, and may impact to the Socioeconomic condition of the public in the construction project area. Therefore, in EIA report has specified to have the survey for life and the living of population, Socioeconomic condition of related public. There will be the survey for public comments on impact from the construction activities project and the satisfaction on the preventive and correcting impact measure by Construction Contractor by interview the community leader/direct and indirect affected people. Information from interview will use to evaluate the impact to socioeconomic condition of related public in ordre for further correction. If it's found out that some measures or the activity impact to life and the living of population. The plan of Socioeconomic conditon survey consists of :

- Project Information acknowledgement
- Impact during the construction and comment on the project
- Issues from project, as well as comment and suggestion to the project.

The obligation of the construction contractor shall survey the socioeconomic condition at the construction area 1 time prior to the construction of the project and 2 times per year during the construction period. The focus groups are as follows:

Before proceeding the project

1) Direct impact group (expropriate and migrate)
2) Public group living in 500 meters distance from the route line and surrounding the Depot and Park and Ride Building, (community leader, indirect impact group) at least 500 households.

During Construction Period

1) Community house in the area of 500 meters from route line, surrounding of Depot Center and Park and Ride building. (Community leader and indirect impact to community) for at least 500 households.

The details of survey are as follows:

1) Field Survey

Trained Interviewer from Consulting company studied the details of construction project, will interview the focus group. The interviewer will understand the major contents as follows:

- Background and objective of the project
- Understanding details of the project
- Objective of asking each question and scope of direct reply
- Introduction method and method creating the informality
- Method for guiding to the interview and method for asking the additional questions.
- Method of recording or interview content
- Method for verification or matching the received reply.

2) Type of Questionnaire

The questionnaire for survey designed to be appropriate with the focus group is the questionnaire for general public by having the structure of questionnaire covering the major issues as follows:

- Section no.1: General, Social Economy Condition
- Section no.2: Living condition and current environment
- Section no.3: Recognition for the public relations of the project
- Section no.4: Comments on the Project

2.5 Environmental Management Plan

Conducting the implementation according to the Environmental Impact Preventive and Mitigation Measures and environmental impact assessment monitoring for Pink Line Khae Rai-Min Buri before the construction period and during construction period of Sino Thai Engineering & Construction Public Company Limited and have the construction period for 39 months, and submit the details of schedule as presented on table 2-5.

Table 2-5 Environmental Quality Monitoring Plan for Pink Line Khae Rai – Min Buri

Sino Thai Engineering & Construction Public Company Limited

สถานีติดตามตรวจสอบคุณภาพสิ่งแวดล้อม	ดัชนีที่ติดตามตรวจสอบ	ปี 2560		ปี 2561												ปี 2562												ปี 2563												ปี 2564		
		ระยะเตรียมการก่อสร้าง		ระยะก่อสร้าง																																						
		9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1. การติดตามตรวจสอบผลกระทบสิ่งแวดล้อมตามรายงาน EIA																																										
1.1 คุณภาพน้ำผิวดิน																																										
1) สถานี W1 คลองบางหลวง	ทางกายภาพ	Baseline																																									
2) สถานี W2 คลองประปา	1) ความลึก (Depth)																																										
3) สถานี W3 คลองเปรมประชากร	2) อุณหภูมิน้ำ (Temperature)																																										
4) สถานี W4 คลองลำชะเล่า	3) ความโปร่งแสง (Transparency)																																										
5) สถานี W5 คลองลองตันนุช	4) ความเค็ม (Salinity)																																										
	5) ค่าความนำไฟฟ้า (Conductivity)																																										
	6) ความเร็วกระแสน้ำ (Velocity)																																										
	ทางเคมี																																										
	1) ความเป็นกรด-ด่าง (pH)																																										
	2) ออกซิเจนละลายน้ำ (Dissolved Oxygen)																																										
	3) ความสกปรกในรูปความต้องการใช้ออกซิเจนสำหรับย่อยสลายอินทรีย์ (BOD_5)																																										
	4) ของแข็งแขวนลอย (Suspended Solids)																																										
	5) น้ำมันและไขมัน (Oil & Grease)																																										
	6) เหล็กทั้งหมด (Total Iron)																																										
	ทางชีวภาพ																																										
	1) แบคทีเรียกลุ่มโคลิฟอร์มทั้งหมด (Total coliform bacteria)																																										
	2) แบคทีเรียกลุ่มฟีคอลโคลิฟอร์มแบคทีเรีย (Fecal coliform bacteria)																																										
	โลหะหนัก																																										
	1) ตะกั่ว (Pb)																																										
	2) แคดเมียม (Cd)																																										
1.2 คุณภาพอากาศ																																											
1) สถานี A1 สถาบันโรคทรวงอก	1) ความเร็วลมและทิศทางลม	Baseline																																									
2) สถานี A2 โรงเรียนชอุประทานสงเคราะห์	2) ฝุ่นละอองรวม (TSP)																																										
3) สถานี A3 โรงเรียนคลองเกลือ	3) ฝุ่นละอองขนาดไม่เกิน 10 ไมครอน (PM-10)																																										
4) สถานี A4 มหาวิทยาลัยราชภัฏพระนคร	4) ก๊าซคาร์บอนมอนอกไซด์ (CO)																																										
5) สถานี A5 โรงพยาบาลสินแพทย์	5) ก๊าซไนโตรเจนไดออกไซด์ (NO_2)																																										
6) สถานี A6 โรงเรียนมีนประสาทวิทยา																																										
1.3 ระดับเสียง																																										
1) สถานี N1 สถาบันโรคทรวงอก	1) ระดับเสียงเฉลี่ย 24 รม. ($L_{eq\ 24\ hr}$)	Baseline																																									
2) สถานี N2 โรงเรียนชอุประทานสงเคราะห์	2) ระดับเสียงเปอร์เซ็นไทล์ที่ 90 (L_{90})																																										
3) สถานี N3 โรงเรียนคลองเกลือ	3) ระดับเสียงกลางวัน-กลางคืน (L_{dn})																																										
4) สถานี N4 มหาวิทยาลัยราชภัฏพระนคร	4) ระดับเสียงสูงสุด (L_{max})																																										
5) สถานี N5 โรงพยาบาลสินแพทย์																																										
6) สถานี N6 โรงเรียนมีนประสาทวิทยา																																										

หมายเหตุ: บริษัทผู้รับเหมาก่อสร้างจะดำเนินการติดตามตรวจสอบคุณภาพสิ่งแวดล้อมจนกว่าการก่อสร้างโครงการแล้วเสร็จ

หากมีการขยายสัญญาก่อสร้าง บริษัทผู้รับเหมาก่อสร้างจะต้องดำเนินการตามมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อมจนกว่าการก่อสร้างโครงการแล้วเสร็จ

ติดตามตรวจสอบในระยะเตรียมการก่อสร้าง 1 ครั้ง เพิ่มเติมจากเงื่อนไขที่ระบุในรายงานฉบับสมบูรณ์ รายงานการขอเปลี่ยนแปลงรายละเอียด ในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม ที่ได้รับความเห็นชอบจากคณะกรรมการสิ่งแวดล้อมแห่งชาติ

Table 2-5 Environmental Quality Monitoring Plan for Pink Line Khae Rai – Min Buri

Sino Thai Engineering & Construction Public Company Limited (Continued)

สถานีติดตามตรวจสอบคุณภาพสิ่งแวดล้อม	ดัชนีที่ติดตามตรวจสอบ	ปี 2560		ปี 2561												ปี 2562												ปี 2563												ปี 2564		
		ระยะเตรียมการก่อสร้าง		ระยะก่อสร้าง																																						
		9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1. การติดตามตรวจสอบผลกระทบสิ่งแวดล้อมตามรายงาน EIA																																										
1.4 ความสั่นสะเทือน																																										
1) สถานี V1 สถาบันโรคทรวงอก	- ความถี่และความเร็วอนุภาคสูงสุด (Peak Particle Velocity)	Baseline																																								
2) สถานี V2 โรงเรียนชอประทานลองเคราะห์																																										
3) สถานี V3 โรงเรียนคลองกลีอ																																										
4) สถานี V4 มหาวิทยาลัยราชภัฏพระนคร																																										
5) สถานี V5 โรงพยาบาลสินแพทย์																																										
6) สถานี V6 โรงเรียนมีนประสาทวิทยา																																										
1.5 ระบบนิเวศวิทยาทางน้ำ																																										
1) สถานี W1 คลองบางคลาด	1) ความหลากหลายทางชีวภาพ	Baseline[1]																																								
2) สถานี W2 คลองประปา	2) ชนิดและความหนาแน่นของแพลงก์ตอนพืชและแพลงก์ตอนสัตว์																																									
3) สถานี W3 คลองเปรมประชากร	3) ความชุกชุมของสัตว์หน้าดิน																																									
4) สถานี W4 คลองลำชะล่า																																										
5) สถานี W5 คลองสองต้นนุ่น																																										
1.6 ระบบคมนาคมขนส่ง																																										
1) ทางแยกแคราย	1) ปริมาณจราจร	Baseline																																								
2) ทางแยกสามเป็นน้ำ	2) สถิติอุบัติเหตุทั้งตำแหน่ง ความรุนแรง และสาเหตุของอุบัติเหตุ																																									
3) ทางแยกปากเกร็ด																																										
4) ทางแยกต่างระดับบริภาร์ดังสิต																																										
5) ทางแยกสามแยกปทุม																																										
6) ทางแยกมีนบุรี																																										
1.7 สภาพเศรษฐกิจสังคม																																										
(1) ระยะก่อนก่อสร้าง	1) การรับรู้ข้อมูลข่าวสารเกี่ยวกับโครงการฯ		Baseline																																							
1) กลุ่มผู้ได้รับผลกระทบโดยตรง (ถูกเวนคืนและถูกพอพโยกย้าย)	2) ผลกระทบที่เกิดขึ้นในระหว่างการก่อสร้างและความคิดเห็นต่อโครงการ																																									
2) กลุ่มผู้อยู่อาศัยในระยะ 500 เมตร จากเขตทางและบริเวณรอบ ศูนย์ซ่อมบำรุงและอาคารจอดแล้วรถ (ผู้นำชุมชนและผู้ได้รับผลกระทบโดยอ้อม) จำนวนอย่างน้อย 500 ครัวเรือน	3) ปัญหาที่เกิดขึ้นจากโครงการ ตลอดจนข้อคิดเห็นและข้อเสนอแนะต่อโครงการ																																									
(2) ระยะก่อสร้าง																																										
1) กลุ่มผู้อยู่อาศัยในระยะ 500 เมตร จากเขตทางและบริเวณรอบ ศูนย์ซ่อมบำรุงและอาคารจอดแล้วรถ (ผู้นำชุมชนและผู้ได้รับผลกระทบโดยอ้อม) จำนวนอย่างน้อย 500 ครัวเรือน																																									
2. การติดตามตรวจสอบการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม																																										
3. การจัดทำรายงาน																																										
1) รายงานแผนการจัดการสิ่งแวดล้อม (EMP)	- 2 ฉบับ (ภาษาไทย)																																									
2) รายงานผลการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม ระยะก่อนก่อสร้าง	- 6 ฉบับ (ภาษาไทย)																																									
3) รายงานระยะก่อสร้าง ประจำเดือน	- 6 ฉบับ (ภาษาไทย)																																									
4) รายงานสรุป 6 เดือน (ส่ง สผ.)	- 6 ฉบับ (ภาษาไทย)																																									

หมายเหตุ: บริษัทผู้รับเหมาก่อสร้างจะดำเนินการติดตามตรวจสอบคุณภาพสิ่งแวดล้อมจนกว่าการก่อสร้างโครงการแล้วเสร็จ

หากมีการขยายสัญญาก่อสร้าง บริษัทผู้รับเหมาก่อสร้างจะต้องดำเนินการตามมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อมจนกว่าการก่อสร้างโครงการแล้วเสร็จ

[1] ติดตามตรวจสอบในระยะเตรียมการก่อสร้าง 1 ครั้ง เพิ่มเติมจากเงื่อนไขที่ระบุในรายงานฉบับสมบูรณ์ รายงานการขอเปลี่ยนแปลงรายละเอียด ในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม ที่ได้รับความเห็นชอบจากคณะกรรมการสิ่งแวดล้อมแห่งชาติ

2.6 Personnel

Personnel in the Environmental Impact Preventive and Mitigation Measures and environmental impact assessment monitoring for Pink Line Khae Rai-Min Buri consists of the following personnel as presented on the figure 2-13 and Appendix B.

Figure 2-13: Personnel for conducting the Environmental Quality Monitoring

Appendix

A. Table for Environmental Impact Preventive and Mitigation Measures and environmental impact assessment monitoring for Pink Line Khae Rai – Min Buri
B. Curriculum Vitae
C. Quality Assurance and Quality Control during performing
D. Calibration Document/Tools Calibration

Appendix A

Table for Environmental Impact Preventive and Mitigation Measures and environmental impact assessment monitoring for Pink Line Khae Rai – Min Buri

(Form Sor Phor 1)

Form of the major environmental impact, Environmental Impact Preventive and Mitigation Measures and environmental impact assessment monitoring for Pink Line Khae Rai – Min Buri**,** current study

Environmental Index	**Environmental Impact**	**Environmental Impact Mitigation Measure**	**Environmental Impact Assessment Monitoring Measure**
1. General Measure		1. Measure Environmental Plan for conducting as follows 1.1Perform according to the Environmental Impact Preventive and Mitigation Measures and environmental impact assessment monitoring of the whole project during execution as mentioned in the Environmental Impact Assessment Report of Pink Line Khae Rai – Min Buri and as per additional recommended by the Environmental Specialist Committee by applying for setting up the criteria in the Contract of construction subcontractor and/or contractor for construction and project management 1.2 Control and regulate the construction designer and/or contractor for construction and project management to perform according to Environmental Impact Preventive and Mitigation Measures and environmental quality monitoring as proposed in the Environmental Impact Assessment Report of Pink Line Khae Rai – Min Buri. 1.3 Provide Third Party to conduct and monitor according to Environmental Impact Preventive and Mitigation Measures and environmental quality monitoring as proposed in the Environmental Impact Assessment Report by setting up the budget in the cost of Pink Line Khae Rai – Min Buri under the supervision of Mass Rapid Transit Authority of Thailand and appoint the Environmental Committee, in which consists of Office of Natural Resources and Environmental Policy and Planning, Mass Rapid Transit Authority of Thailand,	

		Department of Highways, Pollution Control Department, Nonthaburi Province, Bangkok, Office of the Consumer Protection, Private Development Organization and Professional, etc. to monitor in order to comply with environmental measure of the project.	

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Form of the major environmental impact, Environmental Impact Preventive and Mitigation Measures and environmental impact assessment monitoring for Pink Line Khae Rai – Min Buri, current study

Environmental Index	Environmental Impact	Environmental Impact Mitigation Measure	Environmental Impact Assessment Monitoring Measure
Continued ….		2. MRT shall provide EIA monitoring report and environmental quality measure as mentioned in the report and report the result of conducting as per measure during 6 months to Office of Natural Resources and Environmental Policy and Planning and other related authorities for information. 3. MRT performs in accordance with Environmental Impact Preventive and Mitigation Measures and environmental quality monitoring measure according to EIA Report, in which already considered by the environmental specialist committee for EIA regarding transportation of state enterprise or the joint project with private sectors. In case of any modification details of the project or the measures not impact to the major contents of the EIA Report but positive impact or equivalent to the stipulated measurement as mentioned in approved EIA Report by environmental specialist committee, then to submit to the regulator in accordance with local legal and copy to the Office of Natural Resources and Environmental Policy and Planning for information. In case of any modification details of the project or the measures impact to the major contents of the EIA Report, shall submit the report of the modification of EIA to Office of Natural Resources and Environmental Policy and Planning for information in order for the environmental specialist committee to consider prior to any execution. 4. During execution and construction, if it's found out that the project will impact to environment or any complaints, Mass Rapid Transit Authority of Thailand, construction designers and contractor for	

		construction and project management shall protect, prevent and mitigate urgently and inform to the Office of Natural Resources and Environmental Policy and Planning and related authorities for information in order to find the solution and recommendation for solving that issues.	

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Environmental Index	**Environmental Impact**	**Environmental Impact Mitigation Measure**	**Environmental Impact Assessment Monitoring Measure**
2.Physical Environmental Resources 2.1 Topography 2.1.1 Construction Period	**According to the Mass Transit Route and Train Station** - Due to the construction area for Mass Transit System on traffic island, Ratanathibes Road, Tiwanon Road, Chaeng Watthana Road, Ram Indra Road, and Sriburanukit Road that the topography is lowland, always flooding and high elevated of traffic island not more than 3 meters from the medium sea level. The construction is needed to excavate/grade in order for construction to raise the level and train stations, expect that this will impact to the topography in the at least increasing/decreasing or no impact.	• The construction and open for mass transit system for Depot Center and Park and Ride Building at Rom Klao Intersection expects that it does not have any impact to the changed topography and does not to provide any Environmental Impact Mitigation Measure.	
	Depot Center and Park and Ride Building at Rom Klao Intersection - Due to the construction area for Depot Center and Park and Ride Building at Rom Klao Intersection that the topography is lowland, always flooding and high elevated of traffic island not more than 3 meters. The construction is needed to excavate/grade in order to construct 3 storeys of Depot Center and Park and Ride Building at the Rom Klao Intersection, expect that this will impact to the topography in the at least increasing/decreasing or no impact. -		

2.1.2 Execution Period	**According to the Mass Transit Route and Train Station** - The changing of traffic island of Ratanathibes Road, Tiwanon Road, Chaeng Watthana Road, Ram Indra Road, and Sriburanukit Road to be the structure of elevated level and train station		

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Environmental Index	**Environmental Impact**	**Environmental Impact Mitigation Measure**	**Environmental Impact Assessment Monitoring Measure**
Environmental Index 1.1.2 Execution Period	Foundation pillar not higher than 16 meters located on the traffic island periodically or approx. 25-30 meters/foundation pillar, expects not impact the change topography along the mass rapid transit system for 34.50 kilometers. So there will be no impact.		
	At the Depot and Park & Ride Building at Rom Klao Intersection • The changing of the area for Depot and Park & Ride Building by construction 3 storeys reinforced concrete, expects that not having any impact to the		

	change topography in the construction area. So there will be no impact.		
1.2 Soil resources 1.2.1 Construction period	**Along the mass rapid transit system and train station** • Due to the construction of mas rapid transit system is needed to excavate, and open some area to move the existing soil in order to construction the foundation for the elevated structure for 34.50 kilometers and 30 stations, these inevitably impact to condition/structure and soil resources property, including some area of under the structure of elevated structure on Tiwanon Road, Chaeng Watthana Road, Ram Indra Road, and Sriburanukit Road, except the flyover and Sanam Binnam Intersection and Chaeng Watthana Road – Phaholyothin Road – Ram Indra Road Intersection (Phithak Ratthathammanun Monument) or the route line of mass rapid transit system diverse from the traffic island such as Lak Si Plaza at Pak Kred Intersection, intersection at Si Rat Express Way, Khlong Kluea School or Phranakhon Rajabhat University, etc. needs to backfill the area and move the soil resources in which having appropriate properties with fully mineral for low shrub/medium perennial plant to replace	• Clearly specify the construction area by installation the temporary solid fence to barricade the construction area, with at least 2.0 meters from ground in order to avoid any soil collapse flowing into the public gutter or the lowland or the surface water resources. • Specify the activities for excavation/backfilling, infrastructure relocation such as water supply pipe, gutter, and electric poles. To plan the excavation in the dry season in order to avoid any soil collapse. • Soil mound and material & equipment lay down for construction activities shall be farthest from surface water resources such as Khlong Bang Talat, Khlong Prapa, Khlong Premprachakorn, Khlong Tanon/Khlong Bang Bua and Khlong Song Ton Nun. • The construction project area is the open area and empty from any covering, shall cover by gravel/stone flake, or use canvas to cover or temporary planting.	

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Environmental Index	Environmental Impact	Environmental Impact Mitigation Measure	Environmental Impact Assessment Monitoring Measure
Environmental Index 1.2.2 Construction Period (Cotinued..)	The existing resources, then there will be direct negative impact to project/property of soil resource causes to a lot of change. • Excavation activity and backfilling activity in order to construct the structure for elevated route and train stations, especially during rainy season, will have a lot of soil from pile boring drop or fall down at the construction area or road surface during moving from the construction, and will have rain to erode due to slope of the area or road surface into lowland or public water resources, causes medium impact to the alluvion of sediment and shallow of public water resources.	• Specify to bring all excavated soil from the foundation construction to backfill the Depot at Rom Klao Intersection or dump in the permitted area by MRT and not leave the soil berm in the construction site for longer time. • The area for Depot and Park & Ride Building construction at Rom Klao Intersection will have to provide temporary gutter 0.60 x 0.60 meters at the surrounding of the construction area and shall provide 2 sump pits 1.00 x 1.00 x 1.00 meter at the end of temporary gutter in order to filter the soil flowing with water/rain to not flow into the surface water resources, public gutter or lowland. • Excavation activity and backfilling activity in order to construct the structure for elevated route and train stations, Depot and Park & Ride Building at Rom Klao Intersection, if complete the usage, shall complete backfill or grow the plant in order to protect from any soil erosion, especially in rainy season.	
	Depot and Park & Ride Building at Rom Klao Intersection • Will impact to the structure and soil resources property due to lowland and flooding and used to be the agricultural area before (rice field), then shall backfill until have the same elevation as Ramkamhaeng Road		

	surface or small lane from Ramkamhaeng Road by using soil resources from the excavation in order to construct the foundation to support the structure of elevated route line and train stations. Or use soil resources from other area to backfill this area, so this is to inevitably disturb the condition/structure and property of the existing soil resources, then have the medium impact due to the existing area is the unoccupied area and used for agricultural area.		

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Environmental Index	**Environmental Impact**	**Environmental Impact Mitigation Measure**	**Environmental Impact Assessment Monitoring Measure**
1.2.1 Construction Period (Continued)	Soil erosion will have opportunity to moderately occur due to the area in South-Western is the route line of Khlong Song Ton Nun in parallel to the construction area of Depot and Park & Ride Building. Therefore, during rainy season will have a lot of sediment eroded by rains flowing		

	into the slope of the area to Khlong Song Ton Nun, this will impact to the alluvion of sediment and the shallow of Khlong Song Ton Nun.		
1.2.2 Execution Period	**Along the Mass Rapid Transit System and Train Stations** • If the construction for elevated route line and train stations completes, there will be no impact due to the major structures are located on the traffic island which having empty space for structure of elevated route line, then will grow the plant or shrub, medium perennial plant all the route line in order to protect from soil erosion into the public water gutter or lowland or public water resources.	• If the construction for elevated route line and train stations completes, there will be no impact, especially for the soil erosion due to the empty space under the structure of elevated route line, train stations, Depot and Park & Ride Building will grow the plant or shrub, medium perennial plant or concrete floor or concrete barrier / plant the perennial to barricade, then no suggestion for preventive, correction measure to reduce the environmental impact.	
1.3 Geology Status and Earthquake 1.3.1 Construction Period	**Along the Mass Rapid Transit System and Train Stations** • Might have impact to geological structure/geological foundation for the soft clay transfer due to the construction area is located on the soft – medium soft clay landform till the depth of 18 meters. If any bored pile, the possibility that soft clay will easily slide. This could impact in medium level to the soil around bored pile, especially at the train station construction area, closed to water surface resources such as; PK-04, PK-10, PK-11, PK-14, PK-15, PK-20, PK-21, PK-23 and PK-30.	• Must provide steel sheet pile installation around the bored pile driven. The steel sheet pile shall install until the hard – medium clay in which18 meters depth from the existing ground. • Provide steel sheet pile installation at the construction area closed to water surface resources such as; Khlong Bang Ta Lat, Khlong Prapa, Khlong Premprachakorn, Khlong Lamchala, and Khlon Song Ton Nun or loam in order to protect from soil erosion. • In case of bored pile, shall use Polymer Slurry in order to protect from soil erosion and maintain the stability of the pit. This solution has property to reduce insertion to sand and hold small soil or sand particle, and then make it sediment.	

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Environmental Index	Environmental Impact	Environmental Impact Mitigation Measure	Environmental Impact Assessment Monitoring Measure
		• Specify to design the settlement modification structure by construction covering the foundation of elevated route line in which having the overlap with the traffic surface in the horizon road. Settlement modification structure will have scape that already have design for unbalance settlement in which could occur in the vertical line of horizon road with foundation of elevated route line. To avoid any damage to traffic surface and to protect the settlement between road surface and foundation of elevated route line structure at the traffic island. • At some area of the structure with tends to have vibration, in general, shall seize the structure in the level which could stand for vibration in the horizon level, caused from earthquake. To have structural engineer to use Seismic Buffers or Stopper on above column head structure of bridge in order to protect the column head structure or bridge body not to slide from the bridge column head by using Concrete Shear Key Box on the column head safely. Also specify to use Polymer solution pouring into the pit in order to protect	

		from soil erosion and to maintain the stability of the pit. This solution has property to reduce insertion to sand and hold small soil or sand particle, then make it quickly sediment. If the foundation of elevated route line structure and train stations closed to traffic surface, will have different settlement on the traffic surface, then specify to design the settlement modification structure between foundation of elevated route line structure and train stations and horizon road in order to protect from any damage to traffic surface by construction covering the foundation of elevated route line structure and train stations, will have scape that already have design for unbalance settlement in which could occur in the vertical line of horizon road with foundation of elevated route line structure in order to avoid any damage to traffic surface.	

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Environmental Index	Environmental Impact	Environmental Impact Mitigation Measure	Environmental Impact Assessment Monitoring Measure
1.3.1 Construction Period (continued..)	**Depot and Park & Ride Building at Rom Klao Intersection** • Will have impact to geological structure/geological foundation for the soft clay transfer due to the		

	construction area is located on the soft – medium soft clay landform till the depth of 18 meters. If any bored pile, the possibility that soft clay will easily slide. This could impact in medium level to the soil around bored pile, will have easily land slide, equivalent to the soft clay volume in which easily to slide. • Impact from earthquake, expects not to have any impact or very low impact due to the construction area is located on the area 2 Khor (2ก) in which having low risk for any damage from low to medium.		
1.3.2 Execution Period	**Along the Mass Rapid Transit System and Train Stations** • Expects that there is no impact due to the elevated route structure and train stations has designed to support in case of geohazard or earthquake according to AASHTO standard.	• Due to the construction is located on area 2 Khor (2ก) in which having low risk for any damage from low to medium, already have additional design to add extra steel reinforced in elevated route structure in order to protect column head slide from support of structure. For Depot and Park & Ride Building will be the reinforced steel concrete for 3 storeys, will design to support in case of geohazard or earthquake according to Ministry of Interior.	
	Depot and Park & Ride Building at Rom Klao Intersection • There is no impact due to Depot and Park & Ride Building at Rom Klao Intersection will be the reinforced steel concrete for 3 storeys, will design to support in case of geohazard or earthquake according to Ministry of Interior.		

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Form of the major environmental impact, Environmental Impact Preventive and Mitigation Measures and environmental impact assessment monitoring for Pink Line Khae Rai – Min Buri**,** current study

Environmental Index	**Environmental Impact**	**Environmental Impact Mitigation Measure**	**Environmental Impact Assessment Monitoring Measure**
1.4 Surface Water Hydrology and drainage 1.4.1 Preparation for Construction		• To design 2 retention ponds at Depot and Park & Ride Building and Rom Klao Intersection by the smallest of retention pond Zone A has capacity for 5,541.66 cubic meter and the lowest of retention pond Zone B has capacity for 9,775.91 cubic meters and install 3 set of water pumps (2 duty, and 1 standby)	
1.4.2 Construction Period	**Along the Mass Rapid Transit System and Train Stations** • Expects that the flowing of water as per natural will not be changed from existing due to no structure obstruct the water resource, but will have the obstruction for water flowing sometimes due to the construction of elevated route structure and train stations needs to utilize the construction area for approx. 8 meter on traffic island of Rattanathibet Road, Tiwanon Road, Chaeng Watthana Road, Ram Indra Road,	• Tidy store the construction material, equipment, machine for construction in order to protect from soil, sand, clay drop into and contaminate to water resources. • Provide soil berm in order to protect from soil erosion from open cut area in the construction. • Provide the open cut area before rainy season. If necessary to perform during rainy season, shall backfill and carefully move the material, especially soil and concrete in order to protect from soil erosion especially in rainy season. (May – November)	

	and Sriburanukit Road, except route line of Mass Rapid Transit System diverse from the traffic island (such as Lak Si Plaza at Pak Kred Intersection, intersection at Si Rat Express Way, Khlong Kluea School or Phranakhon Rajabhat University, etc.), There is medium impact to water flowing system into public drainage system at footpath for both side of the road due to the constructional waste (such as waste cement, waste stone/soil/sand, etc.) and also piling up the construction equipment and material or installation hard and solid barrier in order to barricade the construction area, this might obstruct the flow of rain water on traffic surface road before flowing into the public gutter slower, causes the flooding on the traffic surface road along the Mass Rapid Transit System, including the experience from the incident of traffic island of Viphavadi Rangsit Road from the construction	• Don't throw waste and constructional waste into the public water resources or public gutter nearby the construction area. • Remains material from the construction, shall store in the appropriate and cover with canvas to protect from any erosion by rain to water resources. • Shall perform the construction activities in dry season such as grading, excavation, etc. to protect from any erosion during rainy season to water resources. • Provide temporary gutter or small pond in order to avoid any flooding in the construction area and nearby. • Excavated soil from foundation construction shall provide the special area for pile up and shall cover or keep in the barricaded area, and shall have truck to carry to dump in the assigned area within 24 hours.	

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1.4.2 Construction Period (Continued….)	Donmuang Elevated Tollway Section no.1 (KM.5+000 till KM.21+000) is found out that there is still some remains material from the construction obstruct the water flow and some flow to pile up and block the public gutter on both side of Viphavadi Rangsit Road. This causes the flooding on Viphavadi Rangsit Road and continues impact to the severe traffic on Viphavadi Rangsit Road for both in-out from the city.	• Perform the preventive activities in the construction work to protect from any oil contamination into water resources. • Pollution from construction such as maintenance equipment contaminated with oil, shall have the correct disposal according to sanitation principal. • Inspect gutter pipeline condition, drainage along the construction project. If it is found out that some obstruction with sand soil or any material, shall quickly remove in order not to obstruct the drainage. • If it is found out that the surrounding area flooded cause from construction project, Contract shall provide water pump to quickly pump water from the area. • Provide the rain protective line waste constructional material contamination, not flow into the public water surface nearby by providing the water collecting system to drain directly into the drainage. • In case of excavation in the construction and leave, shall pile up far from the water resource, provide the special area and completely cover. • Provide the appropriate drainage system, gutter and sump to support the rain water especially for the expanded area and modification for station before drain into the public drainage, also provide regularly maintenance and excavate the sediment in order to have the efficiency drainage system all the times. • Provide appropriate toilet according to sanitation at temporary construction office and labor camp. • In case of maintenance for constructional material and equipment, shall maintenance in the repair store or shop • Provide waste water treatment pond from several activities such as machine and equipment wash	

		• Provide appropriate toilet according to sanitation in the rate for 10 persons/room.	

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1.4.2 Construction Period (Continued….)	**Depot and Park & Ride Building at Rom Klao Intersection** • Expects that there is no impact to Surface Water Hydrology and drainage, although, the current status is the empty area and used to be the agricultural area (rice field), including the construction for Depot and Park & Ride Building for 3 storeys, will bring a lot of material, equipment and machine for further usage. If pile up or inappropriate storage, then can obstruct the flowing of water during heavy rain but no flooding due to having Khlong Song Ton Nun in parallel to the construction area on South-Western as the water resources natural supporting as per capacity to drain water but no flooding.		

1.4.3 Execution Period	**Along the Mass Rapid Transit System and Train Stations.** • Elevated route structure has clear structure with 2 concrete route line in parallel with 4.40 meters spacing from the middle of concrete route, will no reduce the existing area of drainage surface but still have the capacity to support the drainage from rain fall with no flooding. This expects that there is low impact. • Regarding The 30 train stations, roof of train station will support the rain fall, no different from the existing condition before the project development. The edge of route will have gutter for rain water and flow into the rain water pipeline with size of 0.15 meters before flowing into the retention pond at traffic island and flow though steel pipeline with size of 2.0-3.0 meter into the existing gutter of each roads along the Mass Rapid Transit System. There is low impact.	• Provide toilet according to sanitation for staff and permanent officer at station. • Provide waste water treatment system according to sanitation each station. • Inspect the waste water tretment system of each station regularly. • Provide appropriate waste collection and disposal at station, and not throwing into river and khlong.	• Water quality check at soil surface as per the method in the announcement of National Environment Board No.8 (1994) and analysis method a per APHA-AWWA-WEF for 5 water surface resources consisted of Khlong Bang Talat, Khlong Prapa, Khlong Prempracha, Khlong Lamchala, and retention pond Zone A, and Zone B, by collecting the water samples each 3 month for 5 years, after that decrease 1 time/year.

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1.4.3 Execution Period (Continued..)	**Depot and Park & Ride Building at Rom Klao Intersection** • Drainage from 2 retention ponds by retention pond of Zone A has capacity for 5,541.66 cubic meter and the lowest of retention pond of Zone B has capacity for 9,775.91 cubic meters and use DC water pump which has capacity to pump 132 gallon/minute/set (0.50 cubic meter/minute/set) and actual water pump rate is 0.0058 cubic meter/second/set) (calculate 70% efficiency of water pumping). This will see that in case of project development, will have rate to pump water out (0.0058 x 2 = 0.0116 cubic meter/second) has low rate than the drainage rate from the area of Depot and Park & Ride Building in case before the development project (0.3065 cubic meter/second), this will have low impact or no impact.		
1.5 Water Suface quality 1.5.1 Construction Period	**Along the Mass Rapid Transit System and Train Stations** • Impact from open cut for backfilling the foundation in order to support the elevated route structure and train stations or mobilizing constructional material (such as sand stone, cement, soil, etc.), expects to cause low impact due to the construction for foundation of elevated route structure and train stations will have not any construction activities to trespass into the water surface resources. Then, there is no activities to disturb water surface quality except the 10 train stations located far from water surface resources not more than 50 meters; PK-04, PK-10, PK-11, PK-14, PK-15, PK-20, PK-21, PK-23 and PK-30, might have impact from the turbidity from soil surface erosion during bored pile construction	• Contractor to provide "Site Office" in the nearby area the construction area by separating the "labor camp" from site office, including providing/construction the labor camp in the at least 5 kilometers length from Mass Rapid Transport System, and with approval of MRT first, and complying with legal/regulation of local authorities for construction the camp or according to the Building Control Act B.E. 2522 or Ministerial Regulation of Interior No.55, B.E. 2543 strictly. • Provide mesh or canvas to cover the elevated route structure and train stations in order to support construction material such was soil/stone/sand/cement in which	**Water surface quality Index** **Physical** • Depth, • Temperature • Transparency • Salinity • Conductivity • Velocity **Chemical** • Potential Hydrogen (pH) • Dissolved Oxygen • Biochemical Oxygen Demand (BOD) • Suspend Solids

	and backfilling or oil contamination from machine and equipment use,	might fall in to water surface resources, causes the turbidity to water surface resources, especially in the construction area nearby the water surface resources not more than 50 meters	• Oil & Greese • Total Iron

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1.5.1 Construction Period (Continued..)	but expects to have low impact due to the construction area has limited edge only on traffic island including the water surface quality analysis on water surface resources along the Mass Rapid Transit System's found out that every water resources has water quality in rather deterioration due to they are the resources supporting waste water from large community. • Impact from activities in site office and labor camp has 2 cases as follows:	• Construction activites such as open cut excavation/backfil, etc.m shall perform to complete before rainy season. If necessary to perform during rainy seaon, shall complete backfil and carefully mobilize the concrete material in order to aovid any turbidity from soil erosion and waste oil/lubricant contimination of machine and equipment from construction. • Provide no.of appropriate toilet according to sanitation. (10 persons/room)	**Biological** • Total Iron • Total coliform bacteria • Facial coliform bacteria **Heavy Metal** • Lead (Pb) • Cadmium (Cd) **Execution Period** • Every month for the whole construction

	• In case of site office
	  ○ Waste water and sewage quantity occurred from using toilet/rest room/dish wash during working in the day of staff in site office, shall provide appropriate toilet as per sanitation principal (10 persons/room) and install prefabricated waste water treatment system in order to treat waste water from several activities occurred in site office.
	  ○ Waste from several activities during working by staff in site office approx. 200 persons, create blockage and impact to water surface resources nearby. Then it's necessary to prepare the waste bins.
	• In case of site office and labor camp.
	  ○ Waste water and sewage from using toilet/rest room/dish wash or bath during working in the day by staff in site office, labor and officer/labor.
		• Provide the drainage system with capacity 2 cubic meters/tank for 5 tanks in which to treat waste water 10.0 cubic meter/day, to treat waste water and sewage from mobile usage or dish wash during woroking of each day by staff or labor for 200 persons/day within the site office.
		• Provide waste bin with lid cover and capacity 240 litres, seperating into the dry waste, wet waste, hazard waste, and recycle waste, locates as group of 4 bins in several areas within site office area and coordiate with Bankok or local authorities in Nonthaburi to pickup and correctly disposal according to sanitation principal.
		• Waste water from construction activities such as lubricant transfer, constructional equipment & machine wash or vehicle wash, shall collect in site office far from water surface resource not less than 100 meters, shall treat in the waste water treatment before dispose into natural water resources, and specify to install waste water treatment system with capacity of 6 cubic meters for 2 ea. in order to treat waste water for 12 cubic meters.
		• The construction area for Depot and Park & Ride Building at Rom Klao Intersection, must provide temporary gutter size 0.60 x 0.60 meters around surrounding the construction area, and provide 2 sump pits size 1.00 x 1.00 x 1.00 meter at the end of temporary gutter in order to support water from construction activities such as equipment wash.
			period passing the water resources.
			Area for conducting
			• W1: Khlong Bang Talat
			• W2: Khlong Prapa
			• W3: Khlong Premprachakorn
			• W4: Khlong Lamchala
			• W5: Khlong Song Ton Nun
			Budget
			• 17,000 Baht/time/station

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1.5.1 Construction Period (Continued…)	• Waste occurred from several activities during working in the day by staff inside site office and labor in camp approx.1200 persons, cause the blockage and impact to water surface resources nearby. • Impact from continuous construction activities such as constructional equipment, machine and vehicle wash, etc., will use area inside site office, expects to use water not more than 12 cubic meter/day, then shall install prefabricated waste water treatment for occurred several activities. • Depot and Park & Ride Building has construction activities, especially for open cut, backfilling for foundation in order to support the Depot and Park & Ride building strucutre for 3 storeys or construction material mobilization (such as cement, sand, gravel and soil, etc.), expect to have low impact in add turbidigy from using oil for equipment and machine. Although, the area for epot and Park & Ride Building has construction will be located close to water	Constructional equipment or vehicles or sediment trap flowing with rain water/rain, not to flow directly into water surface resources, public gutter or lowland	

	surface resources (Khlong Song Ton Nun), but there is no any construction trepass into Khlong Song Ton Nun and no activities disturb water surface quality of Khlong Song Ton Nun, including during construction, will provide excavation for temporary gutter surrounding the construction area, and have sump pit at the end of temporary gutter in order to support waste water from construction activities before drain to Khlong Son Ton Nun.		

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1.5.2 Execution Period	**Along the Mass Rapid Transit System and Train Stations** • Due to the Mass Rapid Transit System is the monorail running on the elevated route structure, will use electrical system for driven then there is not impact to water surface quality when passing several water resources especially Khlong Prapa. However, for train stations will	**Along the route line project and stations** • Inpsect all waste water treatment every train station in order for regular function. • Provide waste bin with lid cover, seperating into the dry waste, wet waste, hazard waste, and recycle waste, at station in order for waste disposal. • Coordinate with Bangkok and Nonthaburi to collect.	**Water surface quality Index Physical** • Depth • Temperature • Transparency • Salinity • Conductivity • Velocity • Potential Hydrogen (pH)

	have waste water from using toilet by officers such as ticket count34, public relations, security, community, etc. in the day, not more than 10 persons/station, approx. water consumption 50 litres/person/day, equivalent to waste water for 50 X 10 X 0.80 = 400 litres/person/day. (Calculate the waste water rat from 80% from water usage). Therefor the waste water will be treated by prefabricated waste water treatment system with capacity of 2 cubic meters, installed every station, expect there is no impact.		**Chemical** • Potential Hydrogen (pH) • Dissolved Oxygen • Biochemical Oxygen Demand (BOD) • Suspend Solids • Oil & Greese • Total Iron **Biological** • Total coliform bacteria • Facial coliform bacteria **Heavy Metal** • Lead (Pb) • Cadmium (Cd) • Every month for 5 years continuous after operation, then after that conduct 2 times/year, during rainy season and dry season.
	Depot and Park & Ride Building at Rom Klao Intersection • Wil lhave waste water during activities fro using toilet, rest room, and dish wasth of staff inside Depot and Operation Control Center, domitory, food shop, including waste water quantity from the activities for maintenace and train wash. The occurred waste water quantity will be treated by small waste water treatment installed onsite treatment plant, with the combination of using anaaerobic filer and contact aeration process. The occurred waste water quantity inside the administration budling, Operation Control Center and domitory will be collected into the onsite treatment system, the waste water quantity from	**Depot and Park & Ride Building at Rom Klao Intersection** • Install small onsite treatment system with the comibnation of using anaaerobic filer and contact aeration process, capacity of 100.0 cubic meter/tank for 3 tanks, equivalent to 300 cubic meters in order to trat waste water prior to drain to public gutter and further drain into Khlong Song Ton Nun. • General sewage management within Depot and Park & Ride Building such as waste from internal cleaning inside train compartment, material inside office, dust from road and footpath, scrap from lathe of train, residue from Depot, and waste from treatment tank or food scrap, shall perform as follows; o Provide waste bin with lid cover and capacity 240 litres, seperating into the	

		dry waste, wet waste, hazard waste, and recycle waste, locate	

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1.5.2 Execution Period (Continued…)	Food Shop and Depot, and train wash will flow into grease trap to classify grease and oil before collecting into the onsite treatment system prior to drain into Khlong Song Ton Nun, expect to have low impact.	Several areas in Depot by putting the waste bin in the convenient area for usage and mobilization. ○ Provide the temporary storage for waste collection in order to wait to dispose by assigned authorities for further correctly dispose according to sanitation principal. ○ Provide enough and appropriate space for waste storage in order to support occurred waste in Depot at least for 3 days (capacity of 151.59 cubic meter) ○ Several disposal such as oil, grease, chemicals, shall collect to temporary storage in the Dangerous Goods Building in order to wait until the assigned authorities for further disposal such as Industrial Waste Disposal of Samae Dam Bangkhunthien, to design as Pallet Packing System and to have roof cover in order for lifting truck vehicle and truck to easily and safely travel in-out. **Waste water management measure for train wash**	**Area for conducting** • W1: Khlong Bang Talat • W2: Khlong Prapa • W3: Khlong Premprachakorn • W4: Khlong Lamchala • W5: Khlong Song Ton Nun • Retention Pond Zone A • Retention Pond Zone B **Budget**

		Train wash is the activities to perform every 3 days and to use a lot of water. Water conservation and water reuse is the process to reduce water consumption in order to reduce environmental impact, in which of potential water resources conservation can be conducted as follows:
		• Methods for train wash consist of the following steps.
		  • To spray water to be wet prior to any cleaning by automatic water jet.
		  • Train wash by water spraying with shampoo or cleansing to wash the train
		  • Use high pressure water jet to clean the bottom of train, and use brush or high pressure water jet for the side and the bottom of the train.
		  • The first cleaning, use the high pressure water jet.
		  Spray wax solution or coating the train body for shining.
			• 17,000 Baht/time/station

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1.5.2 Execution		• Final cleaning by low pressure water jet • Blow dry • Wipe dry with hand	

Period (Continued…)		• Measure/water conservation technique for train wash • Install small water jet to replace large water jet, can use the lower pressure water jet but still maintaining the capacity of cleaning. • Inspect the water jet hose regularly. The water jet hose is in the wrong position, will cause train wash unclean. • Inspect and repair the water leakage. • Select the stainless or ceramic for water jet hose for high endurance for heavy usage. • Provide water recycle gutter or water tank for using water for plant watering • Grow the plant with be endured with waste water from train wash for decorating landscape. • Maintenance water jet hose according to maintenance procedure regularly, especially for water jet hose for train wash in order to ensure that using water in high efficiency. **Waste Water Management Measure** • Install small onsite treatment plant, with the combination of using anaaerobic filer and contact aeration process with capacity of 100 cubic meter/tank for 3 tanks, equivalent to 300 cubic meters in order to treat the waste water prior to drain to public gutter and further drain to Khlong Song Ton Nun. • Several disposal such as oil, grease, chemicals, shall collect to temporary storage in the Dangerous Goods Building in order to wait until the assigned authorities for further disposal such as Industrial Waste Disposal of Samae Dam Bangkhunthien, to design as Pallet Packing System and to have roof cover in order for lifting truck vehicle and truck to easily and safely travel in-out.	

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1.5.2 Execution Period (Continued…)		**Water Saving Measure** Water saving measure assists the water consumption deduction. One train compartment requires water for cleansing approx. 1.045 cubic meter/train/day. (referred from Bangkok Mass Rapid Transit System Modification B.E. 2543). If implement the water saving measure for train wash by using water recycle into the water filter system for recycling again, will reduce water consumption for 20% or approx. 0.836 cubic meter/train/day. The water saving measure is as follows: • The process needs more water usage, shall consider the quantity and water property, therefore the activities needs more water usage such as: activities in washing plant, shall consider using water saving type for automatic wash. • Reuse water, considers water property for washing plant by recycling water for next wash, can reduce clean water consumption, including for using water for ground cleaning. • Recycle water, project has designed for water recycling after treatment to water plant by designing to have retention pond and water pump for water distribution system for plant watering in Depot and Park & Ride Building. Therefore the central waste water treatment system for Depot and Park & Ride Building will support waste water from activities in Washing Plant and several Workshops, in which is the system to dispose oil and fat efficiency and dispose	

		sediment and contamination in waste water according to standard of Pollution Control Department and Ministry of Industry. **Measure of using Environmental Friendly cleaning agent** Using environmental friendly product or has less impact to environmental to be part of shampoo for train wash, the property is as follows: • Free Phosphate	

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1.5.2 Execution Period (Continued…)		• Free Petrochemical Ingredients • Free Artificial Fragrance • Non-GMO-Enzyme	
1.6 Hydrogeology and settlement/underground water quality	• Expects that the impact to hydrogeology and settlement will not happen due to there is no development and drilling or pumping underground for construction and impact to underground water quality from the contamination of waste water and other contamination from the construction can describe as follows:		

1.6.1 Construction Period	• Construction activities, especially for foundation excavation to support elevated route structure and train stations, will excavate a lot of soil from pit, then cause the large concrete structure trespass into the underground water resources, especially for Bangkok groundwater (average depth approx. 50 meters), then will have opportunity that concrete mixing or any lubricant for several equipment and machine flowing to mix with the mentioned groundwater level. However, the foundation construction will add polymer solution mixed with bentonite into the pit in order to protect from soil erosion and to keep the pit stability. This solution has property to reduce insertion to sand and hold small soil or sand particle, and then quickly make it sediment. Then it expects that to disturb the underground water quality from the mixing concrete and lubricant, will have low impact.		

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1.6.1 Construction Period (Continued…)	• Conducting several activities in site office will have waste water and sewage from using toilet/rest room or dish was during working in a day by staffs inside site office, then specifies that Contractor shall provide appropriate toilet as per sanitation principal. (10 person/room) and install prefabricated waste water system. Therefore, it can foresee that the flowing of waste water to underground water resources will not impact to underground water quality and no contamination from waste and sewage.		
	Depot and Park & Ride Building at Rom Klao Intersection • There will be several activities from construction of Depot and Park & Ride Building at Rom Klao Intersection, especially for excavation the open cut, backfilling for foundation in order to support the structure of Depot and Park & Ride Building for 3 storeys, there is no impact to hydrogeology and settlement, and contamination into underground and lower underground due to the total coliform bacteria / Facial coliform bacteria or other chemical from using toilet, using equipment and machine using oil or waste water from equipment/machine wash during construction, etc., expect to have low impact.		

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1.6.2 Execution Period	**Along the Mass Rapid Transit System and train stations** • Expects to have no impact to hydrogeology and underground water quality. The occurred waste water from train stations by prefabricated waste water system installed every station, then expect to have no impact for the contamination to underground water resources.		
	Depot and Park & Ride Building at Rom Klao Intersection • Wil lhave no impact to hydrogeology and underground water quality. Depot and Park & Ride Building at Rom Klao Intersection a will have waste water from using toilet and dish wash of staff inside the administration buidling, Operation Control Center and domitory will be collected into the onsite treatment system, the waste water quantity from Administration Building and Operation Control Center, domitory, food shop, including waste water quantity from the activities for maintenace and train wash. The occurred waste water quantity will be treated by small waste water treatment installed small onsite treatment plant, with		

	the combination of using anaaerobic filer and contact aeration process prior to drain to external		
1.7 Air quality 1.7.1 Construction Period	• Impact from the dispersion of dust will base on several factors. The density of dust from construction activities at elevated route structure, it can see that during construction of elevated route structure will create maximum dust equivalent to 0.0019 milligram/cubic meter, in parallel to the air quality standard criteria according to the announcement of National Environment Board No. 24 (B.E.2547) "Specification for air quality in general atmosphere", in which specify the density of total dust in general atmosphere.	• Specify the Contractor to perform according to rule and regulation of dust control during several construction activites by Air Pollution Correction Board in Bangkok and community in Thailand • Along the construction area shall install warning light every 30 meter, and shall complete installation prior to the construction work and remove or moblize immediately when the constructin is complete. • Specicy to use ready-mixed concrete from external area of construction in order to protect and mitigate impact to communty area surrounding the construction area.	

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1.7.1 Construction Period (Continued)	Not more than 0.33 milligram/cubic meter. Therefore the dust quantity will instantly occur not for the whole day, vary to construction activities. This is low impact. • The density of dust from construction activities at train stations, will have dust maximum 0.006 milligram/cubic meter in parallel to the air quality standard criteria according to the announcement of National Environment Board No. 24 (B.E.2547), specify the density of dust in the general atmosphere, not more than 0.33 milligram/cubic meter. Therefore the dust quantity will instantly occur not for the whole day, vary to construction activities. This is low impact. • Impact from using vehical for material, equipment and machine mobili ation for construction at the elevated route structure (each seciton , not more than 1,000 meter), it's found out CO for 0.0002 ppmweight, HC for 0.0001 ppmweight, NO_2 for 0.0002 ppmweight, and TSP for 0.00002 milligram/cubic meter, in which not exceed the air quality standard critiria according to the announcement of National Environment Board No. 24 (B.E.2547) "Specification for air quality in general atmosphere", in which specify the density of total dust in general atmosphere, including the construction activities by using the machine not in same time and not continuously for the whole day, then caused the accumulation of toxic from vehicle, equipment and machine is less and the construction duration is not more than 30 days	• Shall water spray on the surface of existing road at least 3-4 times or appropriate in order to reduce the dust dispersion • Mobilize the constructional waste or quickly excavated soil berm from the construction area or within 24 hours. • Provide staff to collect and clean the construction area every day, including the housekeeping of material and equipment pile up in order to protect from dust dispersion during construction. • Provide the maintenance control unit or inspect machine and equipment using in the construction at least once/week in order to protect from dust dispersion (TSP and PM-10) and toxic smoke (such as CO_2, NO_2, SO_2). If it's found any abnormal, shall correct immediately. • Shall provide cleaning and wiping or picking the soil residue/clay from vehicle prior to any leaving from construction site every time at construction area of elevated route line and train stations. • Provide wheel wash area for truck/all vehicle at the exist area in order to protect from soil/clay residue attached with wheel fall into the external traffic surface outside the construction area of Depot and Park & Ride Building • Speed limit of truck for carrying material, equipment driving into the community and sensitive area to environmental impact such as religious place, hospital, education place, etc., shall not more than 30 kilometers/hour in order to reduce dust dispersion and safety during traffic. • Pile up material at the construction area and truck to mobilize the several construction materials into	• Every 3 months (4 times/year) to measure for consecutive 5 days (covering week day and holiday until the construction complete) **The measurement methods** • Measure for consecutive 5 days (covering week day and holiday until the construction complete) by using the measurement according to the standard by the approval of Pullution Control Department. **The operation area.** • Station A1: Central Chest Institute of Thailand • Station A2: Chonprathasongkhro School • Station A3: Khlong Kluea School • Station A4: Phranakhon Rajabhat University

	for each section. The construction will further continue moving along the route line is low impact.	the construction area shall have the cover in order to protest dust dispersion and material residue fall down. • Provide the staffs/labor shall wear PPE for dust and other toxic protection such as CO_2, NO_2, SO_2, etc. whenever working in the construction area that have dust dispersion or toxic from using machine and equipment in construction, especially for open cut during foundation work, removal work, mobilization the constructional material residue or concrete mixing, etc.	• Station A5: Synphaet General Hospital • Station A6: Min Prasat Witthaya School **Budget** • 63,000 Baht/Station

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1.7.1 Construction Period (Continued…)		• Provide thoroughly mesh or canvas to cover under the elevated route structure and train stations, Depot and Park & Ride Building in order to support material/construction equipment in which might fall down from the construction or in order to protect dust dispersion 10 meters from ground level.	

		• Provide traffic surface cleaning on the existing road along the construction work of elevated route structure and train station during night time ate least 4 times/week by specify the performing since 24.00 hrs onward till 0.300 hrs of the following day. • Provide the maintenance control unit or inspect machine and equipment using in the construction at least once/week in order to protect from dust dispersion (TSP and PM-10) and toxic smoke (such as CO_2, NO_2, SO_2). If it's found any abnormal, shall correct immediately. • In case of construction of elevated route structure and train station using traffic island of the existing road, there will be no enough space for construction the area for wheel wash, shall provide 3-4 labor/area for cleaning and wiping or picking the soil residue/clay, cement from vehicle in order to protect that mentioned residue with wheel drop into the traffic surface outside the construction area. • Shall control the driver when carrying construction material or soil, shall carefully drive and with speed limit, not more than 30 kilometer/hour. • Specify enforcement measure to use canvas to cover the truck when carrying material/construction equipment in order to protect from any falling down of material/construction equipment or material residue from the construction into the existing road or water canal along the route line when the vehicle of carrying material/construction equipment pass by.	

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1.7.1 Construction Period (Continued…)		• Provide the staffs/labor shall wear PPE for dust and other toxic protection such as CO_2, NO_2, SO_2, etc. whenever working in the construction area that have dust dispersion or toxic from using machine and equipment in construction, especially for open cut during foundation work, foundation work, removal work, mobilization the constructional material residue or concrete mixing, etc. • Install the traffic sign for diversion/bypass for the traffic user on the existing road to avoid using other route and coordinate with police station in the responsibility area of each avoiding route line.	
1.7.2 Execution Period	**Depot and Park & Ride Buildingt at Rom Klao Intersection** • Impact at the construction area for Depot and Park & Ride Building, it's found out CO for 0.0032 ppmweight, HC for 0.0041 ppmweight, NO_2 for 0.0070 ppmweight, and TSP for 0.00125 milligram/cubic meter, in which not exceed the air quality standard critiria. This has low impact.		**Air quality Measurement Index** • Velocity and Direction • TSP • PM 10 • CO • NO_2 **Excution Period** • Every 3 months (4 times/year) to measure for consecutive 5 days (covering week day and holiday until the construction complete), after that if the value is not more than the standard, shall meausre 2 times/year. **The measurement methods** • Measure for consecutive 5 days (covering week day and holiday until the

	Along the Mass Rapid Transit System and Train Station.
	• In case of elevated route structure, even though the area of land utilization along the Mass Rapid Transit System, some part is the medium-high crowded commercial resources, and density community. But the Mass Rapid Transit System is the monorail with clear structure located on the traffic island of main road (Rattanathibet Road, Tiwanon Road, Chaeng Watthana Road, Ram Indra Road, and Sriburanukit Road)
	• Expects that the density of occurred air pollution (such as Co-1 hour, NO_2-1 hour, and THC) from exhaust of vehicle travelling in-out on main road along the Mass Rapid Transit System
		• MRT will coordinate with the following authorities.
		  • Coordinated with responsible police station such as Provincial Police Station of Nonthaburi Province, Laksi/Bangkhen, Min Buri Police Station, etc. for planning and traffic management system on exiting road at train station for flexibility/reduce the crowded of traffic by installation the traffic sign in order to specify direction and speed for driving under the train station.
		  • Coordinate with Bangkok, Nonthaburi Town Municipality, Pak Kret Town Municipality, or related authorities for maintenance and cleaning the existing road under the construction of elevated route structure and train station by providing the road cleaning and dust vacuum on road surface every 3 months.
			construction complete) by using the measurement according to the standard by the approval of Pullution Control Department.
			The operation area.
			• Station A1: Central Chest Institute of Thailand
			• Station A2: Chonprathasongkhro School
			• Station A3: Khlong Kluea School
			• Station A4: Phranakhon Rajabhat University
			• Station A5: Synphaet General Hospital

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1.7.2 Execution Period (Continued)	Not more than the maximum value in air quality index measure in the current condition Sai Lom Village and Phranakhon Rajabhat University and not having the pollution accumulation, if there is the crowded traffic on the main roads along the Mass Rapid Transit System. In case of CO at train stations calculated to sum with maximum CO from the measurement at Sai Lom Village (Chaeng Wattana Road). In case of speed limit is 0 – 1 kilometer/hour in 2043 (6.87 ppmweight) has less value than the air quality standard criteria in general atmosphere according to of National Environment Board No. 10 (B.E.2538) (CO -1 hours < 30 ppmweight). But the roads below the train stations structure, for almost train stations, except Samakki Station (PK-04) and Phranakhon Rajabhat Station (PK15) will be the open area, no existing high rise buildings. But due to the Mass Rapid Transit System is located along the traffic island on main road, some portion is pass the commercial community, density living community for medium-high alternation with government building/state enterprise building. In the future, there tends to expand the construction property and commercial building along both sides of main roads. Cause the blockage of air flow. Therefore, in order to protect from hygiene in the long term, shall recommend having preventive, correction and reduction for air quality environmental impact.	• If the dust analysis check during execution period has the accumulation of dust under any train station, more than the air quality standard criteria in general atmosphere according to the announcement of National Environment Board No. 24 (B.E.2547), shall install the water spraying under the train station immediately in order to reduce dust. • Install the traffic sign “no parking” for all vehicle at train stations, except for bus station. • Provide the water spraying under the Samakki Station of PK04 and Phranakhon Rajabhat Station PK15 in order to reduce the occurred dust. However, for other train stations shall provide the area for additional installation of water spraying system if it’s found out the dust check during the execution period, having dust accumulation under train stations more than the air quality standard criteria in general atmosphere according to the announcement of National Environment Board No. 24 (B.E.2547)	• Station A6: Min Prasat Witthaya School **Budget** • 63,000 Baht/Station

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Environmental Index	**Environmental Impact**	**Environmental Impact Mitigation Measure**	**Environmental Impact Assessment Monitoring Measure**
1.7.2 Execution Period (Continued..)	**Depot and Park & Ride Building at Rom Klao Intersection** • Entering to Depot and Park & Ride Building of several vehicles will not continuously the whole day and the surrounding is open air without the high rise existing building (more than 2 storeys) to block from pollution ventilation from several vehicles travelling in-out at Depot and Park & Ride Building, impact for good air ventilation in the buildings, no hazard to community hygiene or sensitive area for environmental impact surrounding Depot and Park & Ride Building, then this has low impact.		
1.8 Sound Level 1.8.1 Construction Period	**Along the Mass Rapid Transit System and Train Stations** • Noise impact from construction activities to general community, and sensitive area of environmental impact far from sound source not more than 150 meters as follows: 1. Siam Business Administration Nonthaburi Technological College (SBAC) 2. Rulmuttakin Mosque 3. Sri Sangwan School 4. Khlong Klua School 5. Jitjamroon Witthaya School 6. Apakorn Kindergarden	• Specify the equipment and machine create lower noice and use the reducer or silencer for mechine such as silencer or hood. In case of sound level more than 90 dB (a: sound source is more than 1 hour. • Install concrete barrier with metal sheet 2 meters height at the construciton area on the existing road in order to barricade the construction area and install steel guard rail with 2 meters height barricade the construction area of Depot and Park & Ride Building at Rom Klao Intersection	**Sound level measurement index** • Average sound level 24 hours ($L_{eq\ 24\ hrs}$) • sound level of 90 percentile (L_{90}) • sound level during day time and night time (L_{dn}) • maximum sound level (L_{max}) **Execution Period** • one month prior to the construction period, shall conduct the measurement in order to use as Baseline Data • Every 3 months (4 times/year) for consecutive 5 days (cover the

	7. Charoenphol Witthaya School 8. Wat Phrasimahathat Secondary Demonstration School 9. The Constitution Protection Monument 10. Prachpibal School 11. Pramoch Witthaya School 12. Synphat General Hospital	in order to reduct soud impact from construction. • Inspect several machine and equipment or vehicle using in the construction area in good condition during the construction period in oder not to have impact for noise level more than the standard criteria specified by responsble authorities such as Department of Transport, Office of Natural Resources and Environmental Policy and Planning (ONEP), Pollution Control Department or Bangkok, etc.	weekday and holiday) until the construction complete**.** **Measurement Method** • Measure consecutive 5 days (cover the weekday and holiday) by using the measurement according to the approval of Pollution Control Department.

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1.8.1 Construction Period (Continued)	13. Alkoyyu Mosque 14. Thai Suriya Ram Indra Technological School	- Speed limit of truck for carrying material, equipment driving into the community and sensitive area to environmental impact such as religious place, hospital,	**The operation area.** • Station N1: Central Chest Institute of Thailand

		education place, etc., shall not more than 30 kilometers/hour in order to avoid any noise. - Specify the working hours for construction into 2 periods as follows: - First peirod: day time, specify to work from 8.00 hrs until not more than 18.00 hrs . Working for main structure construction such as elevated route structure and train stations such as excavation for foundation structure to support elevated route structure and train stations, concrete pouring for foundation of elevated route structure and ground of train stations - Second period: night time, specify to work from 21.00 hrs unitl not more than 05.00 hrs of the following day. Construction activities shall not create noise to disturb or having low noise ($L_{eq\ 24\ hrs}$ < 70 dBA or L_{max} < 115 dBA in order not to disturb the rest time of several community on the existing road such as concrete molding/concrete berm/prefabricated concrete slab mobilization or material/mobilization for remaining material or construction equipment in which not using, out from the construction area.	• Station N2: Chonprathasongkhro School • Station N3: Khlong Kluea School • Station N4: Phranakhon Rajabhat University • Station N5: Synphaet General Hospital • Station N6: Min Prasat Witthaya School **Budget** • 25,000 Baht/Station/Day
	Depot and Park & Ride Building at Rom Klao Intersection. • At Rom Klao Intersection has residential community and sensitive area for environmental impact located very close such as Rung Napa 2 Village (200 meters), Ramkamhaeng National Housing (180 meters), Minprasat Witthaya School (200 meters) and Min Buri Child Development Center (180 meters)	• The construction for Depot and Park & Ride building at Rom Klao Intersection construct on the unoccupied land with the fence clearly presented boundary. The working hour during consturction period starts from 8.00 hrs. till not more than 18.00 hrs., and not allow to perform the construciton work after that expect for concrete molding mobilization/column/concrete slab/prefabricated concrete or mobilization of remains material or unused construction equipment out from the construction area, etc. shall perform during 19.00 -21.00 hrs. • Provide that staff/labor working in the construction ara or the area which have sound more than 90 dBA more than 8-10	

		hours, shall were Ear Muffs, or Ear Plugs. The rotation of staff/labors in construction area or the area which have continuous loud noise shall be rorated at least 15 days/set.	

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1.8.1 Construction Period (Continued..)		• Contractor shall provide the sound insulation under the train stations for 2 locations such as Samakki Station PK04 and Phranakhon Rajabhat University Station PK15 in order to reduce the noise. However, to consider the type of sound insulation material of aluminum plate with fiberglass in order to reduce the sound reflection from traffic and to install ceiling board for sound absorption Coefficient not less 70% with frequency 400 Hz, and frequency 1,000 Hz. • The construction activities can create loud noise, shall publicize to public periodically, especially the community nearby the construction area. • Specify to use rubber plate instead of steel place for temporary access in order to reduce noise during vehicle travelling, and use steel plate when it's necessary only.	

		And if there is complaint regarding loud noise from public, shall quickly resolve. • Specify to use bored pile in the construction area in the city or community in order to reduce the noise impact.	
1.8.2 Excution Period	**Along the Mass Rapid Transit System and Train Stations** • Noise impact from vehicles at Samakki Station (PK04), traffic island of Tiwanon Road, and Phranakhon Rajabhat University Station (PK15) has space during train stations and commercial building/area line, in which design for half-close area, having opportunity for sound reflection but not for whole type. This has negative impact in medium level.	• Specity to test the strenght and efficienty of sound absorbtion for installation under train stations once a month. If it's found out some damage or less efficiency of sound absorbtion more than 40% , shall immediately replace with the new one. • If it's found out that the sound level analysis during operation under train staions for some staions, more than the standard of normal sound level according to the announcement of National Environment Board No. 15 (B.E.2540) (<70 dBA, shall install the sound absorption with absorptive material in the area under train stations in order to reduce loud noise. • Specify tht the concessionaire or operators shall take care and maintain wheel and train track in good condition and ready for oparation al lthe times. If it's found any abnormal, shall consider to correct or change the new one immediately.	**Sound level measurement index** • Average sound level 24 hours ($L_{eq\ 24\ hrs}$) • sound level of 90 percentile (L_{90}) • sound level during day time and night time (L_{dn}) • maximum sound level (L_{max}) **Execution Period** • Every 3 months (4 times/year) for consecutive 5 days (cover the weekday and holiday) for 5 years, after that if there is no higher value than standard, shall inspect 2 times/year. **Measurement Method** • Measure consecutive 5 days (cover the weekday and holiday) by using the measurement according to the approval of Pollution Control Department.

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1.8.2 Execution Period	**Depot and Park & Ride Building at Rom Klao Intersection.**	• At Depot and Park & Ride Building at Rom Klao Intersection, shall plant the perennial tree with thick leave and high bunch at least 2 lines twisting such as mast tree, white cheesewood or black board tree, mahogany tree, etc. at surrounding area to be buffer zone and to reduce loud noise from vehicle travelling in-out/trains or train maintenance.	**The operation area.** • Station N1: Central Chest Institute of Thailand • Station N2: Chonprathasongkhro School • Station N3: Khlong Kluea School • Station N4: Phranakhon Rajabhat University • Station N5: Synphaet General Hospital • Station N6: Min Prasat Witthaya School **Budget** • 25,000 Baht/Station/Day
1.9 Vibration 1.9.1 Construction Period	**Along the Mass Rapid Transit System and Train Stations** • The vibration from bored pile activities for foundation construction to support elevated route structure/train station/Depot and Park & Ride Buiding which creat the Peak Particle Velocity	• Detail desing for elevated route structure, train stations, Depot and Park & Ride Building at Rom Klao Intersection shall safely support the vibration from earthquake or geological hazard and according to the Ministrial Regulation of Interior "Specificatin for weight support, resistance, stability of building and area to support building, to resist the vibration of earthquake B.E.2550" issued in Building Control Act B.E.2522 • The construction for foundation to support the elevated route structure, train stations, Depot and Park & Ride Building, to use Circular Bored Pile or Barrette Pile in order to reduce the vibration in sensitive area to environmental impact to the existing road which not far for 30 meters for 14 locations; Siam Business Administration Nonthaburi Technological College (SBAC), Boromarajonani College of Nursing, Central Chest Institute of Thailand, Samarnpichakorn	**Vibration level measurement index** • Peak Particle Velocity **Execution Period** • one month prior to the construction period for one time, shall conduct the measurement in order to use as Baseline Data • Every 3 months (4 times/year) to measure for consecutive 5 days (covering week day and holiday until the construction complete) **Measurement Method** • Measure for consecutive 5 days (covering week day and holiday until the construction complete) by using the measurement according to the standard by the approval of Pullution Control Department. **The operation area.** • Station A1: Central Chest Institute of Thailand • Station A2: Chonprathasongkhro School

	(PPV_{max}) in short period and not continuours at the construction area, might have impact in medium level.	School, Department of Transportation, Chonprathasongkhro School, Sri Sangwan School, Khlong Klua School, Apakorn Kindergarden, Charoenphol Witthaya School, Phranakhon Rajabhat University, Wat Phrasimahathat Secondary Demonstration School, The Constitution Protection Monument , Synphat General Hospital	• Station A3: Khlong Kluea School • Station A4: Phranakhon Rajabhat University • Station A5: Synphaet General Hospital

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		• Steel Sheet Pile driving during construction for foundation in order to support the elevated route structure and train station, needs to install steel sheet pile until the soft –medium soft clay layer with the depth approx.18 meters, will barricade and reduce the vibration in the depth level not to disturb the existing road, especially for sensitive area to environmental impact not far from 30 meters for 14 locations such as; Siam Business Administration Nonthaburi Technological College (SBAC), Boromarajonani College of Nursing, Central Chest Institute of Thailand, Samarnpichakorn	• Station A6: Min Prasat Witthaya School **Budget** • 30,000 Baht/Station/Day

		School, Department of Transportation, Chonprathasongkhro School, Sri Sangwan School, Khlong Klua School, Apakorn Kindergarden, Charoenphol Witthaya School, Phranakhon Rajabhat University, Wat Phrasimahathat Secondary Demonstration School, The Constitution Protection Monument , Synphat General Hospital. • Specify the construction activities in which can create vibration since 8.00 hrs -18.00 hrs. such as excavation for foundation to support the elevated route structure and train station or Depot and Park & Ride Building in order to avoid any disturbance to daily working activities of general community or sensitive area to environmental impact. • If any construction activities will create continuous vibration, especially for excavation for foundation, then needs to decrease the power for excavation each time and increase timing in the excavation in order to reduce vibration might occur. • Control vehicle for mobilization construction equipment to strictly comply with traffic regulation, including providing speed limit for no more than 30 kilometers/hour and weight carrying not more than 25 ton, in case of driving in residential area or commercial building, or sensitive area to environmental impact such as hospital, education place, and religious place, etc. • In case of any complaints, shall verify and analyze the damage. If it's found that the damage was from the construction work	

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1.9.1 Construction Period (Continued…)		Shell immediately assess the damage and find the correction or providing assistance. • If any construction activities closed to sensitive area of environmental impact such as; hospital, education and religious place, shall publicize to public in advance and continuously publicize. • Prior to any construction activities in which could create vibration to household or properties, shall provide officer/Civil Engineer/Structural Engineer to inspect and record the current picture prior to the working every time in order to protect any damage to public.	
1.9.2 Execution Period	**Along the Mass Rapid Transit System and Train Stations** • The vibration from generating source when Mass Rapid Transit System in operation has the Peak Particle Velocity (PPV_{max}) 0.0045 inch/second (0.1143 millimeter/second), in which the vibration will occur at the area especially the foundation of elevated route strucutre and train station only, because the vibration level will transfer from Mass Rapid Transit System to train track to	• Shall inspect strength and efficiency of support rubber boot fastening with train track at the location of train station or rubber at wheel of train 1-2 times/month. If it's found any damage or the the decreasing of efficienty is more than 40% , shall immediately replace with the new one.	**Vibration level measurement index** • Peak Particle Velocity **Execution Period** • Every 3 months (4 times/year) to measure for consecutive 5 days (covering week day and holiday) for 5 years, after that if the value is not more than standard, then shall provide the measure 2 times/year. **Measurement Method** • Measure for consecutive 5 days (covering week day and holiday until the construction complete) by using the measurement according to the standard by the approval of Pullution Control Department. **The operation area.**

	structure of elevated route (including foundation) and pass into ground with the depth more than 50 meters.		• Station A1: Central Chest Institute of Thailand • Station A2: Chonprathasongkhro School • Station A3: Khlong Kluea School • Station A4: Phranakhon Rajabhat University • Station A5: Synphaet General Hospital • Station A6: Min Prasat Witthaya School **Budget** 30,000 Baht/Station/Day
	Depot and Park & Ride Building at Rom Klao Intersection. • There is no general community and sensitive area for environmental impact.		

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Environmental Index	Environmental Impact	Environmental Impact Mitigation Measure	Environmental Impact Assessment Monitoring Measure
2. Biological Resources			

2.1 Aquatic Econology System 2.1.1 Construction Period	**Along Mass Rapid Transit System and Train Stations** • Construction activities, especially for open cut, backfilling, excavation for foundation in order to support the elevated route structure and train stations or construction equipment mobilization (such as sand, stone, cement, soil, etc.), expects no to have any impact to aquatic ecology system for water surface resources. Although, Mass Rapid Transit System will cut through water surface resource for more than 20 locations. But the construction for foundation for elevated route structure and train stations, but there is no any construction trepass into water surface resource. There is no activities to distrub the waster surface resources and to impact directly to aquatic ecololy system except train stations located far from water surface resources not far from 50 meters for 10 locations (such as; PK-04, PK-10, PK-11, PK-14, PK-15, PK-20, PK-21, PK-23 and PK-30.), will impact from the additional turbidity from soil erosion during excavation for foundation and backfilling or oil contamination from machine and equipment. • The turbidity and oil stain will obstruct light from such into water surface resources in some level. This causes plankton can have less photosynthesis and dissolved oxygen produced from phytoplankton will be less. This expects to be the temporary impact during construction only due to the construction area s limited edge of traffic island only.	• Provide tidy storage for construction material, equipment machine for construction in order to protect from soil residue, sand, clay fall down and contaminated to water source. • Provide the soil berm to protect from soil erosion from open cut during construction. • Shall complete open cut before rainy season. If it is necessary to perform in rainy season, shall provide complete backfill and carefully mobilize material especially for soil and concrete in order to avoid soil erosion during rainy season (May – November) • Don't throw waste and construction material residue into the public water source or public gutter nearby the construction area. • Material residue from construction shall be stored in appropriate and have canvas to cover from erosion by rain flowing into water resources. • Perform major construction activities during dry season such as reinstatement, excavation, etc., in order to avoid soil erosion during rainy season, flowing in to water resources. • Provide temporary gutter or small sump in order to avoid flooding in construction area and nearby. • Excavated soil from foundation construction, Contractor shall provide special area and shall close or cover or store in the barricaded area and shall truck to dispose into the assigned area within 24 hours.	**Aquatic Ecology Index** • Biodiversity • Species and density of Phytoplankton and Zooplankton • Density of benthos **Execution Period** • Every month during construction period. **Area for conducting** • W1: Khlong Bang Talat • W2: Khlong Prapa • W3: Khlong Premprachakorn • W4: Khlong Lamchala • W5: Khlong Song Ton Nun **Budget** • 22,000 Baht/time/station

		• Provide preventive methods for construction activities in order to avoid any oil contamination into water resources. • Pollution from construction such as maintenance equipment contaminated with oil, shall dispose correctly according to sanitation principal.	

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2.1.1 Construction Period (Continued…)		• Inspect pipeline condition/gutter along the construction project. If it's found out that some blockage with sand soil or obstructed material, shall quickly remove in order not to obstruct the drainage. • If it's found out that there is flooding surrounding the area caused from the project, Contractor shall provide water pump to quickly pump water from the area. • Provide the berm to protect from rain contaminated with construction residue, not to flow into the water surface	

		resource in nearby area, shall provide the retention water system in order to drain directly. • In case of open cut in construction area and pile up, shall pile up far from water resource, provide the special area and store in the close barricaded area. • Provide appropriate drainage system, gutter and sediment sump pit to support rain, especially in the expansion area and modification area for train prior to any drain to public drainage, including maintenance and dig the sediment regularly in order for drainage system to be ready for utilization efficiently all the time. • Provide appropriate toilet as per sanitation principal at site office and labor camp. • In case of construction equipment maintenance, shall perform within the shop or plant. • Provide sump pit to support the waste water from several activities such as cleaning machine and equipment. • Provide appropriate toilet as per sanitation principal as per labor rate 10 persons/room.	

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2.1.1 Construction Period (Continued…)	**Depot and Park & Ride Building at Rom Klao Intersection** • At Rom Klao Intersection is closed to water surface resources (Khlong Song Ton Nun), but there is no any construction trepass into Khlong Song Ton Nun but it can impact from the addition of turbidity from soil surface erosion, especially when excavation for foundation and backfilling.		
	Along the Mass Rapid Transit System and Train Stations • Mass Rapid Transit System with monorail type will be used to run on the elevated route structure by using electricity driven, then it is no impact to Aquatic Ecology for water surface source during the train passed by especially for Khlong Prapa. The train stations are located far from water surface sources less than 50 meters for 10 locations such as; PK-04, PK-10, PK-11, PK-14, PK-15, PK-20, PK-21, PK-23 and PK-30. Then there will be waste water from using toilet by staff in operation, will be treated by small onsite treatment system with capacity of 2 cubic meters installed at every station. So the quality of waste water is complied with the announcement of Ministry of Natural Resources and Environment	• Provide toilet according to sanitation for staff and permanent officer at station. • Provide waste water treatment system according to sanitation each station. • Inspect the waste water tretment system of each station regularly. • Provide appropriate waste collection and disposal at station, and not throwing into river and Khlong.	

2.1.2 Execution Period	**Depot and Park & Ride Building at Rom Klao Intersection** • Waste water occurred from using toilet/rest room/dish wash during working in the working day of staff inside the administration budling, Operation Control Cente, domitory, food shop and waste water from Maintenace actitivies and train wash. And waste water will be treated by using Onsite Treatment Plant, with the combination of using anaaerobic filer and contact aeration process. So the quality of waste water is complied with the announcement of Ministry of Natural Resources and Environment		**Aquatic Ecology Index** • Biodiversity • Species and density of Phytoplankton and Zooplankton • Density of benthos **Execution Period** • Every month for consecutive 5 years after commencting the operation, and after that will conduct 2 times/year in rainy season and dry season. **Area for conducting** • W1: Khlong Bang Talat • W2: Khlong Prapa • W3: Khlong Premprachakorn • W4: Khlong Lamchala • W5: Khlong Song Ton Nun **Budget** • 22,000 Baht/time/station

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2.2 Terrestrial Ecology			

2.2.1 Forest Resources 2.2.1.1 Construction Period	**Along the Mass Rapid Transit System and Train Stations** • The construction for elevated route structure (34.50 kilometers) and trains stations (30 locations) has considered to use the construction area for approx. 8 meters width on traffic island on Rattanathibet Road, Tiwanon Road, Chaeng Watthana Road, Ram Indra Road, and Sriburanukit Road, except the route line of Mass Rapid Transit System diverse from the traffic island (such as Lak Si Plaza at Pak Kred Intersection, intersection at Si Rat Express Way, Khlong Klua School or Phranakhon Rajabhat University, etc.) It needs to cut and mobilize the tree that taller than 10 meters in which obstruct the construction, especially at the foundation column to support the elevated route structure and train stations. Then, it expects to have low impact to the loss of balance of ecology system and plant society.	• Shall mobilize the total trees in which obstructed the construction out from the construction area by digging around and mobilizing (not allow cutting), then plant in the assigned area by MRT and shall record the species of plant and number of every trees. • Mobilization soil from excavation of foundation or equipment and machine by medium-large truck, needs to be special careful in order not damage the trees in the nearby area. • If the construction of Mass Rapid Transit System complete, shall perform as follows: - To mobilize the excavated tree before the construction and then plant along the Mass Rapid Transit System or within the Depot and Park & Ride Building as appropriate. - Specify to grow pergola plants type medium pergola and heavy pergola such as hara-champa, Bougainvillea, Chinese Honeysuckle, Blue Passion Flower, Jasminnum Adenophyllum Wall, Allamanda Cathartica, etc., in order to reduce the hardness of column of elevated route structure and train stations. • Specify the green area or small garden on the area under the train stations (if there is the space.) or along the Mass Rapid Transit System in order to balance the ecology system, additional scenery or reduce air pollution, sound and other by planting some species of shrub such as Kalamona, Yellow Elder, Chinese Rice Flower, Sky Flower, White Cheesewood, etc. or to provide Pergola arch, wooden arch or made from iron or others in order for the medium Pergola - Heavy Pergola can adhere, bind, or climb such as ara-champa, Bougainvillea, Chinese Honeysuckle, Blue Passion Flower, Jasminnum Adenophyllum Wall, Allamanda Cathartica, etc.	

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2.2.1.1 Construction Period (Continued…)	**Depot and Park & Ride Building at Rom Klao Intersection** • At Rom Klao Intersection, there are 28 trees (3 types), expects that some tree would be mobilized or cut out from the construction area. The moving trees will have no impact to the change of balance of ecology system and economic value, this has low impact.		
2.2.1.2 Execution Period	**Along the Mass Rapid Transit System and Train Stations** • Expects to have low impact to disturb the ecology system and plant society along the Mass Rapid Transit System due to the plant society will have the capability to adapt to various environment in large city. Although, some plant society will receive less sunlight from sun due to the structure of elevated route structure and train stations. This impact to the photosynthesis and could have some effect to the food production of plant.	• Shall take care and maintain trees planting in various areas project to be grown up and to replace when it dies.	
	Depot and Park & Ride Building at Rom Klao Intersection • There is no impact to the change of balance of ecology system and plant society due to already providing design the landscape within Depot and Park & Ride Building for green area/shade and beautiful by adding the green area and add more		

	medium-large plant to replace the existing trees cut or mobilized during construction project.		

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2.2.2 Wild Animal Resources 2.2.2.1 Construction Period	**Along the Mass Rapid Transit System and Train Stations** • The construction for elevated route structure (34.50 kilometers) and trains stations (30 locations) are need to cut and mobilize the tree that taller than 10 meters in which obstruct the construction, especially at the foundation column to support the elevated route structure and train stations. Then, it can disturb the living and activities source of wild animal such as bird group. But the small bird group can migrate quickly, then can migrate to the tree on both sides of the road, including wild animal is used to chaotically of traffic or noise from vehicle or human-being activities in community of large city. They can adapt to change environment, it expects to have low impact.	• The construction and operation of Mass Rapid Transit System, Depot and Park & Ride Building at Rom Klao Intersection, expects the impact to the losses of food sources, residence or shelter in low level due to the wild animal is used to the chaotic of large city society, can adapt themselves to the change, not need to provide any preventive, correction and environmental impact deduction measure.	
	Depot and Park & Ride Building at Rom Klao Intersection • Impact to wild animal group such as bird living in grass or shelter but this animal group can quickly escape to nearby residence		
2.2.2.2 Execution Period	**Along the Mass Rapid Transit System and Train Stations** • After the operation of Mass Rapid Transit System, expects that wild animal, bird group will adapt for living and utilize the existing area as normal without any impact due to this wild animal group is used to the disturbance regularly.		

	Depot and Park & Ride Building at Rom Klao Intersection • After the operation of Mass Rapid Transit System has provided the landscape within Depot and Park & Ride Building.		

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2.2.2.2 Execution Period (Continued..)	To have green/shade and beautiful by adding the green area and medium-large trees in order to replace the existing tree cut or mobilized. This could motivate small wild animal to return to utilize as living source or temporary shelter or living area for some bird species.		
3. The beneficial for human-being			
3.1 Land Utilization	**Along the Mass Rapid Transit System and Train Stations** • The construction for elevated route structure (34.50 kilometers) considered to use the construction area for 8 meters width on traffic island on Rattanathibet Road, Tiwanon Road, Chaeng Watthana Road, Ram Indra Road, and		

3.1.1 Construction Period	Sriburanukit Road, expects to have no impact for changing the land utilization except the route line of Mass Rapid Transit System diverse from the traffic island (such as Lak Si Plaza at Pak Kred Intersection, intersection at Si Rat Express Way, Khlong Klua School or Phranakhon Rajabhat University, etc.) and 30 train stations, needs to permanently change the existing land utilization from the empty land and footpath (Min Buri Station – PK-30, Si Rat Express Way, and Khlong Klua School or the existing commercial building (Phranakhon Rajabhat University Station PK-15) to be the elevated route structure and train stations, expect to have low impact.		
	Depot and Park & Ride Building at Rom Klao Intersection • Depot and Park & Ride Building at Rom Klao Intersection has area for 229 rais, needs to modify the layout of land utilization for some area from the empty area (previously was the rice field) has Khlong Song Ton Nun and ditch		

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Environmental Index	Environmental Impact	Environmental Impact Mitigation Measure	Environmental Impact Assessment Monitoring Measure
3.1.1 Construction phase (Continued)	to be a maintenance center and a three-floor park & ride building. It is expected that this can be low impact because the land use is slightly changed, compared to the surrounding land use which is less dense residential area/semi-commercial mortgage/commercial area.		
3.1.2 Operational phase	**Along public transport systems and train stations** • It is expected that the land use along public transport systems will slightly change from the current state (B.E. 2551-2552) because more than 90% of the current land use cannot be expanded or changed. For example, the land consists of moderately dense-highly dense residential area, commercial area/business area, governmental organizations, utilities and facilities. Therefore, some agricultural area/empty space can be changed according to rules/regulations of The Bangkok City Plan (B.E. 2549) and The Nonthaburi Comprehensive Plan (B.E. 2548). It can be transformed to moderately dense residential area (such as condominiums, apartments or housing estates etc.) or semi-commercial mortgage. This is because it has convenient traffic conditions or public transports that attract significant investment. Especially, the areas around 20 train stations can be developed to be highly dense residential area as well as commercial and		

	business area (such as large shopping centers, office buildings or entertainment venues etc.) As a result, this can be moderate-high impact.		
3.1.2 Operational phase (Continued)	**Maintenance center and park & ride building** • Maintenance center and park & ride building on Romklao Junction cover approximately 229 rai and Min Buri Station (PK-30) is located there. It is expected that the land use of surrounding areas will change from the current state (B.E. 2551-2552) a lot because of the attraction of public transport systems (train stations). More than 75% of the current land use is less dense residential areas and semi-commercial mortgage/business areas. As a result, this can be moderate-high impact.		
3.2 Transport systems 3.2.1 Construction phase	**Along public transport systems and train stations** • Impact on traffic capacity on the existing road networks because construction activities mainly use street medians along Rattanathibet Road, Tiwanont Road, Chaeng Wattana Road, Ram Inthra Road and Seehaburanukij Road. As a result, this can be moderate-high impact. • Impact on service life of the existing road networks because construction	• Offer options for passengers to reduce a number of vehicles on the existing road networks during the construction phase. Especially, route options for avoiding the existing road networks are as follows. • Tiwanon Road (Ngamwongwan Junction-Pakkred Junction) and Chaeng Wattana Road (Pakkred Junction-The Safeguarding the Constitutional Monument Roundabout) - Pass Prachachuen Road, enter Samakkee Road, pass Lieng Muang Pakkred Road and converge	***Transportation system measurement indices*** • Traffic volume • Traffic statistics including locations, severity and causes of accidents ***Operational period*** • Monitor and record traffic volume 1 month before the construction for 1 time, take 2 days (including weekday and weekend) in order to use as

	materials/machinery are mainly transported on the existing road networks (including Rattanathibet Road, Tiwanont Road, Chaeng Wattana Road, Ram Inthra Road and Seehaburanukij Road). As a result, this can be an important reason of damage or deterioration of the existing road networks before expected time.	into Tiwanon Road before Umpornpaisan School. - Pass Bond Street (Soi Chaeng Wattana 23) and converge into Tiwanon before Ordnance Ammunition Depot Division. - Pass Prachachuen Road, enter Soi Chinnakhet, pass Chidchon Road, Rajpruek Club and converge into Khampangphet 6 before Thung Song Hong Police Station. Pass Soi Chaeng Wattana 14, Junction of Kaset Road, Soi Kosum Ruamjai	<u>Baseline Data for traffic counter point of the project</u>. • <u>Monitor and record traffic volume in every 1 month, taking 2 consecutive days (including weekday and weekend) until the project is completed.</u> • <u>Monitor accidental statistics once a month throughout the construction period.</u>
3.2.1 Construction phase (Continued)		and converge into Kampaengphet 6 Road, pass Soi Kosum Ruamjai 5, Soi Kayha Bangbua 1 and converge into Phahonyothin Road in front of Soi Bangbua. • Ram Inthra Road (The Safeguarding the Constitutional Monument Roundabout-end of the project) - Pass Soi Ram Inthra 19 (Sukhapiban 2) and converge into Phahonyothin Road at Soi Phahonyothin 48. - Pass Soi Wat Ladplakao, Kaset-Nawamin Road and converge into Phahonyothin Road at Kaset Intersection. - Pass Soi Ram Inthra 14 and converge into Kaset-Nawamin at Soi Maiyalab.	***<u>Operational sites</u>*** • Kae Rai Junction • Sanam Bin Nam Junction • Pakkred Junction • Siam Park Junction • Min Buri Junction **<u>Budget</u>** • 10,000 baht/time

		- Pass Soi Ram Inthra 23 (Sukhapiban 4), Sukhapiban 5 Road (Or Ngern), Soi Ram Inthra 40, Soi Nuanchan and converge into Praditmanutham Road at Chalong Rat Expressway (Ram Inthra-Artnarong) - Pass Koobon Road, Nawamin Road and converge into Kaset-Nawamin Road at Soi Chanachon 2. - Pass Soi Ram Inthra and converge into Kaset 62 – Nawamin Road at Soi Suwannaprasit. - Pass Panya-Natural Park Road, Khlong 1 Mosque and converge into Hatairaj Road opposite Sammakorn Village. - Pass Saeree Thai Road (Sukhapiban 2), Min Pattana joint, Siam Park joint and converge into Eastern Outer Ring Road at Chuensuk 1 Village. - Physical improvement is required (Details are in (a) to support more traffic volume, enabling traffic flow so that road surfaces are in good conditions. These routes include Soi Chinnakhet, Bond Street, Soi	

3.2.1 Construction phase (Continued)		Chaeng Wattana 15 Road, Soi Kayha Bangbua 1 Road, Wat Ladplakao Road and Soi Maiyalab Road etc. In addition, physical management shall consider sizes of traffic lanes and a width of turning radius according to the standard of turning radius of vehicles. It is defined in AASHTO and the Japanese standards that traffic signs and	***<u>Operational sites</u>*** • Kae Rai Junction • Sanam Bin Nam Junction • Pakkred Junction • Siam Park Junction • Min Buri Junction **<u>Budget</u>**

		symbols shall be displayed at least 1 kilometer ahead of transport system construction site. The signs and symbols include warnings and route suggestion signs, warning signal or flashing light, construction blocks, road marking or traffic cones etc. They shall clearly be displayed according to traffic safety standards of Office of Transport and Traffic Policy and Planning (OTP) to ensure safety, reduce confusion and decrease traffic delay of passengers passing through. • Since there are a lot of passengers from outskirt areas in eastern and western sides travelling into the city through the existing road networks during rush hour (7.00-9.00 am.), Reversible Lane is provided to reduce a number of vehicles to the same number as it has been before the construction begins which can cause a bottleneck problem at converged roads at the end of a reversible land. Therefore, a converged point (40-150 meters) shall be suitable, depending on a speed of vehicle, resulting traffic flow and safety convergence without any accidents. Traffic police shall be provided to ensure safety and traffic flow. • MRTA and the contractor shall inform people or passengers thoroughly via mass media such as leaflets, newspapers, radio stations, websites and television	• 10,000 baht/time

3.2.1 Construction phase (Continued)		channels etc. Additionally, they shall provide information and ask for opinions from relevant organizations as follows. - Avoiding the existing road networks, using other suggested routes or asking for cooperation in following traffic management plan. - Avoiding the existing road networks during rush hours if not needed so that secondary roads can help support a number of vehicles avoiding the existing road networks sufficiently. • Encouraging passengers to use public transports and public boats where they are offered to commute to-from Bangkok or Nonthaburi. For example, those who live on Tiwanon Road or Chaeng Wattana Road at Pakkred Junction can use Chao Phraya Express Boat instead or those who live in Min Buri can use Khlong Saen Saeb Express Boat instead. - Publicizing and encouraging people to follow traffic rules, enforcing traffic rules and monitoring violators especially at a-do-not-turn or no-turning points to ensure traffic flow. • The contractor will formulate a traffic management plan in accordance with a transport system construction plan and propose it to MRTA and relevant organizations including Bangkok, Nonthaburi or police stations responsible for each area before the construction begins. The framework	

		on traffic management on the existing road networks during the construction are as follows.	
3.2.1 Construction phase (Continued)		- Right of way of Rattathibet Road, Chaeng Wattana Road (Pakkred Junction to Lak Si Junction) and Ram Inthra Road (including Seehaburanukij Road) shall be 40 meters wide with 8 traffic lanes (back-forth). The lane is 3.50 meters wide/direction. A raised median is 4.20 meters wide. At least 7 meters shall be kept as construction area, 500 meters for each area. If construction materials need to be transferred or fills are included, 1 more traffic lane shall be provided. Traffic management provides the same number of traffic lanes but reduces the width of traffic lanes. After the construction is completed, the traffic on of Rattathibet Road, Chaeng Wattana Road and Ram Inthra Road including Seehaburanukij Road will return to normal. - Right of way of Chaeng Wattana Road at Lak Si Junction to The Safeguarding the Constitutional Monument Roundabout covers 32 shall be 32 meters wide. The traffic lane is 3.25 meters wide/direction. A number of traffic lanes is reduced from 4 lanes/direction to 3 lanes/direction. However, the width of lane will not be decreased. After the construction is completed, the traffic on Chaeng Wattana Road at Lak Si Junction to The Safeguarding the Constitutional Monument Roundabout will return to normal.	

		- Right of way of Tiwanon Road shall be 33 meters wide with 8 traffic lanes (back-forth).The lane is 3.50 meters wide/direction. A raised median is 4.20 meters wide. At least 8.40 meters shall be kept as construction area, 500 meters for each area. If construction materials need to be transferred or fills are included, 1 more traffic lane shall be provided. The traffic management reduces a number of traffic lanes from 3 lanes/direction to 2 lanes/direction. However, the width of lane is the same. After the construction is completed, the traffic on Tiwanon will return to normal.	
3.2.1 Construction phase (Continued)		• Control and instruct truck drivers who deliver construction materials/equipment to strictly follow the traffic rules and to be more careful when driving pass a community or an environmentally sensitive area such as hospitals, educational institutions and religious places etc. so as to prevent accidents to passengers or drivers. • Limited a speed of trucks that deliver materials when passing a community, educational institutions, hospitals and religious places. The speed must not over 30 kilometers/hour. • Smoothen road surface on the existing road networks under elevated highways and MRT train stations as well as adjacent areas and mark an obvious line for each lane according to sizes of lanes after the construction is completed. • Install lights under MRT train stations and footpaths at the existing road networks to provide lighting to road surface as stated by relevant organizations	

		such as Department of Highways, Bangkok.	
	Maintenance center and Park & ride at Rom Klao Junction •The construction of a Maintenance Center and a Park & Ride Building at Rom Klao Junction requires the existing road networks for transporting construction materials/machinery for constructing a maintenance center and Park & ride building. So, this can be a significant cause of damage to the existing road networks before expected time, affecting traffic capacity on the existing road networks. This is because the construction area of a Maintenance Center and a Park & Ride Building is bounded and is not located on street medians of the existing road networks.		
3.2.2 Operational phase	**Along public transport systems and train stations** • It is expected that the existing road networks (including Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road and Seehaburanukij Road) and nearby areas will not be affected by losing the existing road surface because the construction of elevated highways and train stations will be mostly carried out on street medians	•The development of Pink Line Mass Transit System is a part of the government policy aiming to solve traffic problems in Bangkok (northern area) and Metropolitan Region. Especially, the existing road networks and adjacent areas. The public transport system will transfer more than 200,000 passengers/day (2016), increasing to 480,000 passengers/day in 2025. Travel time will be shorter (not longer than 45 minutes/route). This will be a key option for passengers who use the existing road networks and adjacent areas. This is a positive	***Transportation system measurement indices*** • Traffic volume • Traffic statistics including locations, severity and causes of accidents ***<u>Operational period</u>*** • <u>Check accidental statistics in every 3 month (4 times/year) for 5 consecutive years. After that, if the traffic volume of surrounding areas</u>

	of the existing road networks. So, a number of traffic lanes for each direction will stay the same.	impact on the overall traffic status on the existing road networks and adjacent areas which have traffic flow. Additionally, the structure of elevated highways and train stations does not reduce traffic routes because the construction will be carried out on medians of the existing road networks and some parts of footpaths. Therefore, preventive environmental impact measures are not suggested for this. However, additional suggestions on transport system for the existing road networks and adjacent areas are given instead as follows. - Inform people and personal vehicle riders/drivers to use public transport systems. - Increase motivation periodically such as discount on fare during holidays or giving 20% discount on a monthly pass or exemption on fare for the elderly aged 60 and over etc. - Display do-not-park signs for all vehicles excluding public buses on the existing road networks along 250 meters of a train station. A sign shall be displayed 50 meters ahead of and 50 meters after a train station. - Ask for cooperation from relevant organizations especially from in-charge police stations along public transport routes to manage and control the traffic flow on the existing road networks and adjacent areas to match the in-out period of the public transport systems.	tend to decrease more than 40% compared to the previous period before the development of the project, the statistics can be measured once a year. ***Operational sites*** • Kae Rai Junction • Sanam Bin Nam Junction • Pakkred Junction • Siam Park Junction • Min Buri Junction **Budget** 10,000 baht/time

3.2.2 Operational phase		- Ask bus operating companies to coordinate with relevant organizations to relocate a bus stop to be close to an up-down way of train station as much as possible for more convenience. The relevant organizations include Department of Land Transport, Bangkok Mass Transit Authority (BMTA) etc. - Assign staff to provide convenience for passengers while using MRT at MRT stations.	***Transportation system measurement indices*** • Traffic volume • Traffic statistics including locations, severity and causes of accidents
	Maintenance center and Park & ride at Rom Klao Junction • There will be no impact on an increase or a decrease of traffic capacity during the construction phase.		
3.3 Public utilities and facilities 3.3.1 Construction preparing phase		The contactor shall do the followings before carrying the public transport system construction. • Survey details about utilities and prepare the details for public utility and facility system demolition such as highways, current road networks, expropriation areas, locations of public utility and facility system to be demolished and replacement of public utility and facility system etc. • Prepare a demolition plan for public utilities and facilities that may get affected in accordance with a public utility and facility system construction plan and propose it to BMTA and relevant organizations including Bangkok, Department of Land Transport, Metropolitan Waterworks Authority, Metropolitan Electricity Authority, CAT Telecom Public Company Limited or in-charge police stations for approval at least 30 days before demolishing public utilities and facilities.	

3.2.2 Construction phase	**Along public transport systems and train stations** Impacts on utility and facility demolition are as follows. • Waterworks demolition (Metropolitan Waterworks Authority) involves demolishing 300-millimeter PVC pipes and Asbestos		
3.2.2 Construction phase (Continued)	Cement Pipes (AC) lying along medians and on both sides of Rattanathibet Road (300 meters), Tiwanon Road (1,200 meters), Chaeng Wattana Road (3,089 meters), Ram Inthra Road (15,975 meters) and Seehaburanukij Road (300 meters). • Demolition of high-voltage transmission towers/overhead power lines/electrical equipment (Metropolitan Electricity Authority) along both sides of Rattanathibet Road (156 poles), Tiwanon Road (179 poles), Chaeng Wattana Road (312 poles), Ram Inthra (525 poles) and Seehaburanukij Road (38 poles). • Demolition of public utilitie s (Department of Land Transport) along both sides and on medians of Rattanathibet Road, Tiwanon-Chaeng Wattana Road, Ram Inthra Road and Seehaburanukij Road. • Demolition of 9-D4", 12-D4", 16-D4" telephone lines-aerials (TOT Public Company Limited) along both sides of Tiwanon Road-Chaeng Wattana Road-Ram Inthra Road. • Demolition of communication-fiber optic cables-copper cables and conduits (CAT Telecom Public Company Limited) along both sides of Rattanathibet Road, Tiwanon	• Coordinate and formulate a plan together with in-charge organizations where public utilities and facilities will be demolished including Metropolitan Waterworks Authority, Department of Land Transport, TOT Public Company Limited and CAT Telecom Public Company Limited so as to prepare a public relations plan to inform people/passengers about the demolition at least 30 days ahead of time. • Install at least 2-meter-high solid fences or equivalent to define a demolishing area of public utilities and facilities. • Relocation of public utilities and facilities such as water pipes, drains, power high-voltage transmission towers overhead power lines/electrical equipment, telephone conduits and traffic signs will be carried out during 9.00 p.m. but not later than 05.00 a.m. on the next day or on official holidays. Public relations or an announcement shall be made through media such as leaflets, traffic radio media, notices in demolishing areas to inform people or passengers at least 15 days ahead of time. • Vehicles used in relocating public utilities and facilities shall have nets or canvases to cover trucks to prevent stuff falling down on road surfaces. Speed limit of transporting vehicles shall be limited to 30 kilometers/hour.	

	Road-Chaeng Wattana Road-Ram Inthra Road and Seeharanukij Road. • Demolition of communication-fiber optic cables-copper cables and conduits (True Cooperation Public Company Limited) along both sides of Rattanathibet Road, Tiwanon Road-Chaeng Wattana Road-Ram Inthra Road. • Demolition of communication-fiber optic cables-copper cables and conduits (Total Access Communication Public Company Limited) along both sides of Rattanathibet Road, Tiwanon Road-Chaeng Wattana Road-Ram Inthra Road and Seeharanukij Road.	• If there is a complaint from people or passengers stating that "demolition of public utilities and facilities" causes troubles or damage to them or to the existing public utilities and facilities, such issue must be solved immediately.	
Mr. 3.3.3 Construction phase	**Along public transport systems and train stations** • There will be positive impacts on overall public utilities and facilities because the areas along public transport systems will receive additional public utilities and facilities such as lighting system, waterworks system and communication system etc.		
	Maintenance center and park & ride building • The construction of a maintenance and a park & ride building at Rom Klao Junction during a construction phase and an operational phase does not require additional demolition of public utilities and facilities so there will not be impacts on public utilities and facilities.		
4. Quality of life			
4.1 Economics and Social Status			***Economic-Social Indices***

4.1.1 Construction phase	•Impact on an overall economic system of a community is positive at a low level. •Impact on disagreement between passengers on the existing road networks or people in a community and staff and construction staff tends to rarely occur. •The construction will be mostly carried out on street medians of Rattanathibet Road, Tiwanon Road, Ram Inthra Road and Seehaburanukij Road and within obviously-seen barriers. •Trouble and inconvenience of passengers on the existing road networks or people living nearby the construction areas shall be solved immediately. •The existing business operating at the construction areas, especially at train station construction may be obstructed an entrance of establishments. •Impact on an overall economic system of a community due to an increase of employment of skilled/specialized workers.	• Working at the construction areas shall be publicized among local organizations in Bangkok or Nonthaburi Municipality/Pakkred Municipality, in-charge organizations of the areas, at least 30 days ahead of time so that community leaders can inform their villagers directly. • The contractor shall strictly control staff and construction staff not to cause troubles to or affrays with people in a community or passengers on the existing road networks. • An information center shall be established in the project to receive information or complaints from people. Information boards about contact channels such as Call Center telephone number/E-mail address shall be provided. There shall be a staff stationed for 24 hours. All information, complaints and suggestions shall be reported to Mass Rapid Transit Authority of Thailand (MRTA) once a month to mitigate troubles and inconvenience of people affected by the construction. • The contractor shall undergo construction carefully to prevent loss of life or properties of local people living in the construction areas such as damage on road surface which causes troubles to passengers or communication in a community. If it is impossible to avoid such issue, there shall be improvement to reduce impact or it shall not be longer than 3 days.	• Information receiving about the project • Impacts during the construction and opinion toward the project • Problems caused by the project as well as opinions and suggestions on the project. ***Operational period*** • 2 times/year throughout the project ***Target group*** People living in 500 meters from right of way and around a Maintenance Center and a Park & Ride Building (community leaders and indirectly-affected people) ***Budget*** • 515 baht/sample
4.1.1 Construction phase (Continued)	• Impact on an increase of land value due to the improvement of public transport systems that provide more convenience and rapidness which attracts important investments, especially on 30 train stations and a Maintenance Center and a Park & Ride Building at Rom Klao Junction.	• An announcement shall be made to inform people or passengers on the existing road networks during the construction at least 7 days before closing the traffic, transporting construction materials/large equipment through information boards, leaflets, newspapers, radios, websites or televisions etc.	

	There will be considerable impact on land use.	• There shall be security guards provided for safety in the construction areas and for facilitating traffic flow while construction is undergone. • 70% of construction workers shall live in Bangkok or have evidence to show that they have been living in Bangkok and Metropolitan Region for more than 5 years. • If there is a complaint from business operators along the construction areas, those who complain shall have an opportunity to express their opinions for mitigating problems under the concept "Public Participation According to the Right Stated in Constitution of the Kingdom of Thailand B.E.2550" with a focus on mitigating problems immediately such as giving mental remedies to affected people or improving the blueprint if a location of an escalator or a lift or a ramp for the disabled obstructs business sites etc. • Public relations shall be organized periodically to establish good understanding between the contractor and local people living nearby the construction areas. A meeting to inform about the construction of safety and monitoring system shall be organized in order to avoid possible impacts. Public hearing shall be held to receive information and people's opinions once a month to gather information for improving or mitigating impacts occurring during the construction or for formulating a precise construction plan in accordance with the real needs of people. • Local activities in communities along the construction areas shall be focused and participated so as to establish familiarity and gain acceptance from local people such as developing community or promoting careers, granting scholarships to local children/students/schools,	

		participating in sports event or participating in special occasions including King's, Queen's Birthday Ceremony or religious days etc.	
Mr. Theeraphan Tachasirinugune 4.1.2 Operational phase	• Impact on quality of life of people living nearby public transport systems or passengers on the existing road networks since the transport system to be established is a monorail system which does not cause air pollution, noise pollution and vibration. It also promotes traffic flow. Therefore, it is a positive impact on an improvement of quality of life at a medium level. • It is expected that small establishments (commercial buildings) without parking areas and use areas in front to operate businesses will get a negative impact in a medium level. It is because there will be an escalator obstructing the way. It is also expected that large establishments along public transports systems will get a positive impact. Since communities on both sides of the roads are divided by the existing road networks and they interact with each other through overpasses along public transport systems, there will be no impact on division of communities on both sides of the roads.	• In case that small establishments near 8 train stations including Khae Rai Station (PK02), Sanam Bin Nam Station (PK03), Muang Thong 1 Station (PK11), Rajabhat Phra Nakhon Station (PK15), Wacharaphon (PK21), Koobon Station (PK23), Bang Chan Station (PK27) and Talad Min Buri Station (PK29) are completely affected or cannot avoid impacts, they shall receive special mental remedies such as a privilege to make careers or do businesses on train stations or compensation/metal compensation (opportunity cost) for losing an opportunity to do business etc.	***Economic-Social Indices*** • Information receiving about the project • Impacts during the construction and opinion toward the project • Problems caused by the project as well as opinions and suggestions on the project. ***Operational period*** • 2 times/year throughout the project ***Target group*** People living in 500 meters from right of way and around a Maintenance Center and a Park & Ride Building (community leaders and indirectly-affected people) ***Budget*** • 515 baht/sample

4.2 Relocation and expropriation 4.2.1 Construction preparing phase and construction phase	• Impact on mental state of people who are relocated and their lands are expropriated, especially along public transport systems diverting from street medians of Rattanathibet Road-Tiwanon Road (Km. 9+500-Km.1+656), Chaeng Wattana Road (Km. 9+500-Km.11+150, Km. 14+750-Km.15+950, Km.16+400-Km.18+000, Km.32+135) and Ram Inthra Road-Seehaburanukij (Km.33+800-Km.34+300) •	MRTA shall complete relocation and expropriation before the construction of public transport systems and a Maintenance Center and a Park & Ride Building begins as follows. • Organize a meeting to inform affected people about details of the project, expected benefits, processes/methods of expropriation, rights and duties of expropriators etc. This shall be completed at least 18 months before the construction begins. • A royal decree on land expropriation shall be issued to identify a starting-ending point and the coverage of the decree.	
4.2.2 Construction phase (Continued)		• Display the royal decree at government organizations where the project passes through such as Nonthaburi Government Center, Bangkok Metropolitan Administration, Department of Lands Nonthaburi or Departments of Lands in other provinces, Department of	
		Lands Bangkok, Nonthaburi District Office/Pakkred District Office, Lak Si/Bang Khen/Bueng Kum/Kan Na Yao/ Min Buri District Offices and Nonthaburi Municipality or Pakkred Municipality etc. • Investigation of immovable properties to be expropriated such as lands, buildings, agricultural crops. Staff will send an official notice of investigation to owners' properties at least 15 days ahead of time. Detailed investigation of a number of directly-affected people will be carried out to gather needs of assistance required from the government, methods/guidelines/period of giving compensation or suggestions for relocation so as to be a practical guideline that can serve real needs of affected people as much as possible. • Assign the committee to fix compensation cost of lands, buildings and agricultural crops on	

		expropriated areas. The committee shall include representatives of affected people and community leaders from expropriated areas to consider and develop criteria on compensate determination for properties, how to calculate compensation or payment process etc. • Compensate determination shall primarily consider the following people. - An owner or a lawful occupant of an expropriated land. - An owner of a building that cannot be demolished and that are located on an expropriated land on the effective date of the royal decree or that are built under the permission of officials. A land, a house or a building tenant of an expropriated land with an official document issued before the effective date of the royal decree or after permitted by officials and a land lease is effective on the date when officials or in-charge persons take possession of that land, that house or that building. However compensation for lease fee will be given to those who are required to move out of that land, that house or that building before the lease agreement is suspended.	

4.1.2 Construction phase (Continued)		- An owner of a tree in an expropriated land on the effective date of the royal decree. - An owner of a house or a building that cannot be demolished and that are located on an expropriated land on the effective date of the royal decree but not an owner required to demolish that house or that building after informed by the land owner. A compensation will cover only demolishing cost/transportation cost and construction cost (in the same condition). - A person who loses the right to use a road to lay drain, electric cables or others similar to these along an expropriated area according to Section 1349 or Section 1352 of The Thailand Civil and Commercial Code (in case that that person has paid compensation for such right to the expropriator already). • Consideration on compensate determination shall be made at a fair and appropriate rate accepted by directly-affected people, considering fairness for metal compensation (opportunity cost) and mental loss. A period of compensation paying shall be consistent with the construction plan and a payment shall be completed before the construction begins. An evaluation of compensation for affected people shall consider their loss of income based on actual payment and additional compensation to support their status until the situation returns to normal. • Issue a Royal Decree for Land Expropriation to transfer ownership of immovable properties to the government. • Criteria for compensate determination for expropriated immovable properties and compensation cost for the MRT line extension and	

		new line shall be strictly carried out in accordance with MRTA regulations.	
4.2.2 Operational phase (Continued)	• No additional land and property expropriation is required so it will not affect people living along the public transport systems and a Maintenance Center and a Park & Ride Building at Rom Klao Junction.		

4.3 Public Health and Safety 4.3.1 Construction phase	• People living nearby or passengers will be exposed to Total Suspended Particulate (TSP) or less-than 10 micron (PM-10) particle which spreads in the air. They may get eye irritation or respiratory problem. • A community/a commercial building and an area sensitive to noise (a religious place/hospitals) will highly get affected by construction activities because they are located only 100 meters way from noise source. • Working in the construction area without carefulness, causing damage to machinery and equipment may affect health/life/properties. • Sufficient health service centers and medical staff will cause medium impact. This is because there are health service systems available within the construction and nearby areas as the area is a large community with good utilities and facilities.	• The contractor shall strictly follow the preventive environmental impact measures on air and noise quality during the construction phase. • There can be accidents from working if workers are careless. To prevent severe accidents, the contractor shall follow the followings. - Assign the safety committee to formulate a safety policy for construction area and a safety control measure. Controlling and monitoring workers' safety shall be in line with the safety regulations or law. Examination on a cause of accident and suggestions and staff training shall be organized to ensure their safety etc. - Training for staff and construction workers shall be organized to ensure that they know how to use and maintain machinery and equipment effectively. There shall be staff in charge of machinery and equipment maintenance so that they can work effectively. Repair shall be immediately carried on if machinery/equipment is damaged so as to prevent accidents in the workplace.	

	• Impact on people's mental health if they cannot adjust themselves can be a long-term impact and its severity can be increased. However, this has only a few chance to occur since there is traffic congestion and pollution released from construction and vehicles on the existing road networks.	- Staff and construction workers must wear personal protective equipment (PPE) all the time when working in the construction site to prevent danger and accidents according to Ministerial Regulation on the Prescribing of Standard for Administration and Management of Occupational Safety, Health and Work Environment for Construction Work B.E. 2551 and personal protection strictly. - Control, monitor and prohibit construction workers and drivers from using stimulants or drinking alcohol while working and strict punishment shall be applied to violators such as being suspended for work without an unidentified period, deducting 50% of salary or being fired. - Control driving staff of transporting construction materials to strictly follow traffic rules while driving through communities or environmentally sensitive areas such as hospitals, educational institutions and religious places etc. Speed is limited to 30 km./hour.	

4.3.1 Construction phase (Continued)		- Concrete barriers must be installed with 2-meter-high Metal Sheet at the construction sites on the existing road networks to identify construction areas and 2-meter-high solid fences around the construction site of a Maintenance Center and a Park & Ride Building at Rom Klao Junction in order to reduce noise caused by the construction. - Public relations shall be made through media such as information boards, leaflets, newspapers, radio stations, television channels and websites to inform people or passengers about the closing routes including Rattanathibet Road, Tiwanon Road, Chaeng Wattana Road, Ram Inthra Road	

		and Seehaburanukij Road for demolishing public utilities and facilities or for transporting large construction materials or for laying concrete beam etc. - Control measures are applied to all construction sites. Security guards will be provided to watch and prevent unauthorized people from entering the construction sites and to prevent danger and property losses. - The contractor shall provide nets or canvases to keep the construction sites, elevated highways, train stations and other elements out of accidents caused by falling construction materials or equipment. In case that there is a complaint from people or affected persons, staff shall examine such damage and be responsible for damage cost based on actual condition. - Sufficient lighting shall be installed inside the construction sites to suit construction activities which ensures safety in the workplace. Signal lights or flashing lights shall be installed to identify the construction sites at night to ensure safety of passengers. • The contractor shall prepare a first aid room within the office with at least 1 professional nurse to give initial treatment such as first-aid to sick staff and construction workers. In case of severe accident, an injured person must be delivered to the nearest hospital including Panyananthaphikkhu Medical Center, Mongkutwattana	

4.3.1 Construction phase (Continued)		General Hospital, Synphaet Hospital, Nopparatrajathanee Hospital, Nawamin Hospital, Wetchakarunrasm Hospital, Ladkrabang Hospital, Bangkok etc.	

		• Environmental health within the construction sites or the project officeshall be hygienic according to suggestions of Engineering Institute of Thailand and Requirements of Ministry of Public Health as follows. - Clean drinking water (5 liters/person/day) and water (50 liters/person/day) shall be sufficiently provided for all staff and construction workers within the construction sites or the office of the project. Toilets shall be sufficiently provided at residential areas (10 people/a toilet room). Waste water treatment shall be installed within the construction areas before released used water into public drains. - Hygienic garbage bins shall be provided in the construction sites and the project officewhich can support 240 liters with covers. Garbage bins shall be separated into wet garbage bin, dry garbage bin, dangerous garbage bin and recycled garbage bin. In-charge organizations in communities will be contacted in order to transport waste from the communities at least 3 times a week. • <u>The contractor shall prepare measures for construction workers as follows.</u> **1. <u>Measures for construction workers</u>** **<u>Public health measures</u>** ➢ <u>Prepare a first-aid unit with an ambulance for construction workers and coordinate with nearby hospitals ahead of time so that they can receive services in an emergency case.</u> ➢ <u>Train and provide knowledge about safety in construction areas and residential areas as well as about the use of personal protective equipment.</u>	

		➢ Control and apply rules and regulations about vehicles strictly. ➢ Measures for occupational safety, health and work environment in construction areas for construction workers.	

4.3.1 Construction phase (Continued)		**Safety measures for the use of equipment and machinery in construction** ➢ For safety when using equipment and machinery in construction, the contractor must strictly control construction workers to follow the safety measures for the use of equipment and machinery in construction as follows. ➢ Point sharp parts of equipment down or cover sharp parts when holding sharp equipment such as a compass, a scratching tool. Do not keep them in a pocket. ➢ Do not use damaged equipment such as a broken hammer because it may cause falsity while working. ➢ Tie or keep a tool firmly when working in a high place in order to prevent it from falling. ➢ A machine operator shall know how to stop the machine when operating it. ➢ Stop or switch off a machine when changing its speed or changing a gear belt. ➢ Do not stop a machine with hands or parts of the body. ➢ Be careful that parts of a machine such as a gear, a belt or blades may cause danger. They shall be covered by a guard. ➢ Check a work piece or a blade to see if it is firmly secured or is in the right place before starting working. ➢ Switch off the power every time after work. **Safety measures for lifting or holding heavy objects**	

		For safety when lifting or holding heavy objects, the contractor must strictly control construction workers to follow safety measures for lifting or holding heavy objects as follows. ➢ Lifting heavy objects may cause severe danger so labor-saving tools shall be applied here. Do not use a back to lift heavy objects from the ground. Use leg muscle to lift instead. ➢ Lifting heavy objects by thigh muscle by standing in a position that can hold a weight balance by bending the knees, having straight back, bending down the head, holding an object tightly and standing up on legs. ➢ Avoid lifting sharp objects. ➢ Make sure that you can see a way in front and around yourself when lifting an object up.	

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4.3.1 Construction phase (Continued)		**Safety measures for electrical operation** For safety when using equipment and machinery in construction, the contractor must strictly control construction workers to follow the safety measures for working with electricity as follows. **General Warnings about electrical operation** ➢ Replace or repair a broken guard or a switch box immediately. ➢ Always keep switch areas clean. ➢ Always check inside an electric cabinet or an electric control cabinet to ensure that there is no copper powder or conductive metal left inside. Do not take any parts inside such as a fuse out of the control cabinet. ➢ Use specific fuse with particular job. Switch off an electric circuit before replacing a fuse. ➢ Do not use inflammable guards. ➢ Each switch guard shall have labels showing the following details.	

		▪ Use with AC or DC. ▪ Electric potential (electromotive force/voltage) ▪ Electric current ▪ Electrical equipment connected to the switch ▪ Name of recipient ➢ Switch on an electric circuit when checking or repairing a machine. Display a sign "Under the Repair" on the switch. ➢ Make sure that everything is complete and receive a correct signal before switching off an electric circuit. Always check to make sure that there are not any objects inside a machine before switching on the machine for testing. ➢ Be careful when sending a signal for switching on/off a machine. ➢ Do not turn on-off a switch with a wet hand. ➢ Make sure that you receive a correct signal before switching on-off an electric circuit. ➢ Tighten a screw firmly to hold electric cables. ➢ Do not use broken electrical equipment because it may cause danger.	

4.3.1 Construction phase (Continued)		**Warnings about circuit breaker** ➢ Always check a circuit breaker that is used in a high place. Display a visible label for it. ➢ Display a label "Under the Repair" when checking or repairing a machine. Take the label down when completing. ➢ There shall be regulations or signals for using control switch when operated by many workers. ➢ Be careful when operating the same machine among 2 groups of workers, especially under the repair. Coordinate with technicians before switching on-off an electric circuit. **Warnings about the use of equipment, machinery and electrical equipment**	

		➢ Wrap a broken electrical cable with an insulated tape and check cable harness. ➢ Carefully check a joint and a power connector of movable electrical equipment and replace a broken one immediately. ➢ Replacing or repairing electrical equipment must be carried out by an electrician only even in minor case. ➢ Do not switch electrical cables while the electricity is flowing. ➢ Do not hang electrical wires on sharp objects such as a blade or a saw. ➢ There shall be in-charge person for turning on-off some electrical equipment such as a motor or a transformer. ➢ There shall be a visible signs such as a light signal, a red flag, a red marking tape etc. to identify dangerous electrical equipment. ➢ Switch off an electric circuit immediately when something goes wrong and inform an in-charge person. ➢ Do not take electrical safety equipment off unless permitted. ➢ Always switch off electrical equipment after work and make sure that an electric circuit is on. ➢ Do not wrap a light bulb by paper or cloth. ➢ Do not put inflammable substance or materials near a switch or a plug. ➢ Do not operate tools or electrical equipment with wet hands. ➢ Switch off an electric circuit immediately when there is an injured person caused by electrical accident.	

4.3.1 Construction phase (Continued)		**Warnings about electrical equipment installation**	

		➢ Electrical equipment installation shall be controlled by a technician or an electrical specialist except the installation of less-than-50-volt equipment with ground connection.
		➢ Electrical equipment installation can be processed after consulting with a specialist. Especially, there shall be a communication about prevention while the electricity is flowing or interrupting.
		➢ Avoid working while the electricity is flowing unless an important case only.
		➢ Apart from strictly following the law and electrical standards, installing electrical equipment shall follow the additional details.
		  ➢ Do not open a part of electrical equipment that the electricity or electric charge is flowing. Use a guard or an insulator. Display a label on it if it cannot be covered.
		  ➢ Electrical equipment or electrical cables installed in a high place shall have insulators. Always check them.
		  ➢ Regularly check an insulator of electrical equipment where it is touched or operated.
		  ➢ There must be a safety system for each job when electric cables are installed (even temporarily installed).
		➢ There can be interrupting while operating electrical equipment.
		  ➢ Some machines cannot press on a switch and return to the beginning when operating. There shall be a label to inform about it.
		  ➢ All machines shall have effective grounding system.
		  ➢ Consult a technician or an electrical specialist when there are problems.	

		➢ Make sure that there will not be electrocution before switching and make sure that a grounding system is installed already.	

4.3.1 Construction phase (Continued)		**Measures for first aid assistance** The contractor shall organize training about primary first aid assistance when accidents takes place at the workplace inside the construction sites for construction workers before the construction begins. **Stop breathing** Details of first aid giving to a construction worker who stop breathing while working at the construction site. **Electric shock** ➢ Do not use bare hands to help. ➢ Switch off electric current immediately (switch/plug) ➢ Use an insulator to take an electric cable off. If you do not have an insulator, use a stick instead. ➢ Turn off the switch to let the circuit open in case of blackout. ➢ Turn off the switch immediately when there is electric shock and fire. Put off fire by a type C fire extinguisher such as a dry chemical powder fire extinguisher, CO2 etc. ➢ Do not use water or a water fire extinguisher to put off fire because it may cause danger. ➢ In case of drowning, do not get into the water unless the electricity is switched off. ➢ If a patient is unconscious, immediately do CPR. **Stop bleeding** Details of how to stop bleeding are as follows. ➢ Use clean cloth to wrap around an arm or a leg for 2 times. ➢ Tie a first knot. ➢ Place a stick on the first knot and tie a second knot. ➢ Twirl the stick until it stops bleeding. ➢ Tie two ends of the stick by a small rope.	

		➢ Record the time when you begin to twirl the stick. **Measures for organizing workplace** - A workplace shall not have dangerous objects which can obstruct the work. There shall not be waste, oil and water spilt on the floor. - Walkway shall be cleared so that workers can work safely. - Toilets and sinks shall be clean and hygienic. - Food shall not be stored at a workplace.	

4.3.1 Construction phase (Continued)		- Waste and garbage shall be disposed outside the construction sites every day. - Inflammable objects must not be placed near light bulbs or stuff. - Oil and grease spilt on the floor shall be cleaned immediately. - Materials on the floor shall be kept in place. - Wedges shall be provided to support circular objects to prevent them from moving. **Safety measures for using warning equipment to identify dangerous areas** - The construction areas shall have fences surrounded and a label "Construction site. No Entry for Unauthorized Person" shall be displayed around the construction sites. - Dangerous areas shall be surrounded by fences and a label "Dangerous Areas" shall be displayed. There shall be a red light to identify such area at night. - Strong fences shall be installed around high areas or openings. - Unauthorized people are not allowed to enter the construction sites and dangerous areas. - Staff and construction workers are prohibited from staying in the construction areas. **Safety measures for working at height** - Strong rails shall be installed at least 90 cm. above the ground. - All equipment such as slings, ropes, hooks, shackles shall be examined to ensure its conditions before use. Broken equipment is prohibited. - Workers must stop working and go down when raining or storming.	

		- A construction supervisor shall assign workers to wear a safety belt and a life line all the time while working at a place higher than 4 meters or when it is risk of falling. **Safety measures for using heavy machinery and cranes to move objects** - Only one specialist is assigned for giving a signal. - Do not stay close to moving machinery. - Digging areas shall be surrounded by barriers. - Do not stay under objects being raised up.	
4.3.1 Construction phase (Continued)		- Sufficient lighting shall be provided for the night work all the time. - Modification of cranes is strictly prohibited. - Warning sounds and flashing lights shall be displayed while a crane is moving. - Crane operation in Thai language shall be provided to drivers so that the can operate a crane effectively. **Safety measures for ladders** - Heavy duty ladders manufactured from a factory shall be provided. - Damaged or broken ladders are prohibited and shall be labeled as 'Do not use'. - Do not connect 2 ladders to lengthen them. - Do not place a ladder on slippery areas. - The end of a ladder shall be 3 feet higher than a crossed point. - Turn your face to a ladder when climbing. - Do not lift objects while climbing a ladder. - Do not use a ladder with electrical operation. **Safety measures for scaffolding** - Working in a place higher than 200 meters requires a scaffolding.	

		- A metal scaffolding shall be able to support not less than 4 times of actual weight in use. - A width of a scalding floor shall be not less than 35 centimeters. - A ladder shall be provided for climbing up-down a scaffolding. - A safety net or canvas shall be provided to cover the scaffolding. - A scaffolding structure shall have a support to ensure its stability. In case of working near electric cables without insulators, proper distance from electric cables is required as regulated. Contact Electricity Authority to installed temporary insulators. - A rail with the height of at least 90 centimeters but not over 1.10 meters shall be installed except when transporting materials. - If it is required to work under a high place being operated, a protective equipment shall be installed to prevent workers working under that area from falling objects.	

4.3.1 Construction phase (Continued)		- A supervisor shall assign workers to wear a safety belt while working at a place higher than 4 meters. **Safety measures for selecting hooks, lifting chains, clamps to secure with the structure** - Use a hook when there is only one lifting point and use a chain when there are more than two lifting points. - A hook must have a safety pin (except some types of hooks). - Use a hook to lift an object. A weight of object must weigh down at a hook slit.	

		- Request an approval from the head before securing materials with other structure to ensure that it is not over its capacity. - Do not use a clamp used with metal, pliers, pipe handle instead of a clamp used with the structure. - An approval for using hooks, lifting chains and clamps shall be granted before use. Do not use them with excessive weights. - A weight to be lifted shall be clearly displayed on lifing equipment. - Do not let materials to be lifted become loose and hung on a lifting chain. - Do not stick a part of the body out under an object raised by a lifting chain. - Do not use a chain wrap around object to lift. - Make sure that you check a lifting chain including a defect in hooks before use through eye inspection as they may be misused. **Safety measures for digging** - Digging into the ground or a canal deeper than 1.5 meters requires a support or sloping area. The digging area shall be daily examined and recorded by a staff before entering the site. - A barrier and a marking label shall be displayed around the digging area. - Digging staff must wear safety hats and boots. - No entering to a digging hole or other materials while a machine is working. - A ladder shall be provided when digging an area for entering the site and an exit shall be provided. - Dirt or waste from digging or other materials must be kept at least 1 meter away from the edge of digging	
4.3.1 Construction phase (Continued)		hole.	

		- A digging area shall be examined after raining and flood protection shall be given. **Safety measures for traffic within the construction sites and parking lot management** - Only drivers with official driving licenses are allowed to drive inside the construction site. - Speed is limited to 20 kilometers/hour inside the construction site and drivers must follow traffic signs. - Dangerous driving is prohibited. - Safety surpassing is allowed at a restricted area only. - All drivers shall turn on the light before getting dark. - All drivers must fasten belts while driving. All vehicles must install safety belts. - Staff shall walk on the right side of roads within the construction site while vehicles are passing. - Driving staff must follow traffic signs and give a way to pedestrians. - Staff's or visitors' cars can be parked in front of the office buildings where parking lot is available or at provided areas with authorized signs. - General traffic rules are applied in the construction sites. **Safety measures for fire protection and fire extinguishers** - The contractor shall provide training on fire protection and emergency plan for staff and workers. - Construction workers must know where the fire alarms are and know how to use them. - Constructions workers must know meanings of warning signs such as evacuation or other incidents, fire exits and assembly points.	

		- Construction workers must know the nearest locations of fire extinguishers and know how to use them. - Inflammable objects must be kept away from sparkle source. - Turn off a machine or a machine shall not be hot while filing in fuel. - Fill in fuel when a machine is off or an engine is not hot only.	
4.3.1 Construction phase (Continued)		- Dispose a cigarette in provided place. Do not dispose it in a basket or a bin. - Locations of warning signs shall be displayed on an information boards. - The first person who sees fire must stop fire by using a fire extinguisher provided in the site. **Safety measures for welding/grinding** - Before operating electric/gas welding, an operator shall examine surrounding areas to make sure that there are no inflammable objects within the distance that fire sparkles can reach. This shall apply with welding at height where fire sparkle can fall down. Inflammable objects must be moved away or fireproof blanket shall be provided to cover them. - Inflammable object must be moved away from where fire sparkles can reach. - Fireproof blanket shall be provided to cover an operating area to make sure that fire sparkles cannot reach inflammable objects or reach people nearby. - A container of inflammable object must be washed and ventilated every time after each welding to make sure that there is no inflammable or gas left inside or 0% of lower explosive limit.	

		- Sufficient fire extinguishers shall be installed near a welding area and can be reached immediately during emergency case. - Distance between a welding area and gas tanks shall be identified to prevent fire sparkles. Gas tanks shall be secured firmly. - All equipment shall be examined before working to prevent any leaks and to make sure that it is ready for use. - Electric welding equipment shall be in good condition and not be damaged, broken and torn. - Always turn off electric switch when removing a welding rod for temporary stop. - A fuse of electric welder shall suit the tool and shall be inserted properly. - Do not switch an air tube with a gas tube because it may cause explosion. - Check air tubes, gas tubes and flashback arrestors to	

4.3.1 Construction phase (Continued)		make sure that they are in good conditions. - An operator must always wear protective gloves, glasses and masks while operating. - Make sure that there is no ignition around the construction areas after work. **Safety measures of personal protective equipment** - All construction workers must know locations of personal protective equipment and know how to use it. - Safety hats shall be provided for all construction workers. - Eye and face protective equipment (such as a full face mask and safety glasses for polishing and cutting) shall be used with the work risky to eye and face injuries.	

		- All construction workers must wear safety shoes or strong boots and safety hats all the time. - The contractor must provide personal protective equipment such as ear muffs or ear plugs for all staff working in noisy areas. Staff who work in noisy areas shall be rotated every 30 day. - Construction workers must wear ear protective equipment such as ear muffs or ear plugs when operating job louder than 90 decibels (A), 1 meter away from a noise source. - Construction workers must wear safety belts when working in a place higher than 2 meters. **Safety measures for operating machinery, tools and equipment for construction** - Safety equipment or fences shall be installed to prevent moving parts of machinery/equipment from touching. - Safety equipment must not be removed from machinery/equipment while operating. - Install safety equipment which have been repaired or removed in place before operating. - Make sure that guards or safety equipment are in place before using a grinding motor/a cutter.	

4.3.1 Construction phase (Continued)		**Punishment** - Company employees and/or employees of the contractor who violate the Occupational Safety, Health and Work Environment of the project will receive a warning, a probation, a termination in accordance with the regulations of the contractor and labor legislation (B.E.2541). **Measures for accident and incident reporting** Any of the following incidents must be reported to the head and to the safety department including:	

		- An accident that causes a worker not able to work and an accident that causes injury and requires treatment at a hospital to a worker but still can work. - An accident occurring with vehicles (within the construction site). - Damaged equipment/tools caused by accidents. - Fire and an incident leading to minor accident, unsafe action/state shall be reported to a safety staff immediately. **Occupational Safety, Health and Work Environment for contractors or construction companies** - A construction company/a contractor shall give knowledge and advice to construction workers about disease prevention. - A construction company/a contractor shall provide appropriate workplace environment such as heat, lighting, noise and equipment standards in accordance with a Notification of Ministry of Interior on working environment safety.Occupational Safety, Health and Work Environment - A construction company/a contractor shall prepare an manual for construction workers. Details shall cover issues mentioned in the Measure for Occupational Safety, Health and Work Environment for construction workers as mentioned above. Training and knowledge about safety and machinery operation shall be given to construction workers as stated in the manual before an actual operation. The manuals shall be reachable among construction workers and they shall be sufficient for construction workers in the project. - A construction company/a contractor shall prepare sufficient personal protective equipment including safety	

4.3.1 Construction phase (Continued)		hats, gloves, glasses, masks, noise protective equipment, rubber boots or other personal protective equipment for workers. - A construction company/a contractor shall assign workers to wear personal protective equipment according to certain work and to wear proper clothes without loose or tearing parts. In case of working with electricity, workers shall wear clothes that are not wet. A proper clothes for working with construction machinery are one piece of shirt and pants with good condition. All buttons are fastened. No jewelries such as a necklace, a watch, a ring etc. must not be worn. Shoes or boots shall be worn to prevent feet from spiky parts of construction materials. - In addition, construction workers shall not grow their hair or shall wear a hat if they have long hair. A proper clothes for working within a construction area for construction workers. - A construction company/a contractor shall assign a staff to examine Occupational Safety, Health and Work Environment within a construction site. - A construction company/a contractor shall provide sufficient first-aid units within a construction site. - A construction company/a contractor shall follow measures to reduce impacts on noise, air quality and traffic management to ensure safety while constructing. **Measures for maintaining environmental quality at residential areas of construction workers** - In order to select construction workers' residence, a construction company/a contractor shall prepare a residential area management plan. Types of residence, locations, utilities, facilities and other details shall be proposed to MRTA, the project owner, to ask for an approval before the	

		construction begins. Locations of construction workers' residence and the construction control office shall be at least 50 meters away from underground water source in order to avoid contamination. - An exit of construction workers' residence and the construction control office shall be stable. For example, an exit shall covered by gravels or by materials that reduce dust and erosion and groundcover shall be	
4.3.1 Construction phase (Continued)		planted if possible. - For water and waste water management, MRTA, the project owner, shall control a contractor to follow the followings. - Prepare sufficient clean drinking water and water at least 72 cubic centimeters/day/1 construction workers' residence for daily use. - Prepare sufficient hygienic toilets-bathrooms for construction workers at their residences and install waste water management system like septic tanks-anaerobic tanks to treat waste water before releasing it outside. - Always control a waste water treatment to meet its maximum capability and suck residues from a waste water treatment in every 3 month. Garbage shall be disposed by a contractor as follows. - Provide a container to keep general garbage moving along the construction site with secure lids. A contractor shall collect garbage in the construction sites and dispose it at the project office every day. - Provide a container to keep general garbage from daily life activities to gather daily garbage. Containers shall be placed over the site with lids. Containers are put into wet garbage, dry garbage, and dangerous garbage and recycle garbage.	

		- Contact a nearby municipality or a Subdistrict Administrative Organization (SAO) that has waste management to collect and dispose garbage. **2. Measures for people living in communities around the construction site of train station and train rails** **Safety measures for passengers and nearby communities** - A construction company/a contractor shall display a symbol to identify a construction site within 50-100 meters. - A construction company/a contractor shall control driving staff to strictly follow traffic rules. - A construction company/a contractor shall provide life and property insurance for the 3rd person who get loss/danger from the project. **Measures for quality of environmental change** - A construction company/a contractor shall strictly follow the preventive measures for environmental impacts on	
		air quality, noise, vibration, quality of surface water and transportation so as to reduce impacts caused by activities in the project, leading to environmental deterioration which may affect people's and construction workers' health. -	
4.3.2 Operational phase	• Impact on air quality during the operational phase will come from a release of smoke from exhaust pipes passing on the existing road networks. Health of people living nearby, except people living in commercial buildings near Samakkee Station (PK-04) and Rajabhat Phra Nakhon Station (PK-15), shall be specially paid attention to. • Impact on noise level will less occur at almost train station because buildings or	• Encourage people and personal vehicle users to use public transports more so as to reduce pollution and noise level. • Personal vehicle users or passengers of public transports on the existing road networks, under train stations shall strictly follow traffic rules so as to reduce accidents. • Public relations shall be made through media such as information boards, leaflets, newspapers, radio stations, websites or television channels. Knowledge and understanding shall be established	

	commercial buildings located along public transport systems are not close to the roads and they are open areas. • Access to public health services. The development of the project is an important option that can encourage people in Bangkok or Nonthaburi to use public transports more. This will enable quick patient transferring from an accident site to a hospital. It will be more convenient and people can access to services immediately. This will reduce loss of life and it will be a positive impact in a medium level. • For safety problem, emergency and unexpected cases will less occur or never occur. This is because the development of public transport systems requires preparation of equipment/tools or specialists in accordance with safety standards (such as NFPA-National Fire Protection Association)	among people and those who do not use public transports so as to inform them about the importance and the danger caused by pollution from vehicles and avoid exposure to air pollution directly. They shall take care of their health strictly. • Occupational Safety, Health and Work Environment plan shall meet an international standard. There shall be a test and a drill on an emergency cases at least 2 times/year including fire on train station/floor/ticket floor/platform, passenger evacuation from train station/train, emergency stop, giving assistance to passengers while evacuating/derailing etc. • Red marking line shall be displayed to identify a prohibited area while a train is approaching a platform. A platform floor is rough so that passenger can feel it. • Public life and property insurance shall be provided to passengers and 3rd person. • Ask for cooperation from relevant organizations to monitor safety along public transport systems and areas around a Maintenance Center and a Park & Ride Building such as police stations, hospitals or Department of Disaster Prevention and Mitigation etc. Coordinating system and advance communication system shall be installed so that it can identify an emergency case and send supportive equipment to the site immediately.	
4.4 Historical and Archeological sites 4.4.1 Construction phase	**Along public transport systems and train stations** • There will be no direct impact on loss or demolition of historical and archeological sites because the construction are mostly carried out on street medians of the existing road networks. However, there		

	will be indirect impact on 12 historical and archeological sites in local communities within 500 meters along public transport systems. • Operating more than 1 heavy machine at the same time will cause impact on noise hearers along the existing road networks within 20 meters. The highest value is 86.22 decibels (A) which does not exceed the standard value (70 decibels (A) as stated in the 15th Notification of the National Environment Board (B.E.2540). Therefore, it will be a medium impact, causing annoyance to service users or knowledge seeking at historical and archeological sites in local communities within 50 meters away from noise source. • Vibration caused by drilling piles for construction support for the elevated highway structure and train stations within 30 meters has the highest vibration value (PPV) at 2.387 millimeters/second (when compared to the regulations of vibration to houses/buildings of DIN 4150 (Nelson, 1987), the risk of loss may occur with general building or architectural structures. Therefore, surveillance measures for vibration shall be applied to such activities.) • Obstructing people who want to seek knowledge or perform religious activities at religious places or historical and archeological sites or important places of local communities.		

4.4.2 Operational phase	**Along public transport systems and train stations** • There will be no impact (such as air quality, noise level, vibration and obstruction) on 12 historical and archeological sites or important places of local communities. However, there will be a positive impact on rapid and convenient travel for those who will perform religious activities at religious places.		
	Maintenance Center and a Park & Ride Building at Rom Klao Junction • A Maintenance Center and a Park & Ride Building at Rom Klao Junction during the construction and operational phases will not cause any impacts on historical and archeological sites or important places in local communities within 500 meters since no places mentioned above are located there.		
4.5 Aesthetics 4.5.1 Construction preparing phase		• Design process is as follows. - Urban design is applied for detail design of train stations, focusing on lightness harmonious with the existing environment with modern engineering and architectural structure. However, it shall be simple so as to reduce impacts and increase good scenery around train stations. Detail design of each train station does not require the same pattern. They can be different, depending on particular environment and scenery around each train station so that they can have unique and beautiful characteristics. - Detail design of piles and elevated highways shall be harmonious with the existing environment around train stations. A pile structure shall be	

		bending, compact, light and transparent. Grooving is applied on piles to reduce hardness. - Light or bright colors are considered for materials so that the structure of elevated highways or train stations will be harmonious with the environment and hardness can be reduced to match the existing scenery.	
4.5.2 Construction phase	**Along public transport systems and train stations** • There are 5 historical/cultural sites or buildings with outstanding and unique features located within 50 meters from the public transport systems including Nothaburi City Shrine (New), Makutromsaran Park, Darul Muttaqin Mosque, Choprathanrangsit Temple and The Safeguarding the Constitutional Monument. Therefore, it will be a medium impact on obstruction by high structure which does not get along with elements of scenery.	• 2-meter-high solid fences shall be installed to identify the construction areas. Construction area signs shall be clearly displayed. Scenery view of future public transport system shall be displayed so as to reduce impact on scenery at the construction sites. • Disgusting scenery such as leaving garbage over spilt, placing construction materials left untidily or uncovered etc. shall not be made. After the construction is completed, the followings shall be carried out. - Climbing plants such as climbing ylang-ylang, Bougainvillea, Rangoon Creeper, Passifloraceae and Allamanda cathartica etc. shall be planted to beautify scenery and reduce hardness of piles of elevated highways or train stations. - Green areas or small gardens shall be increased within the sites or under train stations so as to reduce hardness of the structures. Small green gardens give comfortable look, encouraging adjustment to scenery perception that change from the existing environment quickly. Small bushes such as Kalamona, Trumpetbush, Chinese Rice Flower, Golden Dewdrop, White Cheesewood etc. shall be planted. Pergola built from wood or metal or other materials shall be installed to let climbing plants such as climbing ylang-ylang, Bougainvillea, Rangoon Creeper,	

		Passifloraceae and Allamanda cathartica and Star Jasmine etc. grow on them.	
4.5.3 Operational phase	**Along public transport systems and train stations** • There will be no impact on city scenery because the structures of elevated highways and train stations are located on street medians of the existing road networks.		
	Maintenance Center and a Park & Ride Building at Rom Klao Junction • There will be no impact on obstruction by high structure with does not get along with elements of scenery which does not get along with elements of scenery since there are not any historical and cultural sites located within 500 meters.		

Remark: The underlined measures refer to additional **Preventive Environmental Impact Measures or Monitoring Measures**