Addendum to the Environmental and Social Impact Assessment – Policy, Legal, and Administrative Framework

Project Number: 51274-001
May 2018

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

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

CURRENCY EQUIVALENTS

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

ABBREVIATIONS

AADT	–	Annual average daily traffic
ADB	–	Asian Development Bank
AP	–	Affected person
ATC	–	Automatic Train Control System
BOD	–	Biochemical oxygen demand
CO	–	Carbon monoxide
dB(A)	–	A-weighted decibels
DMC	–	Developing member country
DOH	–	Department of Highways
EHS	–	Environment, Health and Safety
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
GHG	–	Greenhouse gas
GMS	–	Greater Mekong Subregion
GRM	–	Grievance Redress Mechanism
IEE	–	Initial Environmental Examination
ITF	–	Intermodal Transit Facility
IUCN	–	International Union on Conservation of Nature
M-MAP	–	Mass Rapid Transit Master Plan in Bangkok Metropolitan Area
MOT	–	Ministry of Transport
MRTA	–	Mass Rapid Transit Authority of Thailand
NEQA	–	National Environmental Quality Act
NGO	–	Non-government organization
NO_2	–	Nitrogen dioxide
NOx	–	Oxides of nitrogen
ONEP	–	Office of Natural Resources and Environmental Policy and Planning
OTP	–	Office of Transport and Traffic Policy and Planning
PCP	–	ADB Public Communications Policy (2011)
PM_{10}	–	Particulate matter < 10 micron
$PM_{2.5}$	–	Particulate matter <2.5 micron
PPP	–	Public-Private Partnership
ROW	–	Right-of-way
SCADA	–	Supervisory Control and Data Acquisition System
SO_2	–	Sulfur dioxide
SOx	–	Oxides of sulfur
SPS	–	ADB Safeguard Policy Statement (2009)
TSP	–	Total suspended particulates
UNFCC	–	United Nations Framework Convention on Climate Change

WEIGHTS AND MEASURES

a	–	annum
oC	–	degree centigrade
µ	–	micron
cm	–	centimeter
h	–	hour
ha	–	hectare
kg/d	–	kilogram per day
km	–	kilometer
km/h	–	kilometer per hour
km2	–	square kilometer
m	–	meter
m2	–	square meter
m3	–	cubic meter
m/s	–	meter per second
m3/d	–	cubic meter per day
m3/s	–	cubic meter per second
mg/l	–	milligram per liter
mg/m3	–	milligram per cubic meter
mm	–	millimeter
s	–	second
t	–	metric ton
y	–	year

NOTE

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

Table of Contents

I. Applicable ADB Policies and Requirements

The key major applicable policies and procedures for environmental impact assessment and environmental management for all projects and their components which are financed by ADB loans (ADB projects) are the Safeguard Policy Statement (SPS, 2009) and the Environmental Safeguards – A Good Practice Sourcebook. SPS 2009, promotes good international practices through the implementation of internationally recognized standards, such as the World Bank Group Environmental, Health, and Safety Guidelines (EHS Guidelines), to avoid potential negative environmental impacts of ADB projects, during the construction and operation phases, to complement applicable domestic policies and procedures.

The environmental safeguard requirements of SPS, 2009 identifies the requirements, steps and processes for screening, assessing potential impacts and identifying and implementing corresponding mitigation measures to ensure that ADB projects are environmentally sound, compliant to applicable domestic regulatory requirements and significant negative environmental and social impacts.

At the earliest stage of project preparation, ADB projects are screened and categorized to determine the significance of potential impacts or risks; identify the level of assessment and institutional resources required for the safeguard measures; and determine disclosure requirements. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. ADB projects are assigned to one of the following four categories:

(i) Category A. A proposed project that is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented which may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required to be prepared and disclosed 120 days before Board consideration.

(ii) Category B. A proposed project with potential adverse environmental impacts which are less adverse than those of Category A projects, site-specific, few if any are irreversible, and can be readily addressed by mitigation measures. An initial environmental examination (IEE) is required to be prepared and disclosed before Board consideration.

(iii) Category C. A proposed project that is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.

(iv) Category FI. A proposed project involving investment of ADB funds to or through financial intermediaries. An Environmental and Social Management System (ESMS) may be required to be in place prior to first fund disbursement.

The project has been classified by ADB as category A.

Additional SPS 2009 requirements which are not considered in the domestic EIA include, establishment of project-level grievance redress mechanism; climate change mitigation and adaptation; economic displacement which are not related to land acquisition and resettlement; inclusion of associated facilities in the project's area of influence which is subject for impacts and risks analysis, environmental audit for existing facilities, if any; justification for the use of domestic standards and/or less stringent standards compared to the EHS Guidelines; and organizational

arrangements and capacity building measures in relation to the implementation of the environmental management plan (Sor Phor 1 Form). These requirements were considered in this EIA and appropriate project assurances will be included

II. Legal and Institutional Framework on Environmental Management in Thailand

The Mass Rapid Transit Master Plan for the Bangkok Metropolitan Region (the master plan), which was approved on 8 February, includes the MRT Yellow Line Project: Lat Phrao-Phatthanakan-Samrong Section and MRT Pink Line: Khae Rai – Min Buri Section.

Thailand Environmental Legal Framework

The Enhancement and Conservation of National Environment Quality Act, B.E. 2535 (1992) is the overarching environmental policy in Thailand. It provides the rights and responsibilities of the public and the civil society organizations (CSOs) in enhancement and conservation of national environmental quality; institutional roles and responsibilities; established the National Environment Board; established the Environmental Fund; protection and management of national parks and wildlife reserves; the environmental quality standards, environmental management planning; defined pollution control measures, including the establishment of the Pollution Control Committee.

The Constitution of the Kingdom of Thailand B.E. 2560 (2017) requires public consultation and evaluation of the impacts on the quality of the environment and health of the people in communities for any project or activity which may have serious impacts to communities in respect to the quality of environment, natural resources and biological diversity.

Thailand Environmental Impact Assessment Framework and Procedures

The country's EIA process is based on the provisions in the Constitution of the Kingdom of Thailand and Enhancement and Conservation of National Environment Quality Act, B.E. 2535 (1992)

Screening Process. Activities or projects are screened based on the type, scale, magnitude of impacts and location. The Notification of Ministry of Natural Resources and Environment in the Government Gazette dated 20 June B.E. 2555 (2012) specifies the types and sizes of projects or activities requiring EIA report and initial environmental examination (IEE) report; and the rules, procedures, practices and guidelines for preparing such reports. IEE reports are required for small projects or for projects with less significant environmental impacts. IEE reports may also be the required for projects situated in Environmentally Protected Areas (EPAs) depending on the notification for each EPA. Projects within Forest Protection Areas that are excluded from EIA and IEE report preparation need to prepare the environmental checklist with the environmental impact mitigation and prevent measures and environmental impact monitoring measures.

Environmental Health Impact Assessment (EHIA) is required to be undertaken following the provisions stipulated in Section 58 of the Constitution of the Kingdom of Thailand B.E. 2560, 2017 for the 11 types and size of project or activity identified in the Notification of Ministry of Natural Resources and Environment dated 31 August B.E. 2553 (2010). The Notification of Ministry of Natural Resources and Environment in Government Gazette dated 29 December B.E. 2552 (2009) specifies the guidelines for the conduct of EHIA, the preparation of the EHIA report and the corresponding submission and approval process.

EIA Review and Approval Procedures. The Ministry of Natural Resources and Environment (MNRE), with the approval of the National Environment Board (NEB), issues notifications published in the Government Gazette on guidelines, procedures and methodologies regarding the country's EIA process. The Office of Natural Resources and Environmental Policy (ONEP), under MNRE, is responsible for the implementation of the EIA process. ONEP conducts preliminary review of EIAs and related documents and refer the report to the Expert Review Committee (ERC) for final consideration. The ERC, appointed by NEB and composed of representatives from ONEP and the permitting agency, and experts in various fields of disciplines which are related to the project, needs to review the and approve the EIA report prior to the issuance of construction or operation permit (**Figure II- 1**)The Cabinet, based on the comments submitted by NEB, will decide to approve or disapprove the issuance of permits if the project proponent is a government agency or state-owned enterprise.

Projects that are required to prepare an EHIA report have additional steps which takes into consideration the results of the public consultation organized by the state agency responsible for the project/activity or by the permitting agency and the opinion from an independent.

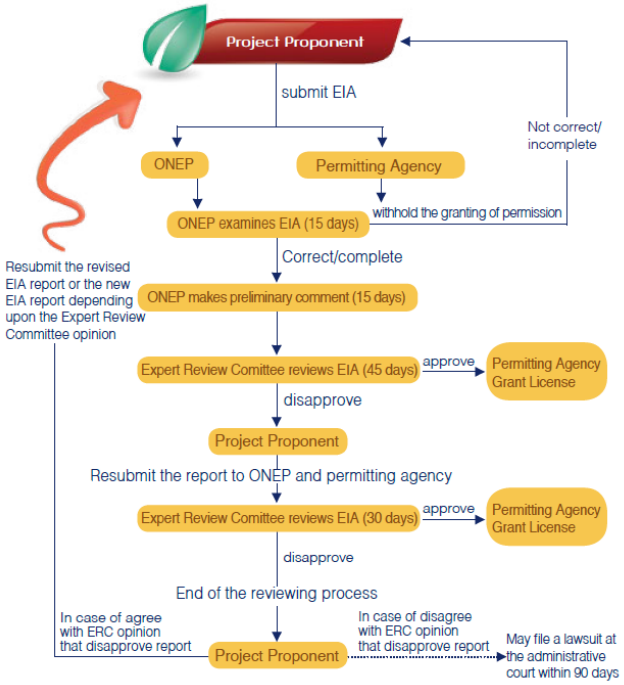
The project proponent, a government agency, a state-owned enterprise, or a private entity, is responsible for the preparation of the EIA/IEE/EHIA. Thailand has a qualification and registration system for legal entities who are qualified to undertake EIA and prepare the EIA report.

EIA Guidelines. Based on the Constitution of the Kingdom of Thailand B.E. 2560 (2017), Enhancement and Conservation of National Environment Quality Act, B.E. 2535 (1992), and related notifications from MNRE, the key elements of the environmental assessment reports include the project location with photos and location map at 1:50000 or other appropriate scale, analysis of alternatives; detailed project description, including land use plan of the project in appropriate scale and direction; existing environmental conditions presenting details and photos of natural resources and environment, physical and biological aspects, which shall be classified into capable and incapable of rehabilitation; details of human use values and quality of life values; as well as current problems around the project location with a map of the surrounding area and land use around the project and the area that may be affected from the project implementation in the short and long term; mitigation measures, including compensation measures in case of unavoidable damage and measures for protection and remedy for projects requiring EHIA; monitoring measures presenting appropriate measures and implementation plan for monitoring environmental impacts and measures of investigation and examination of health and social impacts for projects requiring EHIA report; and a table summarizing significant environmental impacts and corresponding mitigation measures. IEE reports should be prepared accordance with the guidelines for public participation and social impact assessment. EIA reports should be prepared in accordance with the guideline for public participation and social impact assessment and the guideline for health impact assessment

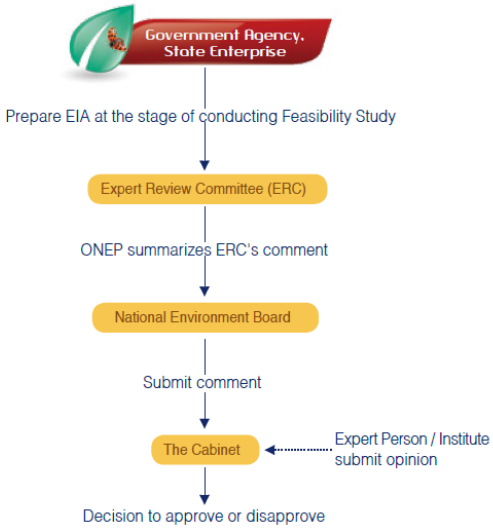
Assessment of Environmental Impacts. The assessment of environmental impacts of a proposed project largely depends on the type, scale and location. However, in the EIA process the scope of analysis should include aquatic and terrestrial physical and biological resources; human use value; and quality of life value (**Table II-1**).

Figure II- 1. EIA Approval Process in Thailand

EIA approval process for projects or activities requiring the preparation of an EIA



EIA approval process for projects or activities requiring the approval of the cabinet.



Source: ONEP.2015. Environmental Impact Assessment in Thailand. Bangkok.

Monitoring and Implementation of Mitigation Measures. All mitigation measures to be implemented by the project proponent based on the approved EIA report, including conditions set by ONEP through the ERC, are the legally binding conditions of the construction or operation permit. The project proponent is required to submit a monitoring report to ONEP and the permitting agency every six months, based on the monitoring plan in the approved EIA report.

Public Participation. Provisions from the Enhancement and Conservation of National Environment Quality Act, B.E. 2535 (1992) and the Constitution of the Kingdom of Thailand requires public participation and availability of information to the public in relation to the development process and matters concerning the enhancement and conservation of environmental quality. Environmental assessments are considered

Grievance Redress. The Enhancement and Conservation of National Environment Quality Act, B.E. 2535 (1992) stipulates the right of any individual to file a petition or lodge a complaint against any party for any act committed in violation of the laws relating to pollution control or conservation

of natural resources. The MNRE operates a Public Service Center with several channels for receiving complaints from the public.[1]

Table II- 1.Scope of assessment of environmental impacts in the EIA process of Thailand and applicable standards/regulations

	Area	Scope	Applicable environmental standards
Physical Resources	Geomorphology	Topography, elevation, unique physical features	
	Soil	Soil profile, sedimentation, erosion, physical and chemical characteristics	Soil Quality Standard as of Notification of National Environment Board No 25 B.E. 2547 (2004)
	Geology	General geological description of project site, seismicity, mineral resources in the project site and surrounding areas	
	Surface and ground water	Water source, quantity, quality and flow rate	Surface water quality standards as of the Notification of National Environmental Board No. 8 B.E.2537 (1994) Ground water quality standards as of Notification of the National Environmental Board No. 20 B.E. 2543 (2000) Prohibition of dumping wastes into rivers, canals, lakes, waterways per Navigation of Thai Waterways Act B.E. 2546 (2003)
	Sea water	Oceanographic characteristics, water quality and current water stratification	Coastal water quality standards as of the Notification of the Environment Board No. 27 B.E. 2549 (2006)
	Air	Rainfall intensity, temperature, air quality, incidence of inversions, fog and storms	Ambient air quality standards as of Notification of the National Environment Board No. 10 B.E. 2538 (1995), announcement of the National Environment Board No. 24 B.E. 2547 (2004) on the standardization of air quality in the atmosphere; Announcement of the National Environment Board No. 36 (2010) on the specification of dust standards of not more than 2.5 microns in the atmosphere in general
	Noise	Intensity and frequency	Community Noise Standard as of Notification of the National Environment Board No. 15 B.E. 2540 (1997)

[1] MNRE e-Petition. http://petition.mnre.go.th/MNRE_PETITION_59/

	Area	Scope	Applicable environmental standards
			Annoyance Standard as of Notification of the National Environment Board No 29 B.E. 2550 (2007) Vibration standard to Protect Impact on Building as of Notification of the National Environment Board No. 37 B.E. 2553 (2010)
Biological Resources	Flora and fauna	Ecology, species, number, distribution, habitat, migration patterns,	
	Rare Species	Species number and importance	
Human use value	Drinking/domestic water	Sources, quantity, quality and adequacy	Groundwater quality standards for drinking purpose as of Notification of the Ministry of Natural Resources and Environment B.E. 2551 (2008)
	Transport	Route	
	Electricity and energy	Sources, kind, type, adequacy	
	Flood control/drainage	System and efficiency	Bangkok Metropolis Regulation on Drainage Control B.E. 2534 (1991)
	Agriculture activities	Agriculture development/promotion, irrigation systems, reforestation	Effluent quality discharged into irrigation systems as of Royal Irrigation Department Order No.73/2554 (2011)
	Industry	Type of industry	
	Mining	Type of Mining	
	Recreation	Type and use of green area and recreation area	
	Land use	Existing land use, area specific zoning	The Ministerial Regulation on The Bangkok Comprehensive Plan 2013 B.E.2556
Quality of life value	Socio-economic	Information on population (occupation, income, language, religion)	
	Health	Sickness rate, infectious diseases, endemic sickness, health services	
	Occupational Health	Occupational disease, work related accidents, health risks	

	Area	Scope	Applicable environmental standards
	Historical	Historical sites, archeological site, traditional customs, traditions and culture	
	Recreational value	Aesthetic value of recreational areas, important natural landmark, preservation or conservation area	

Sources: ONEP. 2015. Environmental Impact Assessment in Thailand. Bangkok; AECEN. 2015. Assessing Environmental Impact Assessment in Thailand: Implementation Challenges and Opportunities for Sustainable Development Planning. Working Paper. Bangkok.

III. Project Domestic Environmental Assessment

Yellow Line. The economic and environmental feasibility study and preliminary detailed design, undertaken by the Office of Transport and Traffic Policy and Planning, Ministry of Transport (OTP), divided the project into two sections: the 12.6 km Ratchada/Lat Phrao – Phattnakan Section using elevated monorail system and the 17.8 km Phattnakan – Samrong section with elevated heavy rail system. The project is located east of Bangkok and Samut Prakan province with no known EPA, Forest Protection Areas or wetlands of international and/or national importance. Annex 3 of the Notification of Ministry of Natural Resources and Environment in the Government Gazette dated 20 June B.E. 2555 (2012) includes all sizes of rail mass transit systems as among the projects or activities that are required to submit an EIA report when applying for project approval or permission. The EIA reports for the two sections were prepared and subsequently approved by the National Environment Board at meeting No. 1/2566 on 16 January 2012.

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

Pink Line. The project is located north of Bangkok, in a highly urbanized and modified area with no known EPA, Forest Protection Areas or wetlands of international and/or national importance. Annex 3 of the Notification of Ministry of Natural Resources and Environment in the Government Gazette dated 20 June B.E. 2555 (2012) includes all sizes of rail mass transit systems as among the projects or activities that are required to submit an EIA report when applying for project approval or permission. The EIA report was prepared and subsequently approved by the National Environment Board at meeting No. 2/2555 on 16 March 2012.

The MRTA commissioned a group of consulting firms who conducted the feasibility study review and preliminary design modifications, and prepared tender documents for the project. The feasibility study review confirmed that the straddle monorail will be adopted for the project. However, 6 additional stations will be included, to ensure optimal distance between stations to provide a more accessible and convenient transportation to passengers in the residential and

commercial areas as well as government offices along the alignment. With these increase the number of stations in the first EIA report from 24 stations to 30 stations.

The depot and park and ride facility to be located at Sanambin Nam intersection in Nonthaburi province were cancelled due plans of the Nonthaburi City Municipality to construct buildings in the allocated land for recreational purposes, municipality offices and other public service facilities. The cancellation will reduce the number of depot and park and ride facilities as assessed in the first EIA from two to one. The depot and park and ride facilities at Romklao intersection will remain and will be expanded from 50.57 rai to 229 rai to accommodate more trains and increase car parking capacity.

The installation of at least 200-meter sound barrier walls in the form of tunnel-like structures in 6 sections near sensitive receptors were also cancelled. Based on the feasibility study review these structures will not be required since the noise levels during operation at sections near the 6 sensitive receptors are almost like the established baseline noise levels which is higher than the domestic threshold (70 dB(A)). The tunnel-like structures may also pose as safety risk during accidents, such as fire, and may hinder passenger evacuation in case of emergencies. Instead, sound absorptive materials will be installed in selected stations.

According to the Thai EIA process, the approving authority must be informed of the changes in the project details or environmental impact and mitigation measures or environmental monitoring measures in the EIA report of the project, as approved by the Specialist Committee[2]. If the approving authority finds that the changes in the project details or environmental impacts and mitigation measures do not affect the substantive content of the environmental impact assessment and mitigation measures in the EIA report which was approved by the Specialist Committee, approval remains valid. The permitting agency will make a copy of the notice to submit to the ONEP. However, if the permitting agency finds that the changes may affect the substantive contents of the environmental impact assessment in the EIA Report, the report on changes will be submitted to ONEP for the approval of the Specialist committee prior to implementing the changes in project scope.

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

IV. Summary of Project Applicable Environmental Standards

The following is a summary of the Project applicable environmental standards for both the Pink and Yellow metro lines. The information has been derived from both Project Environmental and Social Impact Assessments (ESIA) and collated from Thai and World Bank Group Environmental Health and Safety Guidelines (hereafter referred to as the EHS Guidelines).[3] **Table IV- 1** presents a summary of the applicable standard for the project.

[2] Also referred to as Expert Review Committee.

[3]World Bank Group Environmental, Health and Safety Guidelines. 2007. www.ifc.org/ehsguidelines

Table IV- 1.Selection of Applicable Environmental Standard

Parameter	National Standard	International Standard	Applicable Standard Selected	Comment
Surface water quality	Class 5 of the Notification of the Environment Board No. 8, B.E. 2537 (1994)	N/A	National Standard	EHS Guidelines sets the standard for effluent quality but not for ambient water quality. The EHS Guidelines also refer to the World Health Organization (WHO) Guidelines for Drinking-Water Quality in the absence of applicable national acceptability standard.
Wastewater quality	Effluent quality set by the Ministry of Natural Resources and Environment Control Standards for Drainage from Certain Types and Sizes of Buildings, 7 November 2005	WBG EHS Guidelines	National Standard	The EHS Guidelines indicates that the sanitary wastewater discharges standards can be used in the absence of national or local standards when effluent will be discharged to surface water; and effluent must meet the pretreatment and monitoring requirements of the treatment system it will be discharged to.
Air quality	Notification of National Environmental Board No 10, B.E.2538 (1995) and Notification of the National Environment	WHO Ambient Air Quality Guidelines	National Standard	The national standard for ambient air quality meets the WHO Ambient Air Quality Guidelines interim targets. The EHS Guidelines refer to the use of the WHO Ambient Air Quality Guidelines in the

Parameter	National Standard	International Standard	Applicable Standard Selected	Comment
	Board No. 24, B.E. 2547 (2007)			absence of national legislated standards.
Noise	Notification of Environmental Board No 15 B.E. 2540 (1997); Notification of Pollution Control Department: Calculation of Noise Level B.E. 2540 (1997)	WBG EHS Guidelines	National Standard	The noise impacts from the operation of the project will not be significant it is considered acceptable to adopt the Kingdom of Thailand noise standards for these projects. (Please refer to detailed discussion on noise standards in the following section.)
Vibration	Vibration standard for Building Type 2, Announcement of the National Environment Board No. 37, B.E. 2553 (2010)	-	National Standard	There are no specific EHS Guidelines on vibration.

Surface Water. The surface water quality standard adopted for the Project is the Thai Notification of the Environment Board No. 8, B.E. 2537 (1994) as presented below in ***Table IV- 2***. The standard is broken down into five classes as follows. *Class 1 is extra clean fresh surface water resources for use in conservation of water resource ecosystem and for natural organism breeding, without being subjected to water treatment process, but is required to undergo a process for pathogenic destruction. Class 2 is very clean fresh surface water resources for consumption after the required conservational water treatment process, aquatic species conservation, fisheries and recreation. Class 3 is moderately clean fresh surface water resources for consumption after the required conservational water treatment process and agriculture. Class 4 is clean fresh surface water resource for consumption after the required special water treatment process and for use in industries. Class 5 is used for navigation*. [4]

[4] The text in italics is taken from the English translation of the Thai standards and has not been altered.

There are no specific EHS Guidelines for surface water quality. The EHS Guidelines refer to the World Health Organization (WHO) Guidelines for Drinking-Water Quality in the absence of an applicable national acceptability standard. The country's surface water quality standard is therefore adopted for use by the Projects.

The surface water data derived from the sampling points along the alignment of both projects falls under Class 5 which is characteristic of a wastewater receiving body which can be used for transportation.

Water quality will not be affected by either construction or operation of both the Pink and Yellow metro lines.

Table IV- 2.Surface Water Quality Standard of Thailand

Parameter	Unit	Standard Value of Surface Water Class				
		1	2	3	4	5
1. Color, Odor and taste	-	n	n	n	n	-
2. Temperature	^{0} C	n	n'	n'	n'	-
3. pH Value	-	n	5 – 9	5 – 9	5 – 9	-
4. Dissolved Oxygen	mg/l	n	≥ 6.0	≥ 4.0	≥ 2.0	-
5. BOD_5 (20 ^{0} C, 5 days)	mg/l	n	≤ 1.5	≤ 2.0	≤ 4.0	-
6. Total Coliform Bacteria	MPN/100ml	n	≤ 5,000	≤ 20,000	-	-
7. Fecal Coliform Bacteria	MPN/100ml	n	≤ 1,000	≤ 4,000	-	-
8. NO_3-N	mg/l	n	not more than 5.0			-
9. NH_3-N	mg/l	n	not more than 0.5			-
10. Phenols	mg/l	n	not more than 0.0005			-
11. Copper (Cu)	mg/l	n	not more than 0.1			-
12. Nickel (Ni)	mg/l	n	not more than 0.1			-
13. Manganese (Mn)	mg/l	n	not more than 1.0			-
14. Zinc (Zn)	mg/l	n	not more than 1.0			-
15. Cadmium (Cd)	mg/l	n	not more than 0.005* not more than 0.05**			-
16. Cr (hexavalent)	mg/l	n	not more than 0.05			-
17. Lead (Pb)	mg/l	n	not more than 0.05			-

Parameter	Unit	Standard Value of Surface Water Class				
		1	2	3	4	5
18. Hg (total)	mg/l	n	not more than 0.002			-
19. Arsenic	mg/l	n	not more than 0.01			-
20. Cyanide (CN)	mg/l	n	not more than 0.005			-
21. Radioactivity -α Gross - β Gross	 Becquerel/l Becquerel/l	n	 not more than 0.1 not more than 1.0			-
22. Total Organochlorine Pesticides	mg/l	n	not more than 0.05			-
23. DDT	µg/l	n	not more than 1.0			-
24. α – BHC	µg/l	n	not more than 0.02			-
25. Dieldrin	µg/l	n	not more than 0.1			-
26. Aldrin	µg/l	n	not more than 0.1			-
27. Heptachlor & Heptachlor epoxide	µg/l	n	not more than 0.2			-
28. Endrin	µg/l	n	none			-

n = naturally
n' = naturally but changing not more than 3^0 C
* when water hardness is not more than 100 mg/l as $CaCO_3$
** when water harness is more than 100mg/l as $CaCO_3$
Sources: Notification of the Environment Board No. 8, B.E. 2537 (1994); Water Environment Partnership in Asia. Surface Water Quality Standard in Thailand. http://www.wepa-db.net/policies/law/thailand/std_surface_water.htm

Wastewater. Wastewater generated from the operations of different establishments[5], must conform to the effluent quality set by the Ministry of Natural Resources and Environment Control Standards for Drainage from Certain Types and Sizes of Buildings, dated 7 November 2005, before discharge to the public drainage system **(Table IV- 3).** The EHS Guidelines indicate that sanitary wastewater discharges standards can be used in the absence of national or local standards. Thailand's effluent quality standard is therefore adopted for use by both Projects.

[5] This excludes industrial effluents and wastewater from industrial estates which must conform to the standards set by the Ministry of Natural Resources and the Environment for Standardization of Wastewater Discharge from Industrial Sources, Industrial Estates, and Industrial Zones, Dated 29 March 2016.

Table IV- 3. Wastewater Quality Standard in Thailand

Water Quality Index	Unit	Maximum values for Building Types					EHS Guidelines
		A	B	C	D	E	
1. pH value		5-9	5-9	5-9	5-9	5-9	6-9
2. BOD	mg/l	Up to 20	Up to 30	Up to 40	Up to 50	Up to 200	30
3. COD	mg/l						125
4. Solids							
- Suspended solids	mg/l	Up to 30	Up to 40	Up to 50	Up to 50	Up to 60	50
- Settleable solids	mg/l	Up to 0.5	Up to 0.5	Up to 0.5	Up to 0.5	-	
- Total dissolved solids	mg/l	Up to 500*	Up to 500*	Up to 500*	Up to 500*	-	
5. Sulfide	mg/l	Up to 1.0	Up to 1.0	Up to 3.0	Up to 4.0	-	
6. Nitrogen	mg/l	Up to 35	Up to 35	Up to 40	Up to 40	-	10
7. Fat, oil and grease	mg/l	Up to 20	Up to 20	Up to 20	Up to 20	Up to 100	10
8. Total coliform bacteria	MPN/100 ml	-	-	-	-	-	400

***** = Is the increase in the amount of solution in normal water
Building Type A = condominiums with a total of 500 bedrooms and up for all floor of a building or group of buildings that are used as residence; hotels with a total of 200 rooms or more; hospitals with 30 or more beds; school buildings with a combined floor space of 25,000 m^2 or more; buildings of government offices, state enterprises, international organization or private organizations with combined living space on every floor from 55,000 m^2 ; shopping centers with total space of 25,000 m^2 or more; markets with a total floor area of 2,500 m^2 or more; and restaurants or shops with a combined service area of 2,500 m^2 or more.
Building Type B = condominiums with 100 bedrooms to 499 bedrooms for all floor of a building or group of buildings that are used as residence; hotels with 60 rooms to 199 rooms; dormitories with a total of 250 rooms or more; service areas with a total floor space of 5,000 m^2 or more; hospitals with 10 beds to 29 beds; school buildings with a total floor area of 5,000 m^2 to less than 25,000 m^2 ; buildings of government offices, state enterprises, international organization or private organizations with combined living space on every floor from 10,000 m^2 to less than 55,000 m^2 ; shopping centers with total space of 5,000 m^2 to less than 25,000 m^2; markets with a total floor area of 1,500 m^2 to less than 2,500 m^2; and restaurants or shops with a combined service area of 500 m^2 to less than 2,500 m^2.
Building Type C = condominiums less than 100 bedrooms in all floors of a building or group of buildings that are used as residence; hotels with less than 60 rooms; dormitories with a total of 50 rooms to 249 rooms; service areas with a total floor space of 1,000 m^2 to less than 5,000 m^2; buildings of government offices, state enterprises, international organization or private organizations with combined living space on every floor from 5,000 m^2 to less than 10,000 m^2 ; markets with a total floor area of 1,000 m^2 to less than 1,500 m^2; and restaurants or shops with a combined service area of 250 m^2 to less than 500 m^2.
Building Type D = Dormitories with a total of 10 rooms to 49 rooms; markets with a total floor area of 500 m^2 to less than 1,000 m^2; restaurants or shops with a total area of 100 m^2 to less than 250 m^2.
Building Type E = restaurants or shops with floor space of less than 100 m^2.
Source: Pollution Control Department. Water Quality Standards. http://www.pcd.go.th/info_serv/reg_std_water04.html

Air Quality. Ambient air quality standards set the acceptable amount of air pollutants for a given time. Thailand's ambient air quality standards (**Table IV- 4**) present a short-term average standard, for 1 hour, 8 hours and 24 hours, as a means of preventing acute effect on human health. The long-term average standard (1 month and 1 year) is for prevention of chronic effect on human

health. The EHS Guidelines refer to the use of the WHO Ambient Air Quality Guidelines in the absence of national legislated standards. Thailand's ambient air standards are therefore adopted for use by both Projects.

Table IV- 4. Ambient Air Quality Standard in Thailand

Pollutants	Averaging period	Ambient Air Standards	WHO Ambient Air Quality Guidelines
Carbon monoxide (CO)	1 hr 8 hr	Not exceed 30 ppm (34.2 mg/m^3) Not exceed 9 ppm (10.26 mg/m^3)	
Nitrogen dioxide (NO_2)	1 hr 1 year	Not exceed 0.17 ppm (0.32 mg/m^3) Not exceed 0.03 ppm (0.057 mg/m^3)	200 µg/m^3 40 µg/m^3
Ozone (O_3)	1 hr 8 hr	Not exceed 10 ppm (0.20 mg/m^3) Not exceed 0.07 ppm (0.14 mg/m^3)	100 – 160 µg/m^3
Sulfur dioxide (SO_2)	1 year 24 hr 1 hr	Not exceed 0.04 ppm (0.10 mg/m^3) Not exceed 0.12 ppm (0.30 mg/m^3) Not exceed 0.3 ppm (780 µg/m^3)	20 – 125 µg/m^3
Lead (Pb)	1 month	Not exceed 1.5 µg/m^3	
TSP	24 hr 1 year	Not exceed 0.33 mg/m^3 Not exceed 0.10 mg/m^3	
PM_{10}	24 hr 1 year	Not exceed 0.12 mg/m^3 Not exceed 0.05 mg/m^3	50 – 150 µg/m^3 20 – 70 µg/m^3
$PM_{2.5}$	24 hr 1 year	Not exceed 0.05 mg/m^3 Not exceed 0.025 mg/m^3	25 – 75 µg/m^3 10 – 35 µg/m^3

Sources: Notification of national Environmental Board No 10, B.E.2538 (1995); Notification of the National Environment Board No. 24, B.E. 2547 (2007); Notification of the National Environment Board No. 28, B.E. 2550 (2007); Notification of the National Environment Board No. 33, B.E. 2552 (2009); Notification of National Environment Board No. 36, B.E; 2553; Thailand Board of Investment Guide on Environmental Regulations, 19 December 2014.

Noise. Thailand's ambient noise standards (**Table IV- 5**) set acceptable noise limits to manage public health risks, including well-being and comfort, that may arise from excessive noise. The standards are based on the duration that a community is exposed to noise and set noise limits for different activities such as mining and quarry and industrial plant operations. The EHS Guidelines

sets the standards for daytime and nighttime noise levels based on the WHO Guidelines for Community Noise (1999).

The Kingdom of Thailand has adopted a national noise standard of 70 dB(A). This is higher than the noise levels suggested in the EHS Guidelines of 55 dB(A) for daytime and 45 dB(A) for night time. The alignments of the Yellow and Pink Lines follow major roads in Bangkok, passing through zoned commercial and commercial/residential areas[6] , where the major contributors to baseline noise levels are motor vehicles. As would be expected in an Asian mega-city like Bangkok the existing baseline noise levels are already well above those suggested in the EHS Guidelines. Baseline noise levels are already high. The key consideration is the level of additional noise from the operation of the monorail. Noise modelling undertaken for the ESIAs shows that the increase in noise levels during operation will be within the range of +3 dB(A) to 5 dB(A) at the selected receptors, and for both projects typical maximum noise levels as trains pass would be between 57 dB(A) and 63 dB(A) at the kerbside. The operation of the monorails will therefore not result in significant changes in noise levels, and the level of change is predicted to be within the acceptable limits of 3 dB(A) to 5 dB(A) based on the EHS Guidelines for areas with high levels of baseline noise. The EHS Guidelines for noise in commercial areas and the Thai national standards are both 70dB(A). The high existing noise levels, the location of the alignment in zoned commercial areas, and identical noise standards in Thailand and in the EHS Guidelines means it is appropriate to adopt the Thai noise standards for both lines.

Table IV- 5. Ambient Noise Standard in Thailand

<table>
<tr><th></th><th>Receptors</th><th>Thailand Noise Standard</th><th>Guidelines for Community Noise, WHO[a]</th></tr>
<tr><td rowspan="2">Maximum Sound Level (L_{max}) from Fluctuating Noise</td><td>Residential; institutional; educational</td><td rowspan="2">≤ 115 dB(A)</td><td>Daytime: 55 dB(A)
Nighttime: 45 dB(A)</td></tr>
<tr><td>Industrial; Commercial</td><td>70 dB(A)</td></tr>
<tr><td rowspan="2">A-weighted Equivalent Continuous Sound Level (L_{eq}) 24 hours</td><td>Residential; institutional; educational</td><td rowspan="2">≤ 70 dB(A)</td><td></td></tr>
<tr><td>Industrial; Commercial</td><td></td></tr>
<tr><td colspan="2"></td><td>Noise Annoyance Level: 10 dB(A)[b]</td><td>Maximum Increase in noise levels: 3 dB(A)</td></tr>
</table>

[a] A-weighted Equivalent Continuous Sound 1 hour

[6] Areas consisting of traditional Thai shop houses.

[b] Annoyance noise is the noise levels measured outside the project site which resulted from project operation with interference. The noise level is higher than the background noise level and exceeds 10 dB(A). Source: Thailand Board of Investment Guide on Environmental Regulations, 19 December 2014.
Sources: Notification of Environmental Board No 15 B.E. 2540 (1997); Notification of Pollution Control Department: Calculation of Noise Level B.E. 2540 (1997); Thailand Board of Investment Guide on Environmental Regulations, 19 December 2014; The World Bank Group, Environmental, Health, and Safety Guidelines.

Vibration. The Announcement of the National Environment Board No. 37, B.E. 2553 (2010) sets the vibration standard to protect buildings (**Table IV- 6**). There are no specific EHS Guidelines on vibration. The Thai vibration standard is therefore adopted for both Projects.

Vibration standard for Building Type 2 (residential) was used as reference standard for monitoring vibration levels in sensitive areas of the project alignment.

Table IV- 6: ***Vibration Standard for the Protection of Buildings in Thailand***

Building Type	**Area**	**Frequency (Hertz)**	**Velocity (mm/s)**	
			Vibration Case 1	**Vibration Case 2**
1	1.1 Foundation or ground floor of building	f ≤ 10	20	
		10 < f ≤ 50	0.5f + 15	
		50 < f ≤ 100	0.2f + 30	
		f > 100	50	
	1.2 Top floor of building	All frequencies	40*	10*
	1.3 Each building floor	All frequencies	20*	10**
2	2.1 Foundation or ground floor of the building	f ≤ 10	5	
		10 < f ≤ 50	0.25f + 2.5	
		50 < f ≤ 100	0.1f + 10	
		f > 100	20	
	2.2 Top floor of building	All frequencies	15*	5*
	2.3 Each building floor	All frequencies	20**	10**
3		f ≤ 10	3	

Building Type	Area	Frequency (Hertz)	Velocity (mm/s)	
			Vibration Case 1	Vibration Case 2
	3.1 Foundation or ground floor of building	10 < f ≤ 50	0.125f +1.75	
		50 < f ≤ 100	0.04f + 6	
		f > 100	10	
	3.2 Top floor of building	All frequencies	8*	2.5*
	3.3 Each building floor	All frequencies	20*	10**

f = Frequency of vibration at the time of peak particle velocity, expressed as hertz.
*Standards specified for peal particle velocity on the horizontal axis.
**Standards specified for peak particle velocity on the vertical axis
Vibration Case 1 – vibration not causing fatigue or resonance to the building
Vibration Case 2 – vibration which causes fatigue and resonance to the building
Building Type 1 = Factories as stipulated by the Factory Regulation, commercial buildings, office buildings, warehouse buildings, special buildings as stipulated by the Building Control Law.
Building Type 2 = Residential buildings, apartments, row houses, commercial buildings, townhouses, twin houses as stipulated by the Building Control Law, condominiums as stipulated by the Condominiums Regulation, dormitories as stipulated by the Dormitory Law, schools, hospitals, buildings used for religious activities
Building Type 3 = Historic sites as stipulated by the Regulation on Historic Site, Antiquities, Artifact and National Museum, buildings or any structures which are not strong but with cultural value
Sources: Announcement of the National Environment Board No. 37, B.E. 2553 (2010); Thailand Board of Investment Guide on Environmental Regulations, 19 December 2014

V. Relevant International Agreements

Thailand is a signatory to several international agreements on environmental protection. **Table V-1** lists international agreements relevant to the project.

Table V- 1 Relevant International Agreements Signed by Thailand

Name of Agreement	Date	Agreement Objective
Ramsar Convention on Wetlands of International Importance	13 September 1998	Preventing the progressive encroachment on and the loss of wetlands.
Convention Concerning the Protection of the World Cultural and Natural Heritage	17 September 1987	Conservation and protection of cultural and natural heritage sites.

Convention on Biological Diversity	31 October 2003	Conservation and Sustainable Use of Biodiversity.
Kyoto Protocol	16 February 2005	To limit or reduce greenhouse gas (GHG) emissions of developed countries by enhancing national programs to reduce GHG emissions and by setting internationally binding emission reduction targets.
United Nations Framework Convention on Climate Change	28 March 1995	To stabilize GHG concentrations at a level that would prevents dangerous anthropogenic interference with the climate system within a sufficient time-frame.
Montreal Protocol	7 July 1989	To protect the ozone layer by reducing the production and consumption of ozone depleting substances.
Paris Climate Agreement	4 November 2016	Greenhouse gas emissions mitigation, adaptation and finance starting in the year 2020.