Chapter 3
Current environmental condition

3.1 Introduction

The Runway and Taxiway 2 Construction Project for the U-Tapao International Airport falls into the category of projects or activities that may seriously impact the community according to the Notification of the Ministry of Natural Resources and Environment Re: Specifications for Projects, Businesses or Operations that May Severely Impact Natural Resources, Environmental Quality, and the Health, Sanitation, and Quality of Life of People in the Community, in which an environmental impact assessment report must be composed, along with the criteria, procedures, and conditions for the Environmental Impact Assessment Report 2018 and (No. 2) 2019, both in terms of environmental quality, natural resources and health and there must be a process for hearing opinions of the public and stakeholders before the project commences.

3.2 Environmental Issues

Based on the screening of environmental issues with preliminary data, which includes project details, basic environmental data (secondary data) and scope of study for environmental issues, the first public consultation was heard to determine the scope and guidelines for environmental impact assessment. On 4 July 2019, the environmental issues can be summarized as covering 4 main components: physical environmental resources, biological resources, human use value, and quality of life value, totaling 23 issues, as shown in Table 3.2-1.

Table 3.2-1 Environmental Issues in the Environmental Impact Assessment and Study

Physical environmental resources (10)	Biological environmental resources (2)	Human use value (5)	Quality of life value (6)
1. Noise 2. Vibration 3. Air quality 4. Topography conditions 5. Geology and earthquakes 6. Soil resources 7. Surface water hydrology 8. Surface water quality 9. Groundwater quality 10. Marine water quality	1. Terrain Ecology 2. Aquatic ecology	1. Waste management 2. Land use 3. Transportation 4. Public utilities and facilities 5. Drainage and flooding prevention systems	1. Socioeconomic 2. Resettlement and replacement of assets 3. Health and Public Health 4. Occupational health and safety 5. Attractions and Sightseeing 6. Archaeological and historical sites

3.3 Data collection

3.3.1 Source of information

The source of information used in the study of the current environment of the study site is classified as secondary and primary data, as detailed inTable 3.3-1

Table 3.3-1 Summary of data sources used to analyze the current environment

Sequence No.	Environmental Issues	Secondary	Primary	Source of information	Year
3.5 Physical environmental resources					
3.5.1	Noise	✓		Office of Air Quality and Noise Management, Pollution Control Department	Year 2014-2018
		✓		Environmental Research and Training Center, Department of Environmental Quality Promotion	Year 2017
			✓	Field Survey of Project	Year 2019
3.5.2	Vibration		✓	Field Survey of Project	Year 2019
3.5.3	Air quality	✓		Sattahip Meteorology Station, Department of Meteorology	Year 1989-2018
		✓		Pollution Control Department	Year 2014-2018
			✓	Field Survey of Project	Year 2019
3.5.4	Topography conditions	✓		4 year Development Plan, Rayong Province	Year 2018-2021
		✓		4 year Local Development Plan, Phala Subdistrict	Year 2018-2021
		✓		U-Tapao International Airport Master Plan	December 2018
3.5.5	Geology and earthquakes	✓		Department of Mineral Resources	Year 2013-2017
		✓		Earthquake Monitoring Office, Department of Meteorology	Year 2013-2017
3.5.6	Soil resources	✓		Office of Land Development District 2, Department of Land Development	Year 2556
		✓		Department of Land Development	Year 2016-2019
		✓		U-Tapao International Airport Master Plan	December 2018
3.5.7	Surface water hydrology	✓		Water Crisis Prevention Center, Department of Water Resources	Year 2018
		✓		Department of Meteorology	Year 1989-2018
		✓		Royal Irrigation Department	Year 2021
		✓		Institute of Water Resources and Agriculture (Public Organization)	Year 2017
		✓		National Water Resources Office	Year 2021
3.5.8	Surface water quality	✓		Regional Environment Office 13 (Chonburi)	Year 2017
			✓	Field Survey of Project	Year 2019
3.5.9	Groundwater quality	✓		Department of Groundwater Resources	Year 2016
		✓		Office of Environmental Policy and Planning Chonburi Province	Year 2016
3.5.10	Marine water quality	✓		Pollution Control Department	Year 2018
			✓	Field Survey of Project	Year 2019
3.6 Biological environmental resources					
3.6.1	Terrain Ecology	✓		Information Center, Office of Planning and Information, Royal Forest Department	Year 2013-2018
		✓		Department of Airport Safety and Standards, Airports of Thailand Public Company Limited	Year 2018
		✓		U-Tapao Airport	Year 2017-2019
			✓	Field Survey of Project	Year 2019
3.6.2	Aquatic ecology	✓		Research and Development Center for	Year 2019

Table 3.3-1 Summary of data sources used to analyze the current environment

Sequence No.	Environmental Issues	Secondary	Primary	Source of information	Year
				Resources in the Ocean and the East Coast of the Gulf of Thailand	
		✓		Department of Marine and Coastal Resources	Year 1979-2011
			✓	Field Survey of Project	Year 2019
3.7 Human use value					
3.7.1	Waste management	✓		National Statistical Office of Thailand	Year 2014-2018
		✓		Community Wastewater Division, Pollution Control Department	Year 2018
		✓		Water Quality Management Division, Pollution Control Department	Year 2018
		✓		U-Tapao Airport	Year 2019
		✓		Royal Thai Naval Air Division	Year 2019
3.7.2	Land use	✓		Rayong Office of Public Works and Town & Country Planning	Year 2017
		✓		Department of Public Works and Town & Country Planning, Chonburi Province	Year 2017
		✓		Division of Land Use Policy and Planning, Department of Land Development	2016 and 2018
			✓	Field Survey of Project	Year 2019
3.7.3	Transportation	✓		Office of Safety Administration, Department of Highways	Year 2014-2018
		✓		U-Tapao Airport	Year 2019
3.7.4	Public utilities and facilities	✓		Rayong Statistics Office	Year 2013-2017
		✓		4 year Local Development Plan, Phala Subdistrict	Year 2018-2021
		✓		U-Tapao International Airport Master Plan	December 2018
		✓		Provincial Waterworks Authority	Year 2014-2018
		✓		Water supply, Royal Thai Navy Concession Benefits	Year 2019
		✓		Electricity, Royal Thai Navy Concession Benefits	Year 2019
		✓		Royal Thai Naval Air Division	Year 2019
3.7.5	Drainage and flooding prevention systems	✓		Office of Space Technology Development and Information Assets (public organization)	Year 2005-2013
		✓		Information Technology Center, Bureau of Disaster Prevention and Mitigation, Ministry of Interior	Year 2005-2013
		✓		Rayong Provincial Disaster Prevention and Mitigation Division	Year 2015-2018
		✓		4 year Local Development Plan, Phala Subdistrict	Year 2018-2021
3.8	Quality of life value				
3.8.1	Socioeconomic	✓		Local Government Promotion Department	Year 2019
		✓		Department of Local Administration, Ministry of Interior	Year 2019
		✓		Sam Nak Thon Subdistrict Administrative Organization	Year 2019
		✓		Phlu Ta Luang Subdistrict Administrative Organization	Year 2019
		✓		Samaesarn Subdistrict Administrative Organization	Year 2019
		✓		Sam Nak Thon Subdistrict Municipality Office	Year 2019

Table 3.3-1 Summary of data sources used to analyze the current environment

Sequence No.	Environmental Issues	Secondary	Primary	Source of information	Year
		✓		Phala Subdistrict Municipality	Year 2019
		✓		Ban Chang Municipality	Year 2019
		✓		Ban Chang Subdistrict Municipality	Year 2019
		✓		Map Ta Phut Municipality	Year 2019
		✓		Huai Yai Subdistrict Municipality	Year 2019
		✓		Khao Chi Chan Subdistrict Municipality	Year 2019
		✓		Kled Kaew Subdistrict Municipality	Year 2019
		✓		Sattahip Municipality	Year 2019
		✓		Khet Udomsak Subdistrict Municipality	Year 2019
		✓		National Statistical Office of Thailand	Year 2019
			✓	Field Survey of Project	Year 2019-2020
3.8.2	Resettlement and replacement of assets		✓	Field Survey of Project	Year 2020
3.8.3	Health and Public Health	✓		Rayong Provincial Public Health Office	Year 2018
		✓		Chonburi Provincial Public Health Office	Year 2018
			✓	Field Survey of Project	Year 2019
3.8.4	Occupational health and safety	✓		U-Tapao Airport	Year 2019
3.8.5	Attractions and Sightseeing	✓		4 year Local Development Plan, Rayong Province	Year 2018-2021
		✓		4 year Local Development Plan, Chonburi Province	Year 2018-2021
3.8.6	Archaeological and historical sites	✓		Fine Arts Department	Year 2019

3.3.2 Field Survey of the Environmental Condition

An overview of the project's current environment data from field surveys, sampling and measuring the environmental quality. The details are shown in Table 3.3-2. Field survey environmental data and baseline environmental quality measurements such as noise level, vibration, air quality, surface water quality, marine water quality, terrestrial ecology and aquatic ecology have measurement results (Analysis Report) shown as detailed in Appendix 3 Results of Environmental Measurements.

Table 3.3-2 Overall Summary of Project Field Survey of the Environmental Condition

Environmental quality/resources	Implementation area	Method	Action Date
1. Physical environmental resources			
Noise	The area within a distance of not less than 6 kilometers to the east and west, and not less than 10 kilometers to the north and south of the project area boundary.	6 points of noise level measurement (measured for 7 continuous days)	Date 18-24 July 2019 Date 3-9 November 2019
	Additional measuring points at the Wat Sa Kaeo School area	1 point of noise level measurement (measured for 7 continuous days)	Date 3-9 November 2019
	Additional measurement points at the Center for the Development of Quality of Life for the Elderly, Sam Nak Thon Subdistrict Administration Organization	Measured the noise level, at 1 point (measured for 7 continuous days)	Dated 11-17 May 2021
Vibration	The area within a distance of not less than 6 kilometers to the east and west, and not less than 10 kilometers to the north and south of the project area boundary.	6 points of vibration measurement (measured for 7 continuous days)	Date 18-24 July 2019 Date 3-9 November 2019
	Additional measuring points at the Wat Sa Kaeo School area	1 points of vibration measurement (measured for 7 continuous days)	Date 3-9 November 2019
Air quality	to the east and west, up to not less than 6 kilometers and to the north and south up to not less than 10 kilometers of the project's area boundary.	6 points of atmospheric air quality measurement (measured for 7 continuous days)	Date 18-24 July 2019 Date 3-9 November 2019
	Additional measuring points at the Wat Sa Kaeo School area	1 point of atmospheric air quality measurement (measured for 7 continuous days)	Date 3-9 November 2019
Surface water quality	Khlong Bang Phai	3 points of physical, chemical, and biological characteristics of surface water quality measurement	Date 18 July 2019 Date 31 October 2019
	Additional measuring points at Khlong Phala	1 point of physical, chemical, and biological characteristics of surface water quality measurement	Date 31 October 2019
Marine water quality	Marine area to the South, Southeast, and Southwest of runways 1 and 2 are 300 and 500 meters away from the coast	6 points of physical, chemical, and biological characteristics of marine water quality measurement	Date 19 July 2019 Date 1 November 2019
2. Biological environmental resources			
Terrain Ecology	Outside the airport area and surrounding area of U-Tapao International Airport	Forest and wildlife resource survey	Date 19-22 July 2019 Date 15-18 November 2019
		Avian survey	Date 15-17 July 2019 Date 18-20 November 2019

Table 3.3□2 Overall Summary of Project Field Survey of the Environmental Condition

Environmental quality/resources	Implementation area	Method	Action Date
Aquatic ecology	Khlong Bang Phai	3 points of phytoplankton, zooplankton, benthos, aquatic plants and fish sample collection	Date 18 July 2019 Date 31 October 2019
	Additional measuring points at Khlong Phala	1 point of phytoplankton, zooplankton, benthos, aquatic plants and fish sample collection	Date 31 October 2019
Marine Ecology	Marine area to the South, Southeast, and Southwest of runways 1 and 2 are 300 and 500 meters away from the coast	6 points of phytoplankton, zooplankton, benthos, aquatic plants and fish sample collection	Date 19 July 2019 Date 1 November 2019
3. Human use value			
Land use	In the area of U-Tapao International Airport and in the study area surrounding the airport within the study area of the project	Land use	Date 9-20 September 2019
4. Quality of life value			
Socioeconomic	People residing within the study area of the project	Survey the field using questionnaire	Date 16 December 2019 - Date 15 March 2020 and Date: 6-13 June 2020
Resettlement and replacement of assets	Residents living in the contour of NEF ≥ 40 and NEF 30 - 40	Inspect buildings and structures in the field using the questionnaire and location record	6-24 January 2020 and 15-25 June 2020
Health and Public Health	People residing within the study area of the project	Survey the field using questionnaire	Date 16 December 2019 - Date 15 March 2020

3.4 Area sensitive to the impact of the project

From examining the current environment data in the study area of the project, it was found that there were 201 sensitive areas in total, namely 57 educational institutions, 69 religious sites, 18 medical institutions, and 57 communities. The details are shown in Table 3.4**-1** and Figure 3.4**-1**.

Table 3.4□1 Area sensitive to impacts within the study area

Sequence No.	Area sensitive to the impact	Address			Distance from airport boundary (km)		Distance from Runway 2 (km)	
		Subdistrict	District	Province	Border/fence	Closest building	Border/fence	Closest building
Educational institutions (57 sites)								
1	RTN. 6 Nursery Royal Thai Naval Air Division	Phala	Ban Chang	Rayong	located in the airport area	located in the airport area	1.42	1.43
2	Wat Phala School	Phala	Ban Chang	Rayong	1.04	1.05	2.62	2.63
3	Phala Subdistrict Municipality Child Development Center	Phala	Ban Chang	Rayong	1.30	1.31	2.88	2.89
4	Ban Khlong Sai School	Phala	Ban Chang	Rayong	1.57	1.58	3.03	3.04
5	Rayong English Program School	Phala	Ban Chang	Rayong	1.49	1.51	2.80	2.81
6	Rayong Garden International School	Phala	Ban Chang	Rayong	1.61	1.63	2.90	2.92
7	Ban Chang Municipality School 1 (Wat Khiri Pawanaram)	Phala	Ban Chang	Rayong	0.73	0.74	2.51	2.52

Table 3.4□1 Area sensitive to impacts within the study area

Sequence No.	Area sensitive to the impact	Address			Distance from airport boundary (km)		Distance from Runway 2 (km)	
		Subdistrict	District	Province	Border/fence	Closest building	Border/fence	Closest building
8	Wat Khiri Pawanaram School	Phala	Ban Chang	Rayong	0.78	0.79	2.57	2.58
9	Ban Khlong Bang Phai School	Sam Nak Thon	Ban Chang	Rayong	0.04	0.17	1.55	1.59
10	Pattanavechsuksa School	Sam Nak Thon	Ban Chang	Rayong	1.26	1.27	1.74	1.75
11	Pattanavech College	Sam Nak Thon	Ban Chang	Rayong	1.37	1.38	1.86	1.87
12	Saeng Song La Child Development Center 3	Sam Nak Thon	Ban Chang	Rayong	1.81	1.82	2.61	2.62
13	Wat Sa Kaeo School	Sam Nak Thon	Ban Chang	Rayong	1.90	1.95	2.72	2.73
14	Wat Sombun Naram School (Tem Rat Memorial)	Sam Nak Thon	Ban Chang	Rayong	4.86	4.88	6.24	6.26
15	Subdistrict Municipality Child Development Center Sam Nak Thon in Wat Sombun Naram School	Sam Nak Thon	Ban Chang	Rayong	4.86	4.88	6.24	6.26
16	Sajjaseuksa School	Sam Nak Thon	Ban Chang	Rayong	3.80	3.81	5.62	5.63
17	Ban Chang District Center for Non-Formal and Informal Education	Sam Nak Thon	Ban Chang	Rayong	5.06	5.07	6.82	6.83
18	Wat Suwan Rangsan Community School	Sam Nak Thon	Ban Chang	Rayong	4.95	4.97	6.75	6.76
19	Ban Yai Ra Child Development Center	Sam Nak Thon	Ban Chang	Rayong	5.00	5.01	6.79	6.80
20	Wat Samnak Kathon School	Sam Nak Thon	Ban Chang	Rayong	6.90	6.94	8.52	8.56
21	Ban Sam Nak Thon Child Development Center	Sam Nak Thon	Ban Chang	Rayong	6.94	6.95	8.57	8.58
22	Burapatit Child Development Center Sam Nak Thon SAO	Sam Nak Thon	Ban Chang	Rayong	9.55	9.56	11.16	11.17
23	Wat Chak Mak School	Sam Nak Thon	Ban Chang	Rayong	9.47	9.55	11.13	11.21
24	Saint Andrews International School Green Valley Rayong	Sam Nak Thon	Ban Chang	Rayong	10.54	10.58	12.36	12.40
25	Subdistrict Municipality Child Development Center Ban Chang (Phayun Center)	Ban Chang	Ban Chang	Rayong	3.66	3.67	5.14	5.15
26	Ban Phayun School	Ban Chang	Ban Chang	Rayong	3.66	3.67	5.14	5.15
27	Rakpasa Kindergarten	Ban Chang	Ban Chang	Rayong	3.20	3.21	4.59	4.60
28	Wat Ban Chang School (Boonrawdprachanukul)	Ban Chang	Ban Chang	Rayong	3.34	3.35	4.83	4.84
29	Ban Chang Subdistrict Municipality Child Development Center 3 (Ban Prachummit - Lor Kwien)	Ban Chang	Ban Chang	Rayong	5.81	5.82	6.94	6.95
30	Ban Chang Municipality Preschool (Ban Prachummit - Lor Kwien)	Ban Chang	Ban Chang	Rayong	5.81	5.82	6.94	6.95
31	Wat Prachummit Bamrung School	Ban Chang	Ban Chang	Rayong	6.23	6.24	7.55	7.56
32	Udom Wittayanukun School	Ban Chang	Ban Chang	Rayong	7.10	7.11	8.66	8.67

Table 3.4-1 Area sensitive to impacts within the study area

Sequence No.	Area sensitive to the impact	Address			Distance from airport boundary (km)		Distance from Runway 2 (km)	
		Subdistrict	District	Province	Border/fence	Closest building	Border/fence	Closest building
33	Mueang Ban Chang Municipality Child Development Center (Wat Noen Kraprok)	Ban Chang	Ban Chang	Rayong	6.99	6.99	8.59	8.59
34	Wat Noen Kraprok School	Ban Chang	Ban Chang	Rayong	6.99	6.99	8.59	8.59
35	Chonnabot Phatthana Kindergarten	Ban Chang	Ban Chang	Rayong	6.52	6.53	8.17	8.18
36	Aksorn Business Administration Technological College	Ban Chang	Ban Chang	Rayong	4.17	4.19	5.79	5.80
37	Banchang Karnchanakul Wittaya School	Ban Chang	Ban Chang	Rayong	3.74	3.76	5.57	5.59
38	Ban Khao Huai Mahat School	Ban Chang	Ban Chang	Rayong	8.23	8.26	10.04	10.07
39	Ban Phudon - Huai Mahat Child Development Center	Ban Chang	Ban Chang	Rayong	8.23	8.26	10.04	10.07
40	Ban Map Fakthong School	Huai Yai	Bang Lamung	Chonburi	13.10	13.11	13.74	13.75
41	Phuru Yor. Sor. Sor. 80 School	Na Jomtien	Sattahip	Chonburi	11.66	11.88	12.46	12.68
42	Khao Chi Chan School	Bang Sare	Sattahip	Chonburi	7.97	7.98	9.46	9.47
43	Ban Khalot Child Development Center	Phlu Ta Luang	Sattahip	Chonburi	1.13	1.13	3.12	3.12
44	Ban Khalot School	Phlu Ta Luang	Sattahip	Chonburi	0.98	0.99	3.15	3.16
45	Phlu Ta Luang Wittaya School	Phlu Ta Luang	Sattahip	Chonburi	2.93	2.95	4.46	4.48
46	Athittan Kindergarten School	Phlu Ta Luang	Sattahip	Chonburi	3.66	3.67	4.49	4.50
47	Phlu Ta Luang SAO Child Development Center 2, Ban Khao Bai Si	Phlu Ta Luang	Sattahip	Chonburi	4.88	4.90	5.41	5.44
48	Ban Khao Bai Si School	Phlu Ta Luang	Sattahip	Chonburi	4.88	4.94	5.46	5.49
49	Chaleo-Pavana Memorial School (Chonburi Special Education)	Phlu Ta Luang	Sattahip	Chonburi	5.72	5.73	6.33	6.34
50	Ban KM. 5 School	Phlu Ta Luang	Sattahip	Chonburi	4.97	4.97	6.62	6.62
51	Royal Thai Fleet Sattahip District School	Sattahip	Sattahip	Chonburi	6.74	6.75	8.26	8.27
52	RTN. 8 Nursery	Sattahip	Sattahip	Chonburi	6.04	6.08	7.74	7.78
53	Juk Samet School	Sattahip	Sattahip	Chonburi	6.12	6.13	7.82	7.83
54	Juk Samet Child Development Center	Sattahip	Sattahip	Chonburi	6.28	6.29	7.99	8.00
55	Ban Chong Samaesarn Child Development Center	Samaesarn	Sattahip	Chonburi	6.87	6.88	8.52	8.53
56	Samaesarn Subdistrict NFE Center	Samaesarn	Sattahip	Chonburi	6.99	6.99	8.61	8.61
57	Ban Chong Samae San School	Samaesarn	Sattahip	Chonburi	6.61	6.64	8.23	8.26
Religious sites (69 sites)								
1	Wat Phala Vipassana Office	Phala	Ban Chang	Rayong	0.95	0.96	2.47	2.48
2	Wat Phala	Phala	Ban Chang	Rayong	1.18	1.19	2.51	2.52
3	Chao Li Hu Ong Yea Shrine	Phala	Ban Chang	Rayong	0.19	0.24	0.84	0.89
4	Wat Khlong Sai	Phala	Ban Chang	Rayong	1.03	1.04	1.64	1.65
5	Wat Khiri Pawanaram	Phala	Ban Chang	Rayong	0.87	0.87	1.63	1.63
6	Ban Chang Christ Church	Phala	Ban Chang	Rayong	1.41	1.42	2.20	2.21
7	Ban Chang Church	Phala	Ban Chang	Rayong	1.80	1.80	2.54	2.54

Table 3.4-1 Area sensitive to impacts within the study area

Sequence No.	Area sensitive to the impact	Address			Distance from airport boundary (km)		Distance from Runway 2 (km)	
		Subdistrict	District	Province	Border/fence	Closest building	Border/fence	Closest building
8	Wat Ban Khlong Bang Phai	Sam Nak Thon	Ban Chang	Rayong	0.04	0.08	1.46	1.49
9	Admiral Prince Abhakara Kiartivongse Monument	Sam Nak Thon	Ban Chang	Rayong	in the airport	in the airport	1.33	1.34
10	National Naval Aviation Museum	Sam Nak Thon	Ban Chang	Rayong	in the airport	in the airport	1.24	1.27
11	The Royal Monument of King Taksin the Great (Air Defense Regiment 1)	Sam Nak Thon	Ban Chang	Rayong	0.09	0.09	1.01	1.01
12	Somdej Ong Phra Pathom (Air Defense Regiment 1)	Sam Nak Thon	Ban Chang	Rayong	0.15	0.17	0.66	0.68
13	Admiral Prince Abhakara Kiartivongse Monument (Air Defense Regiment 1)	Sam Nak Thon	Ban Chang	Rayong	0.07	0.07	0.55	0.55
14	Admiral Prince Abhakara Kiartivongse Monument (Air Defense Artillery Battalion)	Sam Nak Thon	Ban Chang	Rayong	0.09	0.10	0.09	0.10
15	Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)	Sam Nak Thon	Ban Chang	Rayong	0.04	0.05	0.04	0.05
16	Phra Siam Devadhiraj Shrine (Air Defense Artillery Battalion)	Sam Nak Thon	Ban Chang	Rayong	0.11	0.12	0.18	0.19
17	Wat Sa Kaeo	Sam Nak Thon	Ban Chang	Rayong	1.72	1.77	1.72	1.77
18	The Shrine of King Taksin the Great (at the foot of Khao Khrok Tabak)	Sam Nak Thon	Ban Chang	Rayong	4.93	4.96	5.07	5.10
19	Wat Sombun Naram	Sam Nak Thon	Ban Chang	Rayong	4.93	4.96	5.07	5.10
20	Ban Chang Abundant Grace Church	Sam Nak Thon	Ban Chang	Rayong	6.12	6.12	6.38	6.38
21	Wat Samnak Katon	Sam Nak Thon	Ban Chang	Rayong	6.78	6.79	7.14	7.15
22	Wat Suwan Rangsan	Sam Nak Thon	Ban Chang	Rayong	5.00	5.01	5.56	5.57
23	Wat Nong Bot	Sam Nak Thon	Ban Chang	Rayong	7.31	7.52	7.81	8.05
24	The Shrine of Luang Tia Chak Mak	Sam Nak Thon	Ban Chang	Rayong	9.21	9.23	9.63	9.65
25	Wat Chak Mak	Sam Nak Thon	Ban Chang	Rayong	9.29	9.30	9.70	9.73
26	The Shrine of Luang Tia Ban Phayun	Ban Chang	Ban Chang	Rayong	4.18	4.20	4.87	4.89
27	The Shrine of King Taksin the Great (Ban Chang)	Ban Chang	Ban Chang	Rayong	4.10	4.11	4.79	4.80
28	Wat Chontharam (Phayun)	Ban Chang	Ban Chang	Rayong	3.64	3.65	4.28	4.29
29	Masjid Dawatul Islam	Ban Chang	Ban Chang	Rayong	2.79	2.79	3.45	3.45
30	Chinese shrine at the Buddha Dhamma Foundation	Ban Chang	Ban Chang	Rayong	3.59	3.60	4.34	4.35
31	The Shrine of Luang Tia Ban Chang	Ban Chang	Ban Chang	Rayong	3.24	3.25	3.82	3.83
32	The Shrine of Laoia Guan Yu Ban Chang	Ban Chang	Ban Chang	Rayong	3.26	3.27	3.92	3.93
33	Wat Ban Chang	Ban Chang	Ban Chang	Rayong	3.22	3.24	3.90	3.92
34	Wat Prachummit Bamrung	Ban Chang	Ban Chang	Rayong	6.30	6.31	6.71	6.72

Table 3.4□1 Area sensitive to impacts within the study area

Sequence No.	Area sensitive to the impact	Address			Distance from airport boundary (km)		Distance from Runway 2 (km)	
		Subdistrict	District	Province	Border/fence	Closest building	Border/fence	Closest building
35	The Shrine of Luang Tia Noen Kraprok 1	Ban Chang	Ban Chang	Rayong	6.80	6.81	7.34	7.35
36	The Shrine of Luang Tia Noen Kraprok 2	Ban Chang	Ban Chang	Rayong	6.84	6.85	7.54	7.55
37	Wat Noen Kraprok	Ban Chang	Ban Chang	Rayong	6.90	6.91	7.63	7.64
38	Wat Phudon Nim Sanoh	Ban Chang	Ban Chang	Rayong	7.94	7.97	8.67	8.70
39	Church of Christ Ban Chang	Ban Chang	Ban Chang	Rayong	7.85	7.85	8.56	8.56
40	Anek Kusala Sala (Viharn Sien)	Huai Yai	Bang Lamung	Chonburi	10.91	10.92	11.04	11.05
41	Wat Yan Nasangwararam Woramahawiharn	Huai Yai	Bang Lamung	Chonburi	10.97	11.00	11.08	11.11
42	Sirisirirak Monastery	Huai Yai	Bang Lamung	Chonburi	11.44	11.45	11.44	11.45
43	Anan Buraparam Meditation Center	Huai Yai	Bang Lamung	Chonburi	11.95	11.96	11.95	11.69
44	Wat Map Fakthong	Huai Yai	Bang Lamung	Chonburi	13.17	13.18	13.17	13.18
45	Khao Chi Chan Image of Lord Buddha	Na Jomtien	Sattahip	Chonburi	8.72	8.72	9.08	9.08
46	Wat Khao Chi Chan	Bang Sare	Sattahip	Chonburi	6.63	6.63	7.42	7.42
47	Rat Samakkhi Temple	Phlu Ta Luang	Sattahip	Chonburi	0.92	0.94	2.99	3.01
48	The Shrine of Chao Mae Kuan Im	Phlu Ta Luang	Sattahip	Chonburi	0.98	0.99	3.22	3.23
49	The Monument of Somdej Phra Mahitalathibet Adulyadej Vikrom Boromrajchanok and Somdej Phra Srinakarindra Boromarajonani	Phlu Ta Luang	Sattahip	Chonburi	0.47	0.48	2.69	2.70
50	Prakai Dhamma Meditation Center	Phlu Ta Luang	Sattahip	Chonburi	4.16	4.15	5.81	5.82
51	KM.8 Meditation Center	Phlu Ta Luang	Sattahip	Chonburi	2.67	2.72	4.65	4.73
52	Wat Rangsee Sunthorn (KM.5)	Phlu Ta Luang	Sattahip	Chonburi	5.02	5.04	6.67	6.69
53	Bodhipiya Monastery (Dhammayut), Bodhi Samphan Branch	Phlu Ta Luang	Sattahip	Chonburi	4.97	4.97	7.34	7.34
54	Sattahip Meditation Center (Bandai Kaew)	Phlu Ta Luang	Sattahip	Chonburi	5.04	5.05	7.40	7.41
55	Wat Tung Prong	Phlu Ta Luang	Sattahip	Chonburi	5.91	5.92	8.20	8.21
56	Khao Phlu Ta Luang Meditation Center	Phlu Ta Luang	Sattahip	Chonburi	2.12	2.21	4.22	4.30
57	His Majesty's Admiral Prince Abhakara Kiartivongse's Court	Phlu Ta Luang	Sattahip	Chonburi	2.06	2.09	4.03	4.05
58	Wat Khao Bai Si Santitham	Phlu Ta Luang	Sattahip	Chonburi	4.69	4.75	4.69	4.75
59	Welu Amphawan Vipassana Office	Phlu Ta Luang	Sattahip	Chonburi	4.96	4.97	4.96	4.97
60	The Royal Monument of His Majesty King Bhumibol Adulyadej Phra Nang Klao Chao Yu Hua, Rama 3	Sattahip	Sattahip	Chonburi	3.81	3.84	5.59	5.62
61	The Royal Monument of His Majesty King Bhumibol Adulyadej Phra Mongkut Klao Chao Yu Hua, Rama 6	Sattahip	Sattahip	Chonburi	4.05	4.12	5.68	5.75
62	Samaesarn Pattanakarn Church	Samaesarn	Sattahip	Chonburi	4.43	4.44	6.34	6.35

Table 3.4□1 Area sensitive to impacts within the study area

Sequence No.	Area sensitive to the impact	Address			Distance from airport boundary (km)		Distance from Runway 2 (km)	
		Subdistrict	District	Province	Border/fence	Closest building	Border/fence	Closest building
63	His Majesty Admiral Prince Abhakara Kiartivongse's Court (Samaesarn)	Samaesarn	Sattahip	Chonburi	5.38	5.38	7.13	7.13
64	Wat Chong Samaesarn	Samaesarn	Sattahip	Chonburi	6.79	6.80	8.66	8.67
65	Viharn Luang Por Dam	Samaesarn	Sattahip	Chonburi	7.16	7.16	8.95	8.95
66	The Shrine of King Taksin the Great (Samaesarn)	Samaesarn	Sattahip	Chonburi	7.34	7.35	9.23	9.24
67	Thai Island and Sea Natural History Museum	Samaesarn	Sattahip	Chonburi	7.26	7.29	9.16	9.19
68	Phra Phutthasinghanatara Navy Hall (Naval Special Warfare Command)	Samaesarn	Sattahip	Chonburi	7.47	7.47	9.26	9.26
69	The Royal Monument of King Taksin the Great (Naval Special Warfare Command)	Samaesarn	Sattahip	Chonburi	7.47	7.47	9.28	9.28
Healthcare facilities (18 sites)								
1	Eastern-Nong Muang Community Health Service Center	Phala	Ban Chang	Rayong	0.09	0.09	1.46	1.46
2	Phala Subdistrict Health Promotion Hospital	Phala	Ban Chang	Rayong	1.31	1.31	2.86	2.86
3	Ban Chang Hospital	Phala	Ban Chang	Rayong	2.41	2.44	4.20	4.22
4	Ban Khlong Bang Phai Subdistrict Health Promotion Hospital	Sam Nak Thon	Ban Chang	Rayong	0.85	0.85	1.48	1.48
5	Ban Sa Kaeo Subdistrict Health Promotion Hospital	Sam Nak Thon	Ban Chang	Rayong	1.87	1.87	2.62	2.62
6	Ban Khao Khrok Subdistrict Health Promotion Hospital	Sam Nak Thon	Ban Chang	Rayong	3.94	3.95	5.20	5.21
7	Health Promotion Hospital Ban Yai Ra Subdistrict	Sam Nak Thon	Ban Chang	Rayong	4.96	4.96	6.76	6.76
8	Sam Nak Thon Subdistrict Health Promotion Hospital	Sam Nak Thon	Ban Chang	Rayong	6.69	6.71	8.19	8.22
9	Ban Chak Mak Subdistrict Health Promotion Hospital	Sam Nak Thon	Ban Chang	Rayong	9.57	9.57	11.20	11.20
10	Ban Phayun Subdistrict Health Promotion Hospital	Ban Chang	Ban Chang	Rayong	3.77	3.77	5.25	5.25
11	Public Health Service Center 2 Ban Chang Municipality (Tassanee Center)	Ban Chang	Ban Chang	Rayong	7.80	7.80	9.31	9.31
12	Phudon Huai Mahat Community Health Service Unit	Ban Chang	Ban Chang	Rayong	7.92	7.96	9.74	9.77
13	Wat Yan Nasangwararam Hospital	Huai Yai	Bang Lamung	Chonburi	11.31	11.35	11.88	11.92
14	Somdej Phra Sangkharat Yanasangwon Hospital for the Elderly, Chonburi	Huai Yai	Bang Lamung	Chonburi	11.52	11.52	12.08	12.08
15	Ban Khong Wanphen Subdistrict Health Promotion Hospital	Bang Sare	Sattahip	Chonburi	7.92	7.92	9.39	9.39
16	Queen Sirikit Naval Hospital, Royal Thai Navy Medical Department	Phlu Ta Luang	Sattahip	Chonburi	0.02	0.10	1.91	2.01
17	Sattahip Hospital KM.10	Phlu Ta Luang	Sattahip	Chonburi	1.17	1.18	3.46	3.48
18	Ban Chong Samaesarn Subdistrict Health Promotion Hospital	Samaesarn	Sattahip	Chonburi	6.97	6.97	8.59	8.59

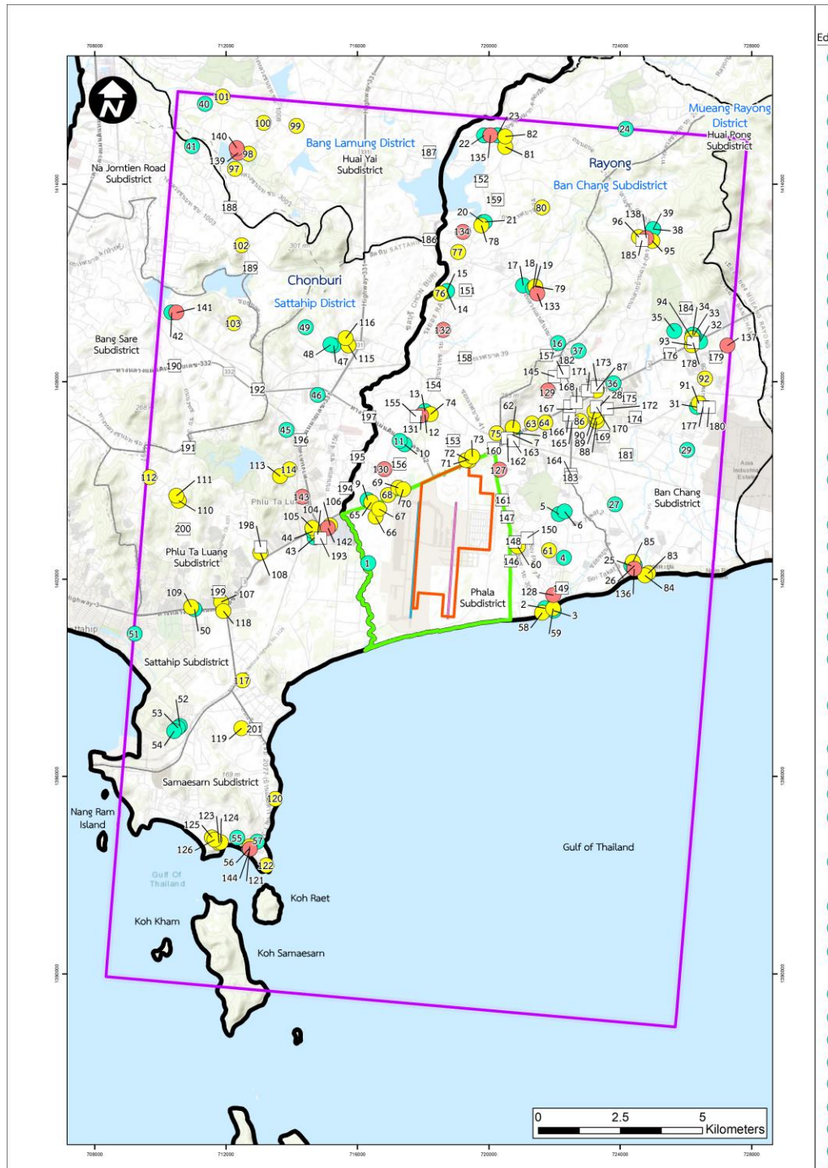
Table 3.4-1 Area sensitive to impacts within the study area

Sequence No.	Area sensitive to the impact	Address			Distance from airport boundary (km)		Distance from Runway 2 (km)	
		Subdistrict	District	Province	Border/fence	Closest building	Border/fence	Closest building
Community sites (57 sites)								
1	Village No. 1 Ban Sakulthong	Phala	Ban Chang	Rayong	2.92	2.92	4.71	4.71
2	Village No. 2, Ban Kilo 16	Phala	Ban Chang	Rayong	0.02	0.02	1.50	1.50
3	Village No. 4, Ban Tung Prong	Phala	Ban Chang	Rayong	0.02	0.02	1.29	1.29
4	Village No. 5, Phala Subdistrict	Phala	Ban Chang	Rayong	0.16	0.16	1.57	1.57
5	Village No. 6, Ban Takat	Phala	Ban Chang	Rayong	1.58	1.58	3.11	3.11
6	Village No. 7, Ban Khlong Sai	Phala	Ban Chang	Rayong	0.53	0.53	1.94	1.94
7	Village No. 1 Ban Sam Nak Thon	Sam Nak Thon	Ban Chang	Rayong	4.95	4.95	6.45	6.45
8	Village No. 2, Ban Chak Mak	Sam Nak Thon	Ban Chang	Rayong	8.21	8.21	9.81	9.81
9	Village No. 3, Ban Sa Kaeo	Sam Nak Thon	Ban Chang	Rayong	0.80	0.80	1.87	1.87
10	Sa Kaeo Community 1	Sam Nak Thon	Ban Chang	Rayong	2.59	2.59	3.59	3.59
11	Sa Kaeo Community 2	Sam Nak Thon	Ban Chang	Rayong	1.93	1.93	2.61	2.61
12	Village No. 4, Ban Khlong Bang Phai	Sam Nak Thon	Ban Chang	Rayong	0.82	0.82	1.32	1.32
13	Village No. 5, Ban Yai Ra	Sam Nak Thon	Ban Chang	Rayong	3.32	3.32	5.13	5.13
14	Village No. 6, Ban Khao Khrok	Sam Nak Thon	Ban Chang	Rayong	2.95	2.95	4.40	4.40
15	Village no. 7, Ban Nong Takhian	Sam Nak Thon	Ban Chang	Rayong	7.64	7.64	9.28	9.28
16	Village No. 8, Ban Cherng Khao	Sam Nak Thon	Ban Chang	Rayong	0.06	0.06	1.88	1.88
17	Eastern-Nong Muang Community	Ban Chang	Ban Chang	Rayong	0.02	0.02	1.12	1.12
18	Wat Khiri Pawanaram Community	Ban Chang	Ban Chang	Rayong	0.58	0.58	2.38	2.38
19	Ban Chang-Phala Community	Ban Chang	Ban Chang	Rayong	0.68	0.68	2.41	2.41
20	Ruam Sompong Community	Ban Chang	Ban Chang	Rayong	2.23	2.23	3.32	3.32
21	Ming Mongkol Community	Ban Chang	Ban Chang	Rayong	2.55	2.55	4.08	4.08
22	Jor Koo Community	Ban Chang	Ban Chang	Rayong	2.55	2.55	4.16	4.16
23	Wirat Phatthana Department Store Community	Ban Chang	Ban Chang	Rayong	2.69	2.69	4.34	4.34
24	Thep Chinda Community	Ban Chang	Ban Chang	Rayong	2.92	2.92	4.57	4.57
25	Health Park Community	Ban Chang	Ban Chang	Rayong	3.34	3.34	4.68	4.68
26	Wat Ban Chang Community	Ban Chang	Ban Chang	Rayong	3.42	3.42	4.97	4.97
27	Dong Dang Community	Ban Chang	Ban Chang	Rayong	3.40	3.40	5.06	5.06
28	Night Market Community	Ban Chang	Ban Chang	Rayong	3.69	3.69	5.19	5.19
29	Ruam Mitr Community	Ban Chang	Ban Chang	Rayong	3.71	3.71	5.37	5.37
30	Ban Chang - Noen Kraprok Community	Ban Chang	Ban Chang	Rayong	4.43	4.43	5.80	5.80
31	Dao Pitak Community	Ban Chang	Ban Chang	Rayong	4.45	4.45	5.95	5.95
32	Taiwa Community	Ban Chang	Ban Chang	Rayong	6.12	6.12	7.70	7.70
33	East Ban Noen Kraprok Community Prachummit	Ban Chang	Ban Chang	Rayong	6.50	6.50	7.81	7.81
34	Ban Noen Kraprok Community	Ban Chang	Ban Chang	Rayong	6.91	6.91	8.49	8.49
35	Nong Yai Community	Ban Chang	Ban Chang	Rayong	7.34	7.34	8.83	8.83

Table 3.4-1 Area sensitive to impacts within the study area

Sequence No.	Area sensitive to the impact	Address			Distance from airport boundary (km)		Distance from Runway 2 (km)	
		Subdistrict	District	Province	Border/fence	Closest building	Border/fence	Closest building
36	Village No. 1, Pan Din Tai	Ban Chang	Ban Chang	Rayong	6.67	6.67	7.97	7.97
37	Village No. 2, Ban Prachummit	Ban Chang	Ban Chang	Rayong	3.98	3.98	5.14	5.14
38	Village No. 3, Ban Noen Samre	Ban Chang	Ban Chang	Rayong	3.21	3.21	4.99	4.99
39	Village No. 4, Ban Phayun	Ban Chang	Ban Chang	Rayong	2.22	2.22	3.32	3.32
40	Village No. 6, Ban Noen Kraprok	Ban Chang	Ban Chang	Rayong	7.29	7.29	8.96	8.96
41	Village No. 7, Ban Khao Phudon Huai Mahat	Ban Chang	Ban Chang	Rayong	7.84	7.84	9.65	9.65
42	Village No. 11, Ban Map Fakthong	Huai Yai	Bang Lamung	Chonburi	6.71	6.71	8.00	8.00
43	Village No. 13, Ban Nong Phakkut	Huai Yai	Bang Lamung	Chonburi	9.28	9.28	10.64	10.64
44	Village No. 6, Khao Chi Chan Subdistrict Municipality	Na Jomtien	Sattahip	Chonburi	9.94	9.94	10.68	10.68
45	Village No. 7, Khao Chi Chan Subdistrict Municipality	Na Jomtien	Sattahip	Chonburi	7.99	7.99	8.80	8.80
46	Village No. 6 (Ban Khao Krating Community)	Bang Sare	Sattahip	Chonburi	6.80	6.80	8.54	8.54
47	Village No. 7 (Ban Nong Hin Community)	Bang Sare	Sattahip	Chonburi	5.07	5.07	7.23	7.23
48	Village No. 11 (Ban Khong Wanphen Community)	Bang Sare	Sattahip	Chonburi	4.58	4.58	6.02	6.02
49	Village No. 1, Ban Phlu Ta Luang	Phlu Ta Luang	Sattahip	Chonburi	0.98	0.98	2.94	2.94
50	Village No. 2, Ban Khalot	Phlu Ta Luang	Sattahip	Chonburi	0.71	0.71	2.29	2.29
51	Village No. 3, Ban Khlong Phai	Phlu Ta Luang	Sattahip	Chonburi	1.52	1.52	2.34	2.34
52	Village No. 4, Ban Khlong Phlu Ta Luang	Phlu Ta Luang	Sattahip	Chonburi	2.60	2.60	4.11	4.11
53	Village No. 5, Ban Khao Bai Si	Phlu Ta Luang	Sattahip	Chonburi	2.50	2.50	3.01	3.01
54	Village No. 6, Ban Khao Tabaek	Phlu Ta Luang	Sattahip	Chonburi	2.66	2.66	4.73	4.73
55	Village No. 7, Ban Nong Ya Noi	Phlu Ta Luang	Sattahip	Chonburi	4.24	4.24	5.93	5.93
56	Village No. 8, Ban Nong Ya	Phlu Ta Luang	Sattahip	Chonburi	4.83	4.83	7.12	7.12
57	Ban Nong Krachong Community	Samaesarn	Sattahip	Chonburi	4.10	4.10	5.84	5.84

Note : (-) indicates that the boundary of the fence is unknown



Educational Institution

1. Early Childhood Daycare, RTN 6, Royal Thai Naval Air Division
2. Wat Phala School
3. Phala Subdistrict Municipality Child Development Center
4. Ban Khlong Sai School
5. Rayong English Program School
6. Rayong Garden International School
7. Ban Chang Municipality School 1 (Wat Khiri Pawanaram)
8. Wat Khiri Pawanaram School
9. Ban Khlong Bang Phai School
10. Pattanavechsuksa School
11. Pattanavech College
12. Saeng Song La Child Development Center 3
13. Wat Sa Kaeo School
14. Wat Sombun Naram School (Tem Rat Memorial)
15. Sam Nak Thon Subdistrict Municipality Child Development Center in Wat Sombun Naram School
16. Sajjaseuksa School
17. Ban Chang District Center for Non-Formal and Informal Education
18. Wat Suwan Rangsan Community School
19. Ban Yai Ra Child Development Center
20. Wat Sam Nak Thon School
21. Ban Sam Nak Thon Child Development Center
22. Burapatit Child Development Center, Sam Nak Thon SAO
23. Wat Chak Mak School
24. St. Andrews International School, Green Valley, Rayong,
25. Ban Chang Subdistrict Municipality Child Development Center (Phayun Center)
26. Ban Phayun School
27. Rakpasa Kindergarten
28. Wat Ban Chang School (Boonrawdprachanukul)
29. Ban Chang Subdistrict Municipality Child Development Center 3 (Ban Prachummit - Lor Kwien)
30. Ban Chang Municipality Kindergarten (Ban Prachummit - Lor Kwien)
31. Wat Prachummit Bamrung School
32. Udom Wittayanukun School
33. Mueang Ban Chang Municipality Child Development Center (Wat Noen Kraprok)
34. Wat Noen Kraprok School
35. Chonnabot Phatthana Kindergarten
36. Aksorn Business Administration Technological College
37. Banchang Karnchanakul Wittaya School
38. Ban Khao Huai Mahat School
39. Ban Phudon - Huai Mahat Child Development Center
40. Ban Map Fakthong School
41. Phuru Yor. Sor. Sor. 80 School
42. Khao Chi Chan School
43. Ban Khalot Child Development Center
44. Ban Khalot School
45. Phlu Ta Luang Wittaya School
46. Athittan Kindergarten School
47. Phlu Ta Luang SAO Child Development Center 2, Ban Khao Bai Si
48. Ban Khao Bai Si School
49. Chaleo-Pavana Memorial School (Chonburi Special Education)
50. Ban KM. 5 School
51. Royal Thai Fleet Sattahip District School
52. RTN. 8 Nursery
53. Juk Samet School
54. Juk Samet Child Development Center
55. Ban Chong Samaesarn Child Development Center
56. Samaesarn Subdistrict NFE Center
57. Ban Chong Samae San School

Religious Sites

58. Wat Phala Vipassana Office
59. Wat Phala
60. Chao Li Hu Ong Yea Shrine
61. Wat Khlong Sai
62. Wat Khiri Pawanaram
63. Ban Chang Christ Church
64. Ban Chang Church
65. Wat Ban Khlong Bang Phai
66. Admiral Prince Abhakara Kiartivongse Monument
67. National Naval Aviation Museum
68. The Royal Monument of King Taksin the Great (Air Defense Regiment 1)
69. Somdej Ong Phra Pathom (Air Defense Regiment 1)
70. Admiral Prince Abhakara Kiartivongse Monument (Air Defense Regiment 1)
71. Admiral Prince Abhakara Kiartivongse Monument (Air Defense Artillery Battalion)
72. Phra Phuttha Nawikapiban Hall (Air Defense Artillery Battalion)
73. Phra Siam Devadhiraj Shrine (Air Defense Artillery Battalion)
74. Wat Sa Kaeo
75. The Shrine of King Taksin the Great (at the foot of Khao Khrok Tabak)
76. Wat Sombun Naram
77. Ban Chang Abundant Grace Church
78. Wat Samnak Katon
79. Wat Suwan Rangsan
80. Wat Nong Bot
81. The Shrine of Luang Tia Chak Mak
82. Wat Chak Mak
83. The Shrine of Luang Tia Ban Phayun
84. The Shrine of King Taksin the Great (Ban Chang)
85. Wat Chonthararam (Phayun)
86. Masjid Dawatul Islam
87. Chinese shrine at the Buddha Dhamma Foundation
88. The Shrine of Luang Tia Ban Chang
89. The Shrine of Laoia Guan Yu Ban Chang
90. Wat Ban Chang
91. Wat Prachummit Bamrung
92. The Shrine of Luang Tia Noen Kraprok 1
93. The Shrine of Luang Tia Noen Kraprok 2
94. Wat Noen Kraprok
95. Wat Phudon Nim Sanoh
96. Church of Christ Ban Chang
97. Anek Kusala Sala (Viharn Sien)
98. Wat Yan Nasangwararam
99. Sirisirirak Monastery
100. Anan Buraparam Meditation Center
101. Wat Map Fakthong
102. Khao Chi Chan Image of Lord Buddha
103. Wat Khao Chi Chan
104. Rat Samakkhi Temple
105. The Shrine of Chao Mae Kuan Im
106. The Monument of Somdej Phra Mahitalathibet Adulyadej Vikrom Boromrajchanok and Somdej Phra Srinakarindra Boromarajonani
107. Prakai Dhamma Meditation Center
108. KM.8 Meditation Center
109. Wat Rangsee Sunthorn (KM.5)
110. Bodhiplya Monastery (Dhammayut), Bodhi Samphan Branch
111. Sattahip Meditation Center (Khao Bandai Kaew)
112. Wat Tung Prong
113. Khao Phlu Ta Luang Meditation Center
114. His Majesty's Admiral Prince Abhakara Kiartivongse's Court
115. Wat Khao Bai Si Santitham
116. Welu Amphawan Vipassana Center
117. The Royal Monument of His Majesty King Bhumibol Adulyadej Phra Nang Klao Chao Yu Hua, Rama 3
118. The Royal Monument of His Majesty King Bhumibol Adulyadej Phra Mongkut Klao Chao Yu Hua, Rama 6
119. Samaesarn Pattanakarn Church
120. His Majesty Admiral Prince Abhakara Kiartivongse's Court (Samaesarn)
121. Wat Chong Samaesarn
122. Viharn Luang Por Dam
123. The Shrine of King Taksin the Great (Samaesarn)
124. Thai Island and Sea Natural History Museum
125. Phra Phutthasinghanatara Navy Hall (Naval Special Warfare Command)
126. The Royal Monument of King Taksin the Great (Naval Special Warfare Command)

Medical Institution

127. Eastern-Nong Muang Public Health Service Center
128. Phala Subdistrict Health Promotion Hospital
129. Ban Chang Hospital
130. Ban Khlong Phai Subdistrict Health Promotion Hospital
131. Ban Sa Kaeo Subdistrict Health Promotion Hospital
132. Ban Khao Khrok Subdistrict Health Promotion Hospital
133. Ban Yai Ra Subdistrict Health Promotion Hospital
134. Sam Nak Thon Subdistrict Health Promotion Hospital
135. Ban Chak Mak Subdistrict Health Promotion Hospital
136. Ban Phayun Subdistrict Health Promotion Hospital
137. Public Health Service Center 2 Ban Chang Municipality (Tassanee Center)
138. Phudon Huai Mahat Community Health Service Unit
139. Wat Yan Nasangwararam Hospital
140. somdej Phra Sangkharat Yanasangwon Hospital for the Elderly, Chonburi
141. Ban Khong Wanphen Subdistrict Health Promotion Hospital
142. Queen Sirikit Naval Hospital
143. Sattahip Hospital KM.10
144. Ban Chong Samaesarn Subdistrict Health Promotion Hospital

Community

145. Village No. 1, Ban Sakulthong
146. Village No. 2, Ban Kilo 16
147. Village No. 4, Ban Tung Prong
148. Village No. 5, Phala Subdistrict
149. Village No. 6, Ban Takat
150. Village No. 7, Ban Khlong Sai
151. Village No. 1, Ban Sam Nak Thon
152. Village No. 2, Ban Chak Mak
153. Village No. 3, Ban Sa Kaeo
154. Sa Kaeo Community 1
155. Sa Kaeo Community 2
156. Village No. 4, Ban Khlong Phai
157. Village No. 7, Ban Yai Ra
158. Village No. 6, Ban Khao Khrok
159. Village no. 7, Ban Nong Takhian
160. Village No. 8, Ban Cherng Khao
161. Eastern-Nong Muang Community
162. Wat Khiri Pawanaram Community
163. Ban Chang-Phala Community
164. Ruam Sompong Community
165. Ming Monkol Community
166. Jor Koo Community
167. Wirat Phatthana Department Store Community
168. Thep Chinda Community
169. Health Park Community
170. Wat Ban Chang Community
171. Dong Dang Community
172. Night Market Community
173. Ruam Mitr Community
174. Ban Chang - Noen Kraprok Community
175. Dao Pitak Community
176. Taiwa Community
177. East Ban Noen Kraprok Community, Prachummit
178. Ban Noen Kraprok Community
179. Nong Yai Community
180. Village No. 1, Pan Din Tai
181. Village No. 2, Ban Prachummit
182. Village No. 3, Ban Noen Samre
183. Village No. 4, Ban Phayun
184. Village No. 6, Ban Noen Kraprok
185. Village No. 7, Ban Khao Phudon Huai Mahat
186. Village No. 11, Ban Map Fakthong
187. Village No. 13, Ban Nong Phakkut
188. Village No. 6, Khao Chi Chan Subdistrict Municipality
189. Village No. 7, Khao Chi Chan Subdistrict Municipality
190. Village No. 6 (Ban Khao Krating Community)
191. Village No. 7 (Ban Nong Hin Community)
192. Village No. 11 (Ban Khong Wanphen Community)
193. Village No. 1, Ban Phlu Ta Luang
194. Village No. 2, Ban Khalot
195. Village No. 3, Ban Khlong Phai
196. Village No. 4, Ban Phlu Ta Luang
197. Village No. 5, Ban Khao Bai Si
198. Village No. 6, Ban Khao Tabaek
199. Village No. 7, Ban Nong Ya Noi
200. Village No. 8, Ban Nong Ya
201. Ban Nong Krachong Community

Provincial zone
District border
Subdistrict border
Runway 1 (Current)
Runway 2
Airport extension area (project area)
U-Tapao International Airport area
Project study area

Figure 3.4-1 Area sensitive to impacts within the study area

3.5 Physical environmental resources

3.5.1 Noise

3.5.1.1 Study Methods

(1) Secondary data

Collecting noise level information in the vicinity of the Office of Air Quality and Noise Management, Pollution Control Department study area during the year 2014-2018.

(2) Primary data

Perform noise level measurements as follows:

- Measurement points and measurement period Two instances of noise level monitoring (measured 24 hours a day continuously over 7 days). The first measurement was taken during rainy season, between 18-24 July 2019, at 6 locations comprising Pattanavechsuksa School, the staff operation building area, the project airside area, Wat Khiri Pawanaram School, Wat Phala School, Ban Khlong Bang Phai School, and Wat Sa Kaeo School. The second measurement was taken during the dry season, between 3-9 November 2019, at 7 locations, with 1 additional location at Wat Sa Kaeo School (Added according to public opinion in the first hearing, including consideration of the impact from project operations), which is a sensitive area that may be affected by the take-off and landing of aircraft. Measurement points were added around the Center for the Development of Quality of Life for the Elderly, Sam Nak Thon Subdistrict Administration Organization, as noise level monitoring point nears Runway 2 and in the NEF area ≥ 40. The noise level needs to be measured prior to runway 2 opening as a basis for comparison in the case of no flights, with measurements taken during 11-17 May 2021. Details are shown in Table 3.5-1 and Figure 3.5-1, with the installation of instruments as shown in Figure 3.5-2
- Measurement index
  - General noise levels include 5-minute average noise level ($L_{eq\ 5\ min}$), 1-hour average noise level ($L_{eq\ 1\ hr}$), 24-hour average noise level ($L_{eq\ 24\ hr}$), maximum noise level (L_{max}), L_{10}, L_{50}, L_{90} and the day and night average noise level (L_{dn}), according to the Announcement of the National Environment Board Announcement No. 15 (1997) Re: Standard general noise level (Table 3.5-2).
  - Aircraft noise levels in community areas, including the day and night average noise level, L_{dn}), which is in accordance with the aircraft noise level measurement method in accordance with the Notification of the Pollution Control Department Re: Methods for Measuring Aircraft Noise in Community Areas (2013). for use in calculating the noise exposure forecast (NEF).

Table 3.5-1 Air quality, noise and vibration measurement points of the project

Sequence No.	Measuring point locations and criteria for review	Monitoring point coordinates		Distance from project area (meters)
		E	N	
1	Pattanavechsuksa School: as a representative of educational sites (educational sites that require extra levels of silence) located in Sam Nak Thon Subdistrict, Ban Chang District, Rayong (located on the north side of the current runway (runway 1)), as a representative of sensitive areas that may be impacted by the noise caused by the aircraft take-off and landing.	717428	1406143	1,740
2	Staff working area: To represent the sensitive areas in the south side of Runway 1, located in the airport area, which is the work area of personnel working within the U-Tapao International Airport area.	717233	1400220	Within project area
3	Project Airside Area: Represents the noise measurement results from the take-off and landing of aircraft.	718584	1402641	Within project area

Table 3.5-1 Air quality, noise and vibration measurement points of the project

Sequence No.	Measuring point locations and criteria for review	Monitoring point coordinates		Distance from project area (meters)
		E	N	
4	Wat Khiri Pawanaram School: Representative of educational institutions (educational institutions that require extra levels of silence) located in Phala Subdistrict, Ban Chang District, Rayong (located on the north side of Runway 2), sensitive areas close to U-Tapao International Airport that may be impacted by the take-off and landing of aircraft.	720741	1406470	2,570
5	Wat Phala School: Representative of educational institutions (educational institutions that require extra levels of silence) located in Phala Subdistrict, Ban Chang District, Rayong (located on the south side of Runway 2), sensitive areas close to U-Tapao International Airport that may be impacted by the take-off and landing of aircraft.	721755	1401085	2,620
6	Ban Khlong Bang Phai School: Representative of educational institutions (educational institutions that require extra levels of silence) located in Sam Nak Thon Subdistrict, Ban Chang District, Rayong (located on the north side of the current runway (Runway 1)), sensitive areas close to U-Tapao International Airport that may be impacted by the take-off and landing of aircraft.	716297	1404423	1,550
7	Wat Sa Kaeo School: Representative of educational institutions (educational institutions that require extra levels of silence) located in Sam Nak Thon Subdistrict, Ban Chang District, Rayong (located on the north side of the current runway (Runway 1)), as a representative of sensitive areas that may be impacted by the noise caused by the take-off and landing of aircraft. Which is an additional measurement location added according to public opinion in the first hearing, including consideration of the impact from project operations.	718052	1407105	2,720

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Table 3.5-1 Air quality, noise and vibration measurement points of the project

Sequence No.	Measuring point locations and criteria for review	Monitoring point coordinates		Distance from project area (meters)
		E	N	
8	Center for the Development of Quality of Life for the Elderly, Sam Nak Thon Subdistrict Administration Organization: Representative of sensitive areas, located in the Sam Nak Thon Subdistrict, Ban Chang District, Rayong (located on the north side of the end of Runway 2 and is in the NEF ≥ 40 area) representative of sensitive areas that may be affected by the take-off and landing of aircraft, which has been determined to have noise measurements taken before Runway 2 becomes operational.	719053	1406327	851

Table 3.5-2 Measurement indexes and methods for measuring noise levels in the study area

Index	Measurement methods
1. Average 5-minute noise level ($L_{eq\ 5\ min}$)	Integrated Sound Level Meter
2. 1-hour average noise level ($L_{eq\ 1\ hr}$)	Integrated Sound Level Meter
3. 24-hour average noise level ($L_{eq\ 24\ hr}$)	Integrated Sound Level Meter
4. Maximum noise level (L_{max})	Integrated Sound Level Meter
5. 10th percentile noise level (L_{10})	Integrated Sound Level Meter
6. 50th percentile noise level (L_{50})	Integrated Sound Level Meter
7. 90th percentile noise level (L_{90})	Integrated Sound Level Meter
8. Night time and day time noise level (L_{dn})	Integrated Sound Level Meter

Subject to changes and approval by the Government of Thailand

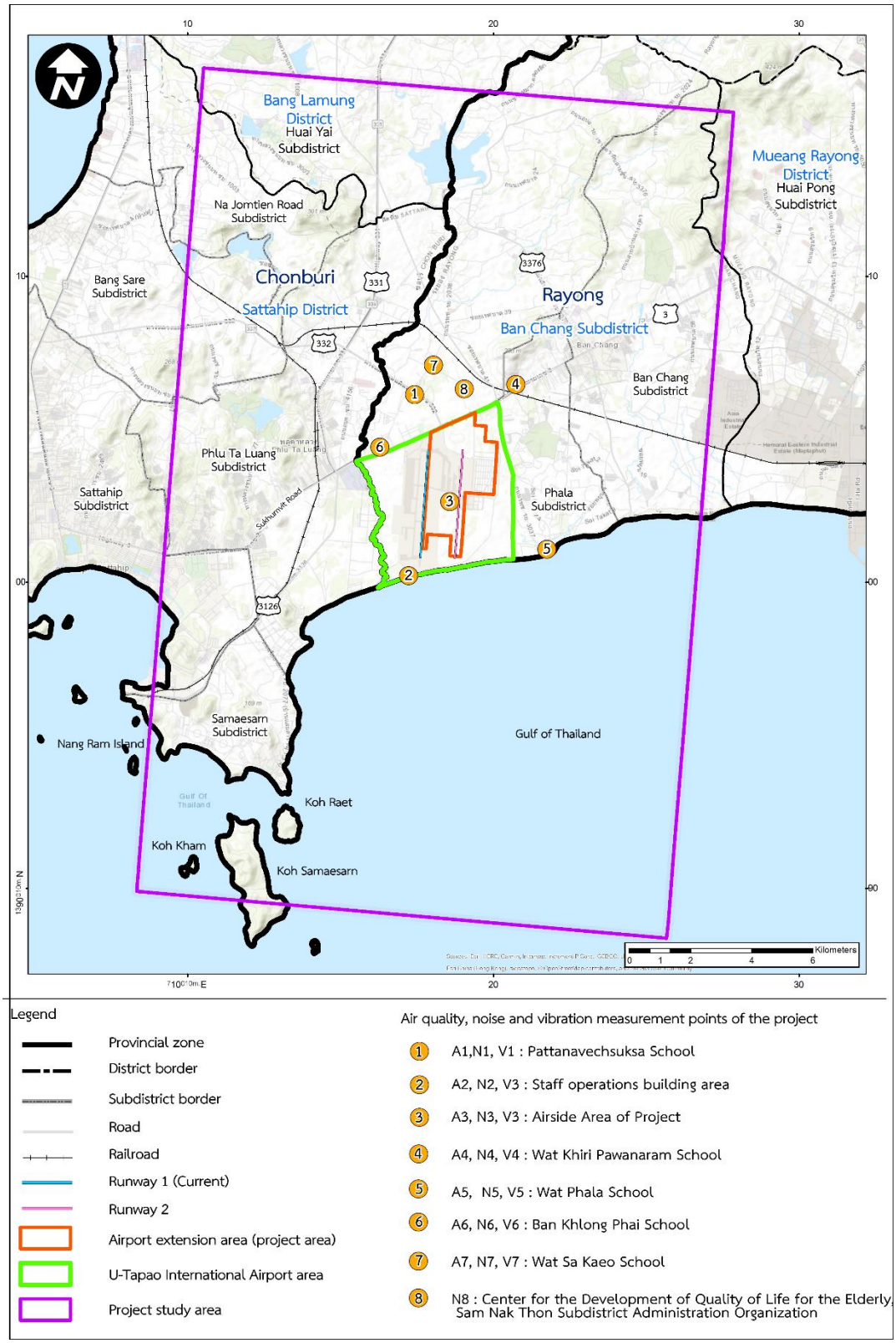

Figure 3.5-1 Noise, vibration and air quality measurement points for the project

1. Pattanavechsuksa School

2. Staff operations building area

3. Airside Area of Project

4. Wat Khiri Pawanaram School

5. Wat Phala School

6. Ban Khlong Bang Phai School

7. Wat Sa Kaeo School

8. Center for the Development of Quality of Life for the Elderly, Sam Nak Thon Subdistrict Administration Organization

Figure 3.5-2 Noise measurement point in the project study area

3.5.1.2 *Study Results*

(1) Secondary data

From the annual review of the situation report on air quality and noise during the year 2014-2018 of the Office of Air Quality and Noise Management, Pollution Control Department, the study area and nearby areas were found to have 2 noise level measurement points (details are shown in Table 3.5-3), summarized as follows:

1) Map Ta Phut Subdistrict Health Promotion Hospital

The 24-hour average noise level during 2014-2018 was in the range of 58.0-73.5 dBA, most of which are in the standard according to Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 dBA, except for 7 days in the years 2015-2016 of (from 595 measurement days) or calculated as 1.18 percent, that exceeded the specified standard.

2) Rayong Provincial Agriculture Office

The 24-hour average noise level during 2014-2018 was in the range of 55.5-69.0 dBA. The values are within the standard according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 dBA.

Table 3.5-3 The results of the noise level measurements in the study area and nearby areas during the years 2014-2018

Monitoring station	Year of measurement	24-hour average noise level (dBA)
Map Ta Phut Subdistrict Health Promotion Hospital	Year 2014	58.5-70.2
	Year 2015	58.0-73.5
	Year 2016	58.8-71.9
	Year 2017	59.1-68.3
	Year 2018	61.7-66.2
Min-Max values		58.0-73.5
Rayong Provincial Agriculture Office	Year 2014	55.5-67.0
	Year 2015	63.1-67.1
	Year 2016	61.8-67.2
	Year 2017	56.9-66.0
	Year 2018	63.7-69.0
Min-Max values		55.5-69.0
Standard		≤70[1/]

Note : underlined means that the standard value is exceeded

[1/] Announcement of the National Environment Board Announcement No. 15 (1997) Re: Standard general noise level

Source : Annual Situation Report on Air Quality and Noise during the years 2014-2018, Office of Air Quality and Noise Management, Pollution Control Department (http://aqnis.pcd.go.th/noise) Retrieved Information as of 21 June 2019

According to a report on the impact of noise in sensitive areas surrounding the U-Tapao International Airport, 2017. Measured by the Environmental Research and Training Center, Department of Environmental Quality Promotion, together with U-Tapao Airport, at 4 points, as detailed in Figure 3.5-3 and Table 3.5-4, summarized as follows:

1) Wat Sombun Naram School

The 24-hour average noise level is in the range of 61.0-64.0 dBA and the max noise level is in the range of 85.8-96.9 dBA, which is within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

2) Prasert Farm

The 24-hour average noise level is in the range of 49.7-59.7 dBA and the max noise level is in the range of 71.3-95.0 dBA, which is within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

3) Saeng Song La Child Development Center

The 24-hour average noise level is in the range of 53.3-69.0 dBA and the max noise level is in the range of 83.4-109.1 dBA, which is within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

4) Pattanavech College

The 24-hour average noise level is in the range of 57.7-63.1 dBA and the max noise level is in the range of 79.5-98.8 dBA, which is within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

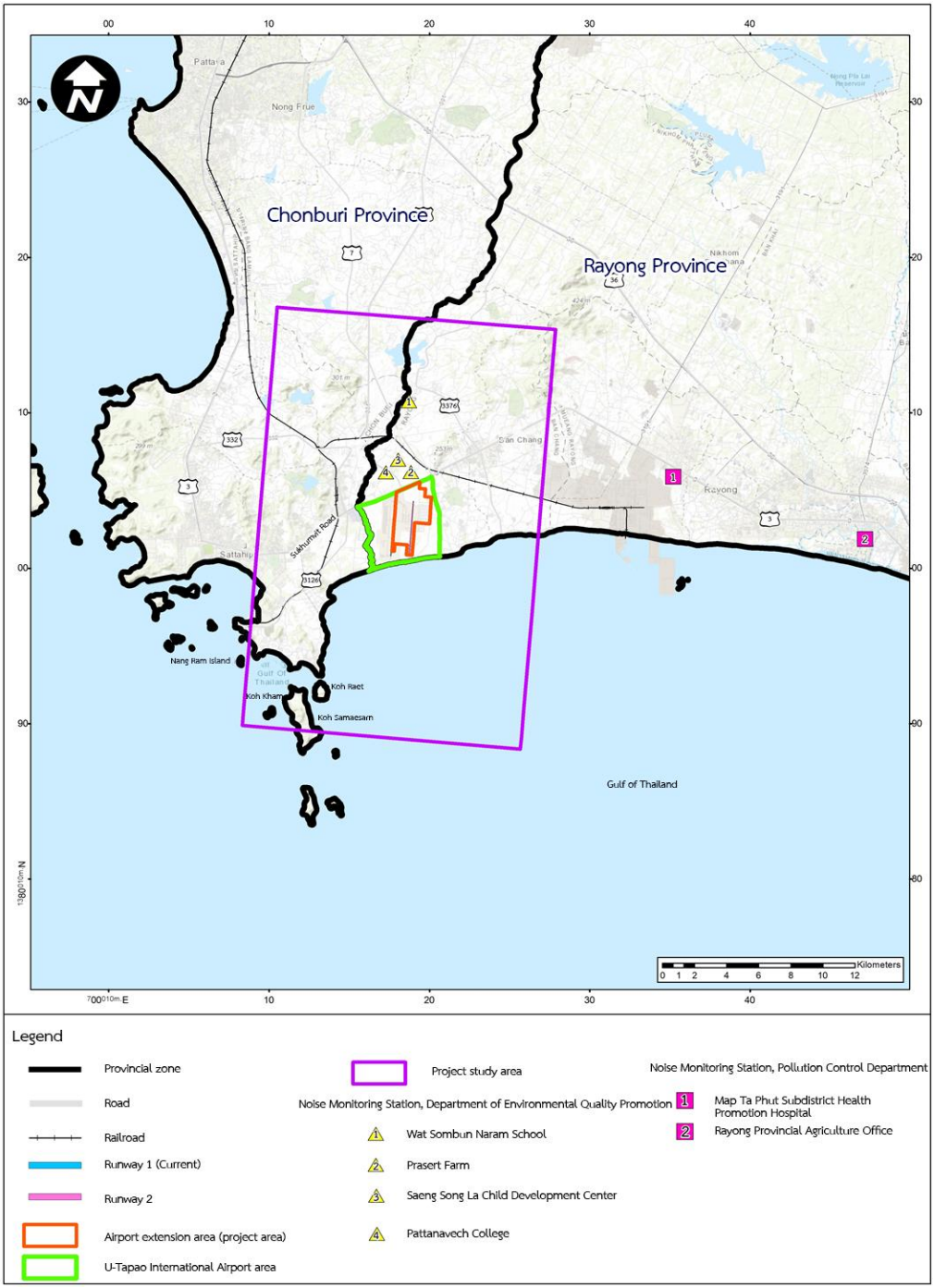

Figure 3.5-3 Noise monitoring stations surrounding U-Tapao International Airport

Table 3.5-4 The results of the noise level measurements in the study area and nearby areas, 2017

Monitoring station	Date	Measurement Results (dBA)	
		24-hour average noise level	Maximum noise level
Wat Sombun Naram School	6-14 March 2017	61.2-62.7	89.5-95.5
	28 March-5 April 2017	61.0-62.4	86.7-92.1
	22-30 May 2017	61.6-64.0	86.2-96.9
	22-30 June 2017	61.9-62.9	85.8-92.9
Min-Max values		61.0-64.0	85.8-96.9
Prasert Farm	6-14 March 2017	49.7-52.7	72.4-84.2
	28 March-5 April 2017	53.3-58.3	78.7-90.5
	22-30 May 2017	51.2-59.7	77.5-95.0
	22-30 June 2017	49.7-59.4	71.3-94.2
Min-Max values		49.7-59.7	71.3-95.0
Saeng Song La Child Development Center	6-14 March 2017	53.3-60.0	86.5-94.9
	28 March-5 April 2017	57.6-60.8	92.2-96.9
	22-30 May 2017	54.7-69.0	87.0-109.1
	22-30 June 2017	53.9-57.0	83.4-88.3
Min-Max values		53.3-69.0	83.4-109.1
Pattanavech College	6-14 March 2017	57.7-59.3	81.9-90.4
	28 March-5 April 2017	58.5-60.0	82.3-85.8
	22-30 May 2017	58.4-63.1	83.0-98.8
	22-30 June 2017	58.3-59.4	79.5-88.9
Min-Max values		57.7-63.1	79.5-98.8
Standard[1/]		≤70	≤115

Note : [1/] Announcement of the National Environment Board Announcement No. 15 (1997) Re: Determination of General Noise Level Standards

Source : Noise impact study report from U-Tapao Airport, Environmental Research and Training Center, Department of Environmental Quality Promotion, 2017

(2) Primary data

Noise level measurement results in the project study area: Two instances of noise level monitoring. The first measurement was taken during rainy season, between 18-24 July 2019, at 6 locations comprising Pattanavechsuksa School, the staff operation building area, the airside area of project, Wat Khiri Pawanaram School, Wat Phala School, Ban Khlong Bang Phai School, and Wat Sa Kaeo School. The second measurement was taken during the dry season, between 3-9 November 2019, at 7 locations, with 1 additional location at Wat Sa Kaeo School (Added according to public opinion in the first hearing, including consideration of the impact from project operations), which is a sensitive area that may be affected by the take-off and landing of aircraft. Measurement points were added around the Center for the Development of Quality of Life for the Elderly, Sam Nak Thon Subdistrict Administration Organization, as noise level monitoring point nears Runway 2 and in the NEF area ≥ 40. The noise level needs to be measured prior to runway 2 opening as a basis for comparison in the case of no flights, with measurements taken during 11-17 May 2021. Details are shown in Table 3.5-5 (as detailed in Appendix 3-1), summarized as follows:

1) Pattanavechsuksa School

- Rainy season

The 5-minute average noise level is in the range of 47.4-69.5 dBA. The 1-hour average noise level is in the range of 48.8-67.0 dBA. The 24-hour average noise level is in the range of 56.3-60.2 dBA. The maximum noise level is in the range of 63.6-89.2 dBA. The 10th percentile noise level is in the range of 49.7-69.6 dBA. The 50th percentile noise level is in the range of 46.6-66.4 dBA. The 90th percentile noise level is in the range of 46.1-62.6 dBA. The average day-night noise level in the community area is in the range of 60.8-63.1 dBA. And, the average day-night (aircraft) noise level is in the range of 34.6-50.0 dBA.

The 24-hour average noise level and the max noise level during the rainy season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

- Dry season

The 5-minute average noise level is in the range of 44.1-69.9 dBA. The 1-hour average noise level is in the range of 46.9-63.7 dBA. The 24-hour average noise level is in the range of 56.8-58.8 dBA. The maximum noise level is in the range of 60.0-86.9 dBA. The 10th percentile noise level is in the range of 48.4-66.6 dBA. The 50th percentile noise level is in the range of 44.1-63.3 dBA. The 90th percentile noise level is in the range of 42.6-59.3 dBA. The average day-night noise level in the community area is in the range of 60.4-62.4 dBA. And, the average day-night (aircraft) noise level is in the range of 33.4-49.1 dBA.

The 24-hour average noise level and the max noise level during the dry season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

2) Staff operations building area

- Rainy season

The 5-minute average noise level is in the range of 53.9-71.9 dBA. The 1-hour average noise level is in the range of 54.9-63.8 dBA. The 24-hour average noise level is in the range of 58.2-59.8 dBA. The maximum noise level is in the range of 62.3-88.9 dBA. The 10th percentile noise level is in the range of 56.7-63.5 dBA. The 50th percentile noise level is in the range of 54.2-59.7 dBA. The 90th percentile noise level is in the range of 49.4-57.8 dBA. The average day-night noise level in the community area is in the range of 63.3-66.0 dBA. And, the average day-night (aircraft) noise level is in the range of 51.8-56.8 dBA.

The 24-hour average noise level and the max noise level during the rainy season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

- Dry season

The 5-minute average noise level is in the range of 44.3-85.0 dBA. The 1-hour average noise level is in the range of 43.9-78.7 dBA. The 24-hour average noise level is in the range of 56.0-67.5 dBA. The maximum noise level is in the range of 54.4-104.0 dBA. The 10th percentile noise level is in the range of 46.5-80.4 dBA. The 50th percentile noise level is in the range of 42.7-73.3 dBA. The 90th percentile noise level is in the range of 39.7-62.1 dBA. The average day-night noise level in the community area is in the range of 58.6-74.4 dBA. And, the average day-night (aircraft) noise level is in the range of 52.8-55.7 dBA.

The 24-hour average noise level and the max noise level during the dry season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

3) Airside Area of Project

- Rainy season

The 5-minute average noise level is in the range of 39.4-82.6 dBA. The 1-hour average noise level is in the range of 43.6-73.9 dBA. The 24-hour average noise level is in the range of 65.1-67.0 dBA. The maximum noise level is in the range of 50.0-99.9 dBA. The 10th percentile noise level is in the range of 42.9-72.0 dBA. The 50th percentile noise level is in the range of 41.3-64.8 dBA. The 90th percentile noise level is in the range of 40.5-62.1 dBA. The average day-night noise level in the community area is in the range of 68.3-71.2 dBA. And, the average day-night (aircraft) noise level is in the range of 54.2-61.0 dBA.

The 24-hour average noise level and the max noise level during the rainy season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

- Dry season

The 5-minute average noise level is in the range of 44.1-88.6 dBA. The 1-hour average noise level is in the range of 44.4-78.6 dBA. The 24-hour average noise level is in the range of 65.5-69.6 dBA. The maximum noise level is in the range of 46.6-102.0 dBA. The 10th percentile noise level is in the range of 44.8-78.2 dBA. The 50th percentile noise level is in the range of 43.7-67.3 dBA. The 90th percentile noise level is in the range of 42.4-62.1 dBA. The average day-night noise level in the community area is in the range of 67.1-71.2 dBA. And, the average day-night (aircraft) noise level is in the range of 60.1-65.1 dBA.

The 24-hour average noise level and the max noise level during the dry season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

4) Wat Khiri Pawanaram School

- Rainy season

The 5-minute average noise level is in the range of 42.2-73.2 dBA. The 1-hour average noise level is in the range of 46.7-68.8 dBA. The 24-hour average noise level is in the range of 61.3-63.0 dBA. The maximum noise level is in the range

of 64.7-91.0 dBA. The 10th percentile noise level is in the range of 50.2-69.3 dBA. The 50th percentile noise level is in the range of 40.8-65.3 dBA. The 90th percentile noise level is in the range of 34.6-62.7 dBA. The average day-night noise level in the community area is in the range of 63.9-66.6 dBA. And, the average day-night (aircraft) noise level is in the range of 47.7-51.2 dBA.

The 24-hour average noise level and the max noise level during the rainy season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

- Dry season

The 5-minute average noise level is in the range of 46.6-76.6 dBA. The 1-hour average noise level is in the range of 51.4-66.5 dBA. The 24-hour average noise level is in the range of 59.7-61.5 dBA. The maximum noise level is in the range of 66.2-93.9 dBA. The 10th percentile noise level is in the range of 55.2-69.1 dBA. The 50th percentile noise level is in the range of 44.3-63.4 dBA. The 90th percentile noise level is in the range of 38.7-59.7 dBA. The average day-night noise level in the community area is in the range of 63.6-65.1 dBA. And, the average day-night (aircraft) noise level is in the range of 45.7-54.0 dBA.

The 24-hour average noise level and the max noise level during the dry season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

5) Wat Phala School

- Rainy season

The 5-minute average noise level is in the range of 48.4-85.5 dBA. The 1-hour average noise level is in the range of 51.5-75.1 dBA. The 24-hour average noise level is in the range of 59.8-65.0 dBA. The maximum noise level is in the range of 60.4-110.4 dBA. The 10th percentile noise level is in the range of 53.5-73.6 dBA. The 50th percentile noise level is in the range of 47.9-67.3 dBA. The 90th percentile noise level is in the range of 45.4-65.2 dBA. The average day-night noise level in the community area is in the range of 66.0-69.1 dBA. And, the average day-night (aircraft) noise level is in the range of 47.2-56.3 dBA.

The 24-hour average noise level and the max noise level during the rainy season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

- Dry season

The 5-minute average noise level is in the range of 47.0-76.9 dBA. The 1-hour average noise level is in the range of 48.2-69.2 dBA. The 24-hour average noise level is in the range of 60.8-63.9 dBA. The maximum noise level is in the range of 56.1-100.6 dBA. The 10th percentile noise level is in the range of 49.3-69.8 dBA. The 50th percentile noise level is in the range of 47.2-66.2 dBA. The 90th percentile noise level is in the range of 46.0-64.0 dBA. The average day-night noise level in the community area is in the range of 66.8-70.6 dBA. And, the average day-night (aircraft) noise level is in the range of 53.7-56.6 dBA.

The 24-hour average noise level and the max noise level during the dry season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

6) Ban Khlong Bang Phai School

- Rainy season

The 5-minute average noise level is in the range of 42.6-79.3 dBA. The 1-hour average noise level is in the range of 44.4-68.8 dBA. The 24-hour average noise level is in the range of 56.8-61.5 dBA. The maximum noise level is in the range of 55.4-99.3 dBA. The 10th percentile noise level is in the range of 46.8-62.7 dBA. The 50th percentile noise level is in the range of 43.1-59.1 dBA. The 90th percentile noise level is in the range of 40.9-56.1 dBA. The average day-night noise level in the community area is in the range of 61.1-64.0 dBA. And, the average day-night (aircraft) noise level is in the range of 36.6-49.0 dBA.

The 24-hour average noise level and the max noise level during the rainy season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

- Dry season

The 5-minute average noise level is in the range of 51.2-75.8 dBA. The 1-hour average noise level is in the range of 52.4-71.3 dBA. The 24-hour average noise level is in the range of 56.2-61.5 dBA. The maximum noise level is in the range of 62.2-98.3 dBA. The 10th percentile noise level is in the range of 53.4-73.5 dBA. The 50th percentile noise level is in the range of 51.1-69.5 dBA. The 90th percentile noise level is in the range of 49.2-60.6 dBA. The average day-night noise level in the community area is in the range of 61.6-65.7 dBA. And, the average day-night (aircraft) noise level is in the range of 40.9-56.0 dBA.

The 24-hour average noise level and the max noise level during the dry season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

7) Wat Sa Kaeo School

- Dry season

The 5-minute average noise level is in the range of 49.0-69.9 dBA. The 1-hour average noise level is in the range of 51.2-64.9 dBA. The 24-hour average noise level is in the range of 57.6-59.6 dBA. The maximum noise level is in the range of 62.7-82.8 dBA. The 10th percentile noise level is in the range of 52.5-66.5 dBA. The 50th percentile noise level is in the range of 50.0-62.9 dBA. The 90th percentile noise level is in the range of 48.1-59.7 dBA. The average day-night noise level in the community area is in the range of 62.2-63.5 dBA. And, the average day-night (aircraft) noise level is in the range of 38.8-48.2 dBA.

The 24-hour average noise level and the max noise level during the dry season are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

8) Center for the Development of Quality of Life for the Elderly, Sam Nak Thon Subdistrict Administration Organization

The 5-minute average noise level is in the range of 41.8-63.8 dBA. The 1-hour average noise level is in the range of 43.3-59.0 dBA. The 24-hour average noise level is in the range of 50.3-52.8 dBA. The maximum noise level is in the range of 53.4-80.9 dBA. The 10th percentile noise level is in the range of 42.0-62.0 dBA. The 50th percentile noise level is in the range of 41.5-59.1 dBA. The 90th percentile noise level is in the range of 38.9-58.9 dBA. The average day-night noise level in the community area is in the range of 57.0-60.8 dBA. And, the average day-night (aircraft) noise level is in the range of 25.8-45.1 dBA.

The 24-hour average noise level and the max noise level are within the standard criteria according to the Notification No. 15 of the National Environment Board (1997) which specifies that the noise level must not exceed 70 and 115 dBA, respectively.

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Table 3.5-5 The results of the noise level measurement in the study area of the project

Measurement points	Measurement period	Dates of measurement	Measurement Results (dBA)									
			5-minute average noise level	1-hour average noise level	24-hour average noise level	Maximum noise level	10th percentile noise level	50th percentile noise level	90th percentile noise level	Night time and day time average noise level (community areas)	Night time and day time average noise level (Aircraft)	NEF
1. Pattanavechsuksa School	First time - rainy season	18 July 2019	47.4-69.5	48.8-66.3	58.4	64.4-78.7	49.7-69.1	46.6-66.2	46.1-61.9	62.1	38.5	3.5
		19 July 2019	48.0-68.2	50.3-65.8	60.0	65.4-89.2	51.7-67.9	47.5-64.0	46.9-60.7	63.1	48.2	13.2
		20 July 2019	48.7-64.7	50.3-58.5	56.3	64.3-85.0	52.5-59.8	47.9-56.3	47.4-53.3	61.2	45.1	10.1
		21 July 2019	48.2-63.5	51.4-58.6	56.4	66.7-83.6	53.9-59.8	47.5-55.8	47.0-52.0	60.8	50.0	15.0
		22 July 2019	48.9-68.4	50.4-67.0	60.2	63.6-83.3	51.9-69.6	48.1-66.4	47.8-62.6	63.1	49.2	14.2
		23 July 2019	49.2-68.5	51.6-63.2	59.2	65.0-85.3	53.8-64.7	49.1-61.0	48.7-57.7	62.7	44.6	9.6
		24 July 2019	50.4-68.6	52.3-66.6	59.8	63.6-84.8	52.7-69.2	50.2-66.2	49.5-62.1	62.9	34.6	NOT MET THE CRITERIA
	Min-Max values		47.4-69.5	48.8-67.0	56.3-60.2	63.6-89.2	49.7-69.6	46.6-66.4	46.1-62.6	60.8-63.1	34.6-50.0	3.5-15.0
	Second time - dry season	3 November 2019	44.1-69.9	46.9-61.7	57.2	60.0-86.9	48.4-61.9	44.1-58.6	42.6-54.5	60.4	47.1	12.1
		4 November 2019	48.6-65.6	51.4-62.8	58.6	62.5-79.0	53.4-64.7	49.8-60.5	48.7-57.0	62.4	48.3	13.3
		5 November 2019	49.6-63.3	51.5-59.4	57.1	63.5-83.0	52.8-62.4	49.3-58.0	48.6-53.8	62.2	41.7	6.7
		6 November 2019	50.5-62.0	54.2-58.7	56.8	67.3-77.3	56.5-60.3	51.9-56.9	49.7-52.9	62.4	49.1	14.1
		7 November 2019	48.0-67.4	51.6-63.7	58.8	64.1-84.9	52.9-65.7	49.8-62.4	49.1-59.3	62.3	47.8	12.8
		8 November 2019	49.2-66.9	52.0-62.0	58.3	64.7-81.7	53.0-63.5	49.1-59.9	48.4-56.3	62.3	43.9	8.9
		9 November 2019	49.0-66.7	52.0-63.7	58.2	65.5-81.2	52.5-66.6	49.7-63.3	47.8-58.8	61.9	33.4	NOT MET THE CRITERIA
	Min-Max values		44.1-69.9	46.9-63.7	56.8-58.8	60.0-86.9	48.4-66.6	44.1-63.3	42.6-59.3	60.4-62.4	33.4-49.1	6.7-14.1
2. Staff operations building area	First time - rainy season	18 July 2019	55.3-62.9	58.5-60.8	59.6	67.3-72.3	59.5-63.5	55.6-59.3	51.6-56.5	66.0	51.8	16.8
		19 July 2019	55.1-63.7	58.1-60.8	59.5	66.0-73.2	58.8-62.9	55.7-58.9	51.9-55.8	66.0	55.7	20.7
		20 July 2019	55.0-64.3	58.1-61.3	59.4	66.9-73.9	59.1-62.6	55.3-59.4	51.2-56.3	65.4	56.6	21.6
		21 July 2019	54.5-71.9	57.9-63.5	59.8	66.5-88.9	59.4-62.5	55.7-59.7	51.6-57.8	65.6	53.0	18.0
		22 July 2019	54.9-69.3	56.6-62.1	59.0	64.0-86.0	58.6-60.7	54.2-57.7	49.4-56.3	64.5	56.8	21.8
		23 July 2019	55.5-70.4	56.4-63.8	59.0	63.0-86.3	58.6-60.5	55.3-58.0	52.0-56.6	64.0	55.5	20.5
		24 July 2019	53.9-67.3	54.9-61.2	58.2	62.3-83.6	56.7-60.6	53.8-59.1	49.8-57.8	63.3	54.6	19.6
	Min-Max values		53.9-71.9	54.9-63.8	58.2-59.8	62.3-88.9	56.7-63.5	54.2-59.7	49.4-57.8	63.3-66.0	51.8-56.8	16.8-21.8
	Second time - dry season	3 November 2019	42.5-74.3	43.9-65.0	56.0	54.4-98.7	46.5-57.1	42.7-51.2	39.7-49.0	58.6	55.7	20.7
		4 November 2019	46.9-84.1	49.3-78.7	67.5	56.5-104.0	51.2-65.0	48.3-54.6	45.0-52.1	69.5	53.0	18.0
		5 November 2019	44.4-85.0	46.9-74.3	63.5	56.7-102.6	48.7-63.6	45.8-55.7	42.9-51.7	64.6	54.6	19.6
		6 November 2019	44.3-83.4	45.6-76.3	63.9	54.8-97.8	47.0-61.7	44.9-58.1	42.4-56.1	64.4	52.8	17.8
		7 November 2019	46.8-83.9	47.4-77.2	65.0	55.6-101.6	49.4-65.6	46.2-52.5	44.2-49.6	65.7	55.5	20.5
		8 November 2019	46.7-78.5	49.6-73.1	63.9	57.6-89.2	50.4-76.5	46.8-63.9	44.4-54.2	64.9	54.3	19.3
		9 November 2019	47.8-80.7	48.4-76.4	67.2	57.7-94.4	51.1-80.4	46.9-73.3	44.4-62.1	74.4	54.9	19.9
	Min-Max values		44.3-85.0	43.9-78.7	56.0-67.5	54.4-104.0	46.5-80.4	42.7-73.3	39.7-62.1	58.6-74.4	52.8-55.7	17.8-20.7
3. Airside Area of Project	First time - rainy season	18 July 2019	39.4-81.6	44.3-73.1	66.0	62.0-99.9	44.7-68.2	43.9-63.7	42.1-60.3	69.8	54.2	19.2
		19 July 2019	41.4-82.2	43.8-72.7	66.6	50.0-97.6	43.2-72.0	41.8-66.2	41.0-62.1	69.0	56.9	21.9
		20 July 2019	40.9-82.6	47.8-73.6	67.0	71.7-96.5	42.9-70.0	41.3-62.7	40.5-59.0	70.8	60.7	25.7
		21 July 2019	44.2-82.0	45.1-72.6	65.1	50.2-94.5	44.8-70.3	44.3-61.1	43.8-59.4	68.3	56.0	21.0
		22 July 2019	43.6-82.1	46.1-73.9	66.1	61.7-94.5	46.4-71.1	44.0-64.5	43.4-60.8	71.2	54.4	19.4
		23 July 2019	43.1-80.8	43.6-73.5	66.1	54.4-96.5	43.6-69.2	43.1-59.9	42.7-57.1	69.7	61.0	26.0
		24 July 2019	43.1-79.6	44.2-73.3	66.7	55.7-95.0	43.9-71.5	43.3-64.8	42.9-61.9	69.4	59.2	24.2
	Min-Max values		39.4-82.6	43.6-73.9	65.1-67.0	50.0-99.9	42.9-72.0	41.3-64.8	40.5-62.1	68.3-71.2	54.2-61.0	19.2-26.0
		3 November 2019	43.5-81.6	53.3-72.6	66.9	69.6-99.8	46.5-75.7	43.7-66.8	42.4-59.0	71.2	60.1	25.1

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Table 3.5-5 The results of the noise level measurement in the study area of the project

Measurement points	Measurement period	Dates of measurement	Measurement Results (dBA)									
			5-minute average noise level	1-hour average noise level	24-hour average noise level	Maximum noise level	10th percentile noise level	50th percentile noise level	90th percentile noise level	Night time and day time average noise level (community areas)	Night time and day time average noise level (Aircraft)	NEF
	Second time - dry season	4 November 2019	47.2-88.6	54.6-73.4	67.9	74.5-95.0	55.4-78.2	49.5-66.3	46.4-59.8	70.1	64.7	29.7
		5 November 2019	45.4-86.2	47.1-77.7	69.6	61.0-101.4	46.8-77.4	45.7-67.3	45.1-60.6	70.9	61.1	26.1
		6 November 2019	45.0-86.2	46.1-78.6	68.5	53.6-102.0	46.1-74.3	45.3-64.8	44.8-60.3	69.2	65.1	30.1
		7 November 2019	43.8-86.5	45.6-78.0	68.8	49.9-102.0	45.6-71.5	45.0-62.3	43.7-56.6	69.9	60.7	25.7
		8 November 2019	44.2-81.1	45.9-73.3	66.3	60.1-93.6	46.2-74.5	44.9-66.0	44.5-62.1	69.5	60.4	25.4
		9 November 2019	44.1-79.0	44.4-70.9	65.5	46.6-92.7	44.8-72.3	44.2-66.2	43.7-56.9	67.1	60.2	25.2
	Min-Max values		44.1-88.6	44.4-78.6	65.5-69.6	46.6-102.0	44.8-78.2	43.7-67.3	42.4-62.1	67.1-71.2	60.1-65.1	25.1-30.1
4. Wat Khiri Pawanaram School	First time - rainy season	18 July 2019	42.2-68.1	46.7-64.1	61.3	64.7-91.0	50.2-66.1	40.8-63.4	34.6-60.7	63.9	47.9	12.9
		19 July 2019	47.5-73.2	53.5-68.8	63.0	70.3-82.0	57.3-69.3	46.0-64.4	39.4-62.0	66.6	47.9	12.9
		20 July 2019	50.5-66.9	52.9-65.1	62.5	69.8-86.8	57.2-66.9	48.3-63.9	41.7-60.6	66.2	50.3	15.3
		21 July 2019	50.2-68.3	54.3-64.7	62.1	69.5-87.6	57.1-66.3	50.7-63.6	43.9-60.9	65.6	51.2	16.2
		22 July 2019	47.8-67.0	52.5-65.6	62.0	68.8-83.3	56.5-67.7	46.3-64.8	39.0-61.9	65.6	47.7	12.7
		23 July 2019	49.5-68.7	52.2-66.1	62.9	67.8-83.7	56.3-67.6	46.3-65.3	40.4-62.7	66.3	48.2	13.2
		24 July 2019	46.6-68.5	51.2-66.0	62.1	67.9-83.6	55.1-67.8	44.6-65.0	39.5-61.9	65.6	49.0	14.0
	Min-Max values		42.2-73.2	46.7-68.8	61.3-63.0	64.7-91.0	50.2-69.3	40.8-65.3	34.6-62.7	63.9-66.6	47.7-51.2	12.7-16.2
	Second time - dry season	3 November 2019	50.1-76.6	53.5-63.3	60.3	70.7-86.5	57.3-64.7	47.8-61.0	40.1-57.2	65.1	52.9	17.9
		4 November 2019	49.1-73.7	52.5-65.8	61.5	69.7-92.2	55.5-68.1	44.3-62.8	39.6-59.3	64.4	54.0	19.0
		5 November 2019	47.3-71.6	52.3-66.5	61.3	66.2-93.9	56.3-69.1	45.6-63.4	39.0-59.7	64.5	49.9	14.9
		6 November 2019	46.6-67.5	51.4-64.3	60.6	66.5-82.7	55.2-67.3	45.6-62.6	41.5-58.9	63.7	49.4	14.4
		7 November 2019	48.3-70.5	52.9-65.3	60.5	71.3-84.6	56.4-68.0	46.8-62.2	38.7-59.0	63.9	46.2	11.2
		8 November 2019	47.8-68.2	52.3-64.8	60.6	67.8-84.1	56.0-67.3	45.7-63.1	39.5-59.4	64.0	49.4	14.4
		9 November 2019	47.7-65.2	52.9-62.5	59.7	69.3-83.9	56.4-64.3	46.8-61.2	41.2-57.7	63.6	45.7	10.7
	Min-Max values		46.6-76.6	51.4-66.5	59.7-61.5	66.2-93.9	55.2-69.1	44.3-63.4	38.7-59.7	63.6-65.1	45.7-54.0	10.7-19.0
5. Wat Phala School	First time - rainy season	18 July 2019	48.4-85.5	51.5-75.1	65.0	62.9-110.4	53.5-70.0	47.9-63.4	45.4-59.8	66.8	47.2	12.2
		19 July 2019	55.4-74.1	56.6-69.3	61.8	64.8-87.7	58.1-73.6	55.3-60.4	52.9-57.3	66.2	49.7	14.7
		20 July 2019	55.8-70.8	56.6-63.7	60.2	61.9-88.5	58.2-62.5	55.7-58.9	52.8-57.5	66.4	56.3	21.3
		21 July 2019	55.1-71.6	56.3-63.3	59.8	62.0-90.6	57.1-63.0	55.0-59.1	53.2-56.6	66.0	51.6	16.6
		22 July 2019	53.8-73.0	54.7-69.0	62.0	62.9-86.2	55.4-70.1	53.9-67.3	51.3-65.2	69.1	51.2	16.2
		23 July 2019	53.7-72.4	54.0-66.3	62.0	60.4-89.0	54.9-65.5	53.5-60.7	52.2-58.0	68.5	50.2	15.2
		24 July 2019	52.9-72.3	55.1-64.8	61.9	71.9-88.0	54.9-65.1	53.0-62.1	51.3-59.2	67.5	54.8	19.8
	Min-Max values		48.4-85.5	51.5-75.1	59.8-65.0	60.4-110.4	53.5-73.6	47.9-67.3	45.4-65.2	66.0-69.1	47.2-56.3	12.2-21.3
	Second time - dry season	3 November 2019	53.7-76.9	56.2-67.9	63.1	68.1-97.5	57.0-68.6	51.3-66.2	48.0-64.0	70.2	54.1	19.1
		4 November 2019	47.0-74.4	48.2-69.2	63.1	56.1-100.6	49.3-67.6	47.2-63.1	46.0-60.3	70.4	56.6	21.6
		5 November 2019	48.1-73.9	58.2-66.8	63.1	65.6-93.5	53.1-66.6	48.6-62.8	46.5-60.4	70.6	55.1	20.1
		6 November 2019	49.7-72.9	56.0-66.3	63.5	64.8-89.5	56.0-66.8	50.1-64.0	47.9-63.3	70.3	56.1	21.1
		7 November 2019	47.9-73.5	56.9-68.2	63.9	67.2-90.0	54.1-68.7	51.7-64.2	50.9-63.3	70.4	54.5	19.5
		8 November 2019	49.9-71.1	55.0-67.0	62.7	72.2-91.7	55.7-69.8	51.4-65.1	49.2-62.6	67.3	54.1	19.1
		9 November 2019	54.1-71.0	56.4-65.3	60.8	62.9-83.6	55.8-65.5	53.5-60.1	52.7-58.9	66.8	53.7	18.7
	Min-Max values		47.0-76.9	48.2-69.2	60.8-63.9	56.1-100.6	49.3-69.8	47.2-66.2	46.0-64.0	66.8-70.6	53.7-56.6	18.7-21.6
6. Ban Khlong Bang Phai School		18 July 2019	42.6-79.3	44.4-68.8	61.5	55.4-99.3	46.8-61.1	43.1-57.6	40.9-54.6	61.1	48.6	13.6
		19 July 2019	51.1-65.6	52.5-62.2	57.8	64.8-80.7	54.0-62.7	51.3-58.5	50.6-55.2	62.2	44.5	9.5

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Table 3.5-5 The results of the noise level measurement in the study area of the project

Measurement points	Measurement period	Dates of measurement	Measurement Results (dBA)									
			5-minute average noise level	1-hour average noise level	24-hour average noise level	Maximum noise level	10th percentile noise level	50th percentile noise level	90th percentile noise level	Night time and day time average noise level (community areas)	Night time and day time average noise level (Aircraft)	NEF
	First time - rainy season	20 July 2019	47.9-65.2	52.8-62.3	57.9	63.7-92.4	54.1-62.1	51.6-58.4	49.7-55.0	63.6	37.2	2.2
		21 July 2019	52.4-62.2	53.4-59.4	57.3	63.3-78.9	55.4-61.2	52.0-58.3	50.7-55.0	64.0	36.6	1.6
		22 July 2019	51.1-67.8	52.3-62.0	57.6	63.1-87.4	53.4-61.7	51.3-58.3	50.5-55.1	61.9	48.1	13.1
		23 July 2019	51.1-65.5	52.1-63.7	57.7	62.6-82.3	53.1-61.9	51.1-58.8	50.2-55.7	61.7	49.0	14.0
		24 July 2019	49.6-64.7	51.5-60.9	56.8	63.5-89.5	53.3-62.2	48.8-59.1	46.5-56.1	61.4	45.3	10.3
	Min-Max values		42.6-79.3	44.4-68.8	56.8-61.5	55.4-99.3	46.8-62.7	43.1-59.1	40.9-56.1	61.1-64.0	36.6-49.0	1.6-14.0
		3 November 2019	51.2-75.8	52.6-71.3	61.5	64.7-98.3	54.4-73.5	51.1-69.5	50.3-60.4	65.6	56.0	21.0
		4 November 2019	53.7-71.1	55.3-63.6	59.6	63.2-91.0	57.2-65.1	54.2-62.1	50.1-60.6	65.7	52.6	17.6
	Second time - dry season	5 November 2019	52.2-69.0	53.1-62.3	58.4	62.2-85.6	54.1-63.6	52.1-58.3	51.6-55.0	62.7	52.7	17.7
		6 November 2019	51.8-70.1	53.4-62.5	57.9	63.4-88.9	54.8-62.3	52.0-57.6	51.2-54.1	62.1	51.8	16.8
		7 November 2019	51.6-69.1	53.0-62.7	57.5	66.7-88.0	53.9-62.5	51.3-57.8	50.9-54.4	61.9	51.6	16.6
		8 November 2019	51.6-66.7	52.6-61.6	57.3	66.2-84.6	53.5-62.0	51.5-58.0	51.1-54.7	61.9	49.1	14.1
		9 November 2019	51.4-61.1	52.4-58.3	56.2	64.6-78.1	53.4-60.7	51.4-57.2	49.2-53.4	61.6	40.9	5.9
	Min-Max values		51.2-75.8	52.4-71.3	56.2-61.5	62.2-98.3	53.4-73.5	51.1-69.5	49.2-60.6	61.6-65.7	40.9-56.0	5.9-21.0
7. Wat Sa Kaeo School	First time - dry season	3 November 2019	50.1-69.0	52.8-64.9	59.1	62.7-81.7	53.7-65.9	50.1-62.1	48.1-58.2	62.7	48.2	13.2
		4 November 2019	50.5-66.2	52.8-62.5	58.8	65.7-77.6	53.5-64.7	50.0-60.5	48.5-57.6	62.4	43.7	8.7
		5 November 2019	50.6-63.0	52.3-59.4	57.6	65.1-76.6	53.4-61.7	49.9-57.8	48.9-54.8	62.2	40.0	5.0
		6 November 2019	49.8-64.5	53.2-61.1	58.6	67.0-77.2	54.0-63.4	50.4-59.1	49.3-55.9	62.9	47.3	12.3
		7 November 2019	49.0-69.9	51.2-64.8	59.6	64.0-79.6	52.5-66.5	49.1-62.9	48.2-59.7	62.7	47.4	12.4
		8 November 2019	49.0-69.7	52.1-64.6	59.3	63.5-80.1	53.5-65.0	50.3-61.3	49.6-57.8	62.9	43.9	8.9
		9 November 2019	49.4-67.4	53.3-64.2	59.6	68.2-82.8	53.9-66.3	51.1-62.8	49.8-59.2	63.5	38.8	3.8
	Min-Max values		49.0-69.9	51.2-64.9	57.6-59.6	62.7-82.8	52.5-66.5	50.0-62.9	48.1-59.7	62.2-63.5	38.8-48.2	3.8-13.2
8. Center for the Development of Quality of Life for the Elderly, Administrative Organization Sam Nak Thon Subdistrict		11 May 2021	42.6-59.9	45.2-59.0	52.1	56.2-77.3	42.0-59.8	43.1-59.1	39.3-58.9	60.8	45.1	10.1
		12 May 2021	42.5-63.4	44.3-58.1	51.8	55.4-79.2	46.1-58.5	43.2-57.7	40.4-56.8	59.9	34.3	NOT MET THE CRITERIA
		13 May 2021	42.1-63.8	45.5-57.2	51.0	61.9-80.9	46.5-56.9	41.5-55.7	38.9-54.6	59.1	36.8	1.8
		14 May 2021	42.2-60.0	43.3-56.6	51.6	54.8-77.3	45.7-58.8	41.7-55.9	38.9-55.1	59.0	32.3	NOT MET THE CRITERIA
		15 May 2021	42.1-59.9	43.6-56.4	50.7	56.8-79.1	45.4-58.7	42.2-54.3	39.6-53.2	58.5	36.8	1.8
		16 May 2021	41.9-61.6	43.9-58.5	52.8	54.3-80.8	45.9-62.0	42.4-56.3	39.3-52.4	58.1	25.8	NOT MET THE CRITERIA
		17 May 2021	41.8-58.3	43.4-54.8	50.3	53.4-75.4	45.0-57.6	42.3-53.9	39.5-52.8	57.0	42.3	7.3
	Min-Max values		41.8-63.8	43.3-59.0	50.3-52.8	53.4-80.9	42.0-62.0	41.5-59.1	38.9-58.9	57.0-60.8	25.8-45.1	1.8-10.1
Standard			-	-	≤70[1/]	≤115[1/]	-	-	-	-	-	-

Note : (-) indicates that there is no specified standard
NOT MET THE CRITERIA means it is not significant (NEF is less than the noise level threshold)
[1/] Announcement of the National Environment Board Announcement No. 15 (1997) Re: Determination of General Noise Level Standards
Source : United Analyst and Engineering Consultants Co., Ltd. (Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

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3.5.2 Vibration

3.5.2.1 *Scope of Study*

Compile the data of the vibrations measured in the study area to use as basic information supporting the assessment of the potential impacts of the vibrations from the project.

3.5.2.2 *Study Methods*

Conduct the measurement of vibrations in the project area, detailed as follows:

- Measurement points and measurement period Two instances of vibration monitoring (measured 24 hours a day continuously over 7 days). The first measurement was taken during rainy season, between 18-24 July 2019, at 6 locations comprising Pattanavechsuksa School, the staff operation building area, the project airside area, Wat Khiri Pawanaram School, Wat Phala School, Ban Khlong Bang Phai School, and Wat Sa Kaeo School. The second measurement was taken during the dry season, between 3-9 November 2019, at 7 locations, with 1 additional location at Wat Sa Kaeo School (Added according to public opinion in the first hearing, including consideration of the impact from project operations), which is a sensitive area that may be affected by the take-off and landing of aircraft. The details of the measurement points and installation of tools are shown in Figure 3.5-1 and Figure 3.5-4.
- Measurement index Peak Velocity and Frequency, as detailed in Table 3.5-6

Table 3.5-6 Measurement index and vibration measurement method

Index	Measurement Methods[1/, 2/]
1. Vibrations (Peak velocity) (mm/sec)	Vibration Meter
2. Frequency (Hz)	Vibration Meter

Note : [1/] Minimum value that the instrument can analyze (Resolution) is 0.0635 mm/s
[2/] Setting of the Trigger Source is 0.3 mm/s

1. Pattanavechsuksa School

2. Staff operations building area

3. Airside Area of Project

4. Wat Khiri Pawanaram School

5. Wat Phala School

6. Ban Khlong Bang Phai School

7. Wat Sa Kaeo School

Figure 3.5-4 Vibration measurement point in the project study area

3.5.2.3 *Study Results*

(1) Primary data

Two instances of vibration monitoring. The first measurement was taken during rainy season, between 18-24 July 2019, at 6 locations comprising Pattanavechsuksa School, the staff operation building area, the project airside area, Wat Khiri Pawanaram School, Wat Phala School, Ban Khlong Bang Phai School, and Wat Sa Kaeo School. The second measurement was taken during the dry season, between 3-9 November 2019, at 7 locations, with 1 additional location at Wat Sa Kaeo School (Added according to public opinion in the first hearing, including consideration of the impact from project operations), which is a sensitive area that may be impacted. The details of the measurement results are shown in Table 3.5-7 (details are shown in Appendix 3-2) which can be summarized as follows:

1) Pattanavechsuksa School

Vibration measurement results found that during the rainy season the maximum particle velocity on all three axes (XY and Z axis) ranged from 0.047-0.363 mm/s. During the dry season the maximum particle velocity in all three axes (XY and Z axes) ranged from 0.118-1.130 mm/s. The vibration during the rainy and dry season was within the standard of vibrations to prevent impacts on buildings, according to Notification No. 37 of the National Environment Board (2010) in the case of type 2 buildings [1].

2) Staff operations building area

Vibration measurement results found that during the rainy season the maximum particle velocity on all three axes (XY and Z axis) ranged from 0.095-0.567 mm/s. During the dry season the maximum particle velocity in all three axes (XY and Z axes) ranged from 0.063-1.550 mm/s. The vibration during the rainy and dry season was within the standard of vibrations to prevent impacts on buildings, according to Notification No. 37 of the National Environment Board (2010) in the case of type 2 buildings [1].

3) Airside Area of Project

Vibration measurement results found that during the rainy season the maximum particle velocity on all three axes (XY and Z axis) ranged from 0.063-0.315 mm/s. During the dry season the maximum particle velocity in all three axes (XY and Z axes) ranged from 0.063-1.090 mm/s. The vibration during the rainy and dry season was within the standard of vibrations to prevent impacts on buildings, according to Notification No. 37 of the National Environment Board (2010) in the case of type 2 buildings [1].

4) Wat Khiri Pawanaram School

Vibration measurement results found that during the rainy season the maximum particle velocity on all three axes (XY and Z axis) ranged from 0.047-0.552 mm/s. During the dry season the maximum particle velocity in all three axes (XY and Z axes) ranged from 0.047-0.284 mm/s. The vibration during the rainy and dry season was within the standard of vibrations to prevent impacts on buildings, according to Notification No. 37 of the National Environment Board (2010) in the case of type 2 buildings [1].

5) Wat Phala School

Vibration measurement results found that during the rainy season the maximum particle velocity on all three axes (XY and Z axis) ranged from 0.047-0.252 mm/s. During the dry season the maximum particle velocity in all three axes (XY and Z axes) ranged from 0.071-0.339 mm/s. The vibration during the rainy and dry season was within the standard of vibrations to prevent impacts on buildings, according to Notification No. 37 of the National Environment Board (2010) in the case of type 2 buildings [1].

6) Ban Khlong Bang Phai School

Vibration measurement results found that during the rainy season the maximum particle velocity on all three axes (XY and Z axis) ranged from 0.039-1.180 mm/s. During the dry season the maximum particle velocity in all three axes (XY and Z axes) ranged from 0.039-0.678 mm/s. The vibration during the rainy and dry season was within the standard of vibrations to prevent impacts on buildings, according to Notification No. 37 of the National Environment Board (2010) in the case of type 2 buildings [1].

7) Wat Sa Kaeo School

Vibration measurement results found that during the dry season the maximum particle velocity in all three axes (XY and Z axes) ranged from 0.047-0.536 mm/s. The vibration during the rainy and dry season was within the standard of vibrations to prevent impacts on buildings, according to Notification No. 37 of the National Environment Board (2010) in the case of type 2 buildings.[1].

[1] **Note** : Type 2 building means
(1) Residential building, multiple occupancy residential building, shophouse, townhouse, unit, duplex under the building control laws, (2) Buildings under the apartment building laws, (3) Dormitories under the dormitory laws, (4) Buildings used

as medical facilities under the law on medical facilities and buildings used as a public hospitals, (5) Buildings used as places of study under the private schools laws, buildings used as public schools, buildings used as a private education institutions under the law on private education institutions and buildings used as public education institutions, (6) Buildings used for religious activities, (7) Any other building with the same characteristics for use in a building under (1) (2) (3) (4) (5) and (6).

Source : Announcement of the National Environment Board No. 37 (2010) Re: Determination of Vibration Impact on Building Standards

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Table 3.5-7 The results of the vibration measurement in the project study area

Measurement points	Measurement period	Dates of measurement	Transverse						Vertical		
			X-axis		Standard speed Maximum particles	Y-axis		Standard speed Maximum particles	Z-axis		Standard speed Maximum particles[1/]
			Speed Maximum particles (millimeters/second)	Frequency (Hertz)		Speed Maximum particles (millimeters/second)	Frequency (Hertz)		Speed Maximum particles (millimeters/second)	Frequency (Hertz)	
1. Pattanavechsuksa School	First time - rainy season	18 July 2019	0.063-0.142	2.8-36.6	5.0-11.7	0.063-0.118	4.8-73.1	5.0-17.3	0.118-0.213	2.3-73.1	5.0-17.3
		19 July 2019	0.071-0.166	1.1-25.6	5.0-8.9	0.071-0.134	1.0-42.7	5.0-13.2	0.126-0.205	19.7-56.9	7.4-15.7
		20 July 2019	0.079	2.2	5.0	0.055	24.4	8.6	0.134	16.5	6.6
		21 July 2019	0.055-0.079	46.5	14.1	0.063	4.6	5.0	0.150	20.5	7.6
		22 July 2019	0.055-0.118	1.1-73.1	5.0-17.3	0.055-0.142	3.5 -64.0	5.0-16.4	0.126-0.252	2.8-64.0	5.0-16.4
		23 July 2019	0.047-0.134	1.0-73.1	5.0-17.3	0.055-0.110	6.3-85.3	5.0-18.5	0.126-0.363	1.9-56.9	5.0-15.7
		24 July 2019	0.063-0.181	1.4-39.4	5.0-12.4	0.055-0.110	2.5-85.3	5.0-18.5	0.126-0.229	1.9-51.2	5.0-15.1
	Second time - dry season	3 November 2019	0.315-0.355	5.8-5.8	5.0-20.0	0.197-0.213	1.4-51.2	5.0-15.1	0.276-0.859	1.3-85.3	5.0-18.5
		4 November 2019	0.197	NOT APPLICABLE	20.0	0.118	1.8	5.0	0.300	1.3	5.0
		5 November 2019	0.796	4.1-4.1	5.0	1.130	15.1	6.3	0.378	1.7	5.0
		6 November 2019	0.276-0.536	NOT APPLICABLE	20.0	0.402-1.060	14.6-39.4	6.2-12.4	0.370-0.489	1.3-19.0	5.0-7.3
		7 November 2019	0.331	NOT APPLICABLE	20.0	0.197	1.5	5.0	0.418	1.5	5.0
		8 November 2019	0.315	NOT APPLICABLE	20.0	0.252-0.220	1.3	5.0	0.828	1.5	5.0
		9 November 2019	<0.300	NOT APPLICABLE	20.0	<0.300	NOT APPLICABLE	20.0	<0.300	NOT APPLICABLE	20.0
2. Staff operations building area	First time - rainy season	18 July 2019	0.095-0.118	2.0-24.4	5.0-8.6	0.150-0.173	0.0	20.0	0.197-0.213	64.0-73.1	16.4-17.3
		19 July 2019	0.095-0.118	1.7-25.6	5.0-8.9	0.142-0.166	NOT APPLICABLE	20.0	0.205-0.276	36.6-64.0	11.7-16.4
		20 July 2019	0.095-0.213	1.0-73.1	5.0-17.3	0.142-0.181	NOT APPLICABLE	20.0	0.118-0.567	1.0-73.1	5.0-17.3
		21 July 2019	0.126	30.1	10.0	0.173	NOT APPLICABLE	20.0	0.236	39.4	12.4
		22 July 2019	0.095-0.118	1.3-64.0	5.0-16.4	0.150-0.189	NOT APPLICABLE	20.0	0.197-0.284	16.0-73.1	6.5-17.3
		23 July 2019	0.110-0.126	1.9-21.3	5.0-7.8	0.150-0.181	NOT APPLICABLE	20.0	0.213-0.252	23.3-73.1	8.3-17.3
		24 July 2019	0.095-0.110	1.6-2.6	5.0	0.158-0.166	NOT APPLICABLE	20.0	0.197-0.244	42.7-56.9	13.2-15.7
	Second time - dry season	3 November 2019	0.087-0.378	1.2-19.0	5.0-7.3	0.095-0.221	39.4-85.3	12.4-20.0	0.221-0.528	11.6-56.9	5.4-15.7
		4 November 2019	0.087-0.134	6.4-16.5	5.0-6.6	0.079-0.118	6.4	5.0-20.0	0.260-0.284	23.3-56.9	8.3-15.7
		5 November 2019	0.071-0.260	2.1-39.4	5.0-12.4	0.063-0.252	2.6-73.1	5.0-17.3	0.189-0.284	11.9-51.2	5.5-15.1
		6 November 2019	0.087-1.130	1.6-24.4	5.0-8.6	0.079-0.189	NOT APPLICABLE	20.0	0.197-0.426	1.6-25.6	5.0-8.9
		7 November 2019	0.087-1.550	2.1-10.2	5.0-5.1	0.079-0.355	4.5-73.1	5.0-20.0	0.221-1.410	13.8-28.4	6.0-9.6
		8 November 2019	0.378	1.7	5.0	0.181	3.1	5.0	0.284	1.1	5.0
		9 November 2019	0.095-0.260	7.8-39.4	5.0-12.4	0.079-0.402	17.1-51.2	6.8-20.0	0.236 - 0.300	11.1-36.6	5.3-11.7

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Table 3.5-7 The results of the vibration measurement in the project study area

Measurement points	Measurement period	Dates of measurement	Transverse						Vertical		
			X-axis		Standard speed Maximum particles	Y-axis		Standard speed Maximum particles	Z-axis		Standard speed Maximum particles[1/]
			Speed Maximum particles (millimeters/second)	Frequency (Hertz)		Speed Maximum particles (millimeters/second)	Frequency (Hertz)		Speed Maximum particles (millimeters/second)	Frequency (Hertz)	
3. Airside Area of Project	First time - rainy season	18 July 2019	0.158	NOT APPLICABLE	20.0	0.166	5.4	5.0	0.158	10.9	5.2- 5.2
		19 July 2019	0.150	NOT APPLICABLE	20.0	0.158	11.2	5.3	0.118	3.4	5.0
		20 July 2019	0.158	NOT APPLICABLE	20.0	0.071	85.3	18.5	0.315	64.0	16.4
		21 July 2019	0.181	NOT APPLICABLE	20.0	0.142	11.2	5.3	0.118	16.0	6.5
		22 July 2019	0.126-0.221	NOT APPLICABLE	5.0-20.0	0.079-0.134	8.7-34.1	5.0-11.0	0.150-0.213	1.6.0	5.0-6.5
		23 July 2019	0.142-0.173	NOT APPLICABLE	20.0	0.142-0.158	3.9-6.0	5.0	0.158-0.221	16.5-34.1	6.6-11.0
		24 July 2019	0.126-0.158	NOT APPLICABLE	20.0	0.063-0.071	14.6-20.5	6.2-7.6	0.126-0.158	5.0-13.5	5.0-5.9
	Second time - dry season	3 November 2019	0.063-0.087	21.3-85.3	7.8-18.5	0.071-0.15	2.3-51.2	5.0-15.1	0.181-0.292	26.9-73.1	9.2-17.3
		4 November 2019	0.071-0.189	8.8-42.7	5.0-13.2	0.095-0.268	7.8-42.7	5.0-13.2	0.142-0.583	3.4-42.7	5.0-13.2
		5 November 2019	0.071-0.087	9.1-85.3	5.0-18.5	0.118-0.197	1.5-36.6	5.0-11.7	0.150-0.434	5.5-46.5	5.0-14.1
		6 November 2019	0.063-0.118	5.8-51.2	5.0-15.1	0.079-0.205	4.0-56.9	5.0-15.7	0.173-0.418	2.6-73.1	5.0-17.3
		7 November 2019	0.071-0.181	10.0-51.2	5.0-15.1	0.095-0.197	1.2-30.1	5.0-10.0	0.158-0.426	9.7-46.5	5.0-14.1
		8 November 2019	0.063-0.134	4.3-85.3	5.0-18.5	0.063-0.252	8.7-56.9	5.0-15.7	0.173-0.418	1.9-73.1	5.0-17.3
		9 November 2019	0.071-0.300	7.5-73.1	5.0-17.3	0.071-0.497	1.9-64.0	5.0-16.4	0.142-1.090	2.1-64.0	5.0-16.4
4. Wat Khiri Pawanaram School	First time - rainy season	18 July 2019	0.047-071	36.6-85.3	11.7-18.5	0.087-0.150	3.1-73.1	5.0-17.3	0.197-0.481	42.7	13.2-20.0
		19 July 2019	0.047-0.102	13.5-85.3	5.9-18.5	0.095-0.150	1.1-36.6	5.0-11.7	0.252-0.552	7.2	5.0-20.0
		20 July 2019	0.221	85.3	18.5	0.189	1.3	5.0	0.252	1.2	5.0
		21 July 2019	0.063	85.3	18.5	0.095	34.1	11.0	0.244	NOT APPLICABLE	20.0
		22 July 2019	0.055-0.079	8.0-2.7	5.0-13.2	0.126-0.142	1.5-42.7	5.0-13.2	0.213-0.347	85.3	18.5-20.0
		23 July 2019	0.055-0.079	4.2-85.3	5.0-8.5	0.079-0.221	2.9-73.1	5.0-17.3	0.166-0.292	42.7-85.3	13.2-20.0
		24 July 2019	0.055-0.087	17.7-73.1	6.9-17.3	0.087-0.189	1.1-64.0	5.0-16.4	0.229-0.26	1.1-85.3	5.0-20.0
	Second time - dry season	3 November 2019	0.047	46.5-46.5	14.1	0.047	16.0	6.5	0.166	56.9	15.7
		4 November 2019	0.071	>100	20.0	0.150	52.1	15.2	0.181	51.7	15.2
		5 November 2019	0.071	73.1	17.3	0.047	73.1	17.3	0.158	85.3	18.5
		6 November 2019	0.055-0.284	36.6-51.2	11.7-20.0	0.063-0.236	73.1-85.3	17.3-18.5	0.118-0.173	73.1-85.3	17.3-18.5
		7 November 2019	0.071	73.1	17.3	0.079	56.9	15.7	0.181	85.3	18.5
		8 November 2019	0.079	NOT APPLICABLE	20.0	0.095	51.8	15.2	0.166	85.3	18.5
		9 November 2019	0.047	NOT APPLICABLE	20.0	0.055	51.2	15.1	0.181	19.7	7.4

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Table 3.5-7 The results of the vibration measurement in the project study area

Measurement points	Measurement period	Dates of measurement	Transverse						Vertical		
			X-axis		Standard speed Maximum particles	Y-axis		Standard speed Maximum particles	Z-axis		Standard speed Maximum particles[1/]
			Speed Maximum particles (millimeters/second)	Frequency (Hertz)		Speed Maximum particles (millimeters/second)	Frequency (Hertz)		Speed Maximum particles (millimeters/second)	Frequency (Hertz)	
5. Wat Phala School	First time - rainy season	18 July 2019	0.150-0.158	NOT APPLICABLE	20.0	0.047	36.6-85.3	11.7-18.5	0.055-0.063	6.7-56.9	5.0-15.7
		19 July 2019	0.150-0.158	NOT APPLICABLE	20.0	0.047-0.055	16.5-85.3	6.6-18.5	0.047-0.071	4.5-85.3	5.0-18.5
		20 July 2019	0.150	NOT APPLICABLE	20.0	0.047	51.2-85.3	15.1-18.5	0.055-0.063	10.7-85.3	5.2-18.5
		21 July 2019	0.150	NOT APPLICABLE	20.0	0.047	85.3	18.5	0.047	85.3	18.5
		22 July 2019	0.150-0.158	NOT APPLICABLE	20.0	0.047	46.5-64.0	14.1-16.4	0.055-0.063	4.5-11.6	5.0-5.4
		23 July 2019	0.150	NOT APPLICABLE	20.0	0.047-0.055	25.6-85.3	8.9-18.5	0.047-0.071	4.3-85.3	5.0-18.5
	Second time - dry season	24 July 2019	0.150-0.197	1.7	5.0-20.0	0.047-0.071	13.8-85.3	6.0-18.5	0.047-0.252	5.3-85.3	5.0-18.5
		3 November 2019	0.126-0.205	NOT APPLICABLE	20.0	0.071-0.118	5.5-30.1	5.0-10.0	0.213-0.339	18.3-64.0	7.1-16.4
		4 November 2019	0.118-0.166	2.1	5.0-20.0	0.095-0.110	19.0-46.5	7.3-14.1	0.205-0.252	20.5-36.6	7.6-11.7
		5 November 2019	0.102	NOT APPLICABLE	20.0	0.110	85.3	18.5	0.268	17.7	6.9
		6 November 2019	0.110	NOT APPLICABLE	20.0	0.095	73.1	17.3	0.229	85.3	18.5
		7 November 2019	0.142-0.158	NOT APPLICABLE	20.0	0.079-0.118	16.5-32.0	6.6 - 10.5	0.229-0.307	7.3-25.6	5.0-8.9
		8 November 2019	0.189	1.8	5.0	0.071	26.9	9.2	0.315	17.7	6.9
		9 November 2019	0.150-0.158	NOT APPLICABLE	20.0	0.079-0.102	11.1-25.6	5.3-8.9	0.252-0.268	16.0-19.0	6.5-7.3
6. Ban Khlong Bang Phai School	First time - rainy season	18 July 2019	0.047-0.166	56.9-85.3	15.7-18.5	0.063-0.481	23.3-73.1	8.3-17.3	0.166-1.19	21.3-85.3	7.8-18.5
		19 July 2019	0.039-0.118	56.9-85.3	15.7-18.5	0.102-0.331	14.2-85.3	6.1-18.5	0.166-0.347	13.8-85.3	6.0-18.5
		20 July 2019	0.055-0.126	9.7-73.1	5.0-17.3	0.071-0.386	7.3-85.3	5.0-18.5	0.173-0.370	25.6-73.1	8.9-17.3
		21 July 2019	0.039	73.1	17.3	0.071	85.3	18.5	0.166	39.4	12.4
		22 July 2019	0.055-0.063	46.5-85.3	14.1-18.5	0.173-0.205	64.0-85.3	16.4-18.5	0.142-0.268	46.5-64.0	14.1-16.4
		23 July 2019	0.047-0.173	25.6-85.3	8.9-18.5	0.063-0.465	34.1-85.3	11.0-18.5	0.126-1.180	19.7-85.3	7.4-18.5
		24 July 2019	0.055-0.079	46.5-85.3	14.1-18.5	0.142-0.244	39.4-85.3	12.4-18.5	0.126-0.347	42.7-64.0	13.2-16.4
	Second time - dry season	3 November 2019	0.039	73.1	17.3	0.158	85.3	18.5	0.331	46.5	14.1
		4 November 2019	0.047	36.6	11.7	0.189	85.3	18.5	0.197	64.0	16.4
		5 November 2019	0.055	85.3	18.5	0.071	56.9	15.7	0.236	8.3	5.0
		6 November 2019	0.039-0.063	25.6-56.9	8.9- 15.7	0.079-0.252	51.2-56.9	15.1-15.7	0.236-0.678	30.1-46.5	10.0-14.1
		7 November 2019	0.047	73.1-85.3	17.3-18.5	0.087-0.095	64.0-85.3	16.4-18.5	0.205-0.221	46.5	14.1
		8 November 2019	0.047	73.1	17.3	0.126	85.3	18.5	0.181	46.5	14.1
		9 November 2019	0.047-0.055	7.30-73.1	5.0-17.3	0.071-0.197	64.0-85.3	16.4-8.5	0.229-0.331	42.7-73.1	13.2-17.3

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Table 3.5-7 The results of the vibration measurement in the project study area

Measurement points	Measurement period	Dates of measurement	Transverse						Vertical		
			X-axis		Standard speed Maximum particles	Y-axis		Standard speed Maximum particles	Z-axis		Standard speed Maximum particles[1/]
			Speed Maximum particles (millimeters/second)	Frequency (Hertz)		Speed Maximum particles (millimeters/second)	Frequency (Hertz)		Speed Maximum particles (millimeters/second)	Frequency (Hertz)	
7. Wat Sa Kaeo School	Second time - dry season	3 November 2019	0.095	NOT APPLICABLE	20.0	0.102	73.1	17.3	0.197	73.1	17.3
		4 November 2019	0.110-0.158	1.4-.5	5.0-0.0	0.063-0.142	5.5-73.1	5.0-17.3	0.197-0.307	19.0-85.3	7.3-18.5
		5 November 2019	0.079-0.197	1.4-51.2	5.0-20.0	0.063-0.142	2.70-73.1	5.0-17.3	0.197-0.307	13.1-64.0	5.8-16.4
		6 November 2019	0.071-0.197	4.5-85.3	5.0-20.0	0.071-0.181	1.0-85.3	5.0-18.5	0.197-0.307	19.7-85.3	7.4-8.5
		7 November 2019	0.087-0.134	12.8-13.1	5.7-20.0	0.063-0.110	2.0-73.1	5.0-17.3	0.197-0.394	19.0-56.9	7.3-15.7
		8 November 2019	0.095-0.229	2.5-46.5	5.0-20.0	0.047-0.260	1.4-56.9	5.0-15.7	0.134-0.536	25.6-5.3	8.9-18.5
		9 November 2019	0.118-0.173	3.3-16.0	5.0-6.5	0.095-0.118	2.4-19.7	5.0-7.4	0.244-0.268	34.1-39.4	11.0-12.4

Notes: NOT APPLICABLE means nonexistent ZC frequency

[1/]Vibration standards to prevent impact on buildings According to Notification No. 37 of the National Environment Board, published in the Government Gazette, Volume 127, Special Section 69 Ng, dated 2 June 2010

Source : United Analyst and Engineering Consultants Co., Ltd. (Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

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3.5.3 Air quality

3.5.3.1 *Scope of Study*

Collect and study meteorological data and general atmospheric air quality that are measured in the area to use as basic information supporting the assessment of the potential impacts from the project.

3.5.3.2 *Study Methods*

(1) Secondary data

Collect relevant information, including:

- Meteorological and climatic data over a 30-year period (1989-2018) from Sattahip Meteorological Station, Department of Meteorology
- Data on air quality measurement results in the study area during the years 2014-2018 from the Pollution Control Department, 3 stations, namely Map Ta Phut Subdistrict Health Promotion Hospital, Rayong Agronomy Research Center and Rayong Provincial Agriculture Office.

(2) Primary data

Survey and measure the general atmospheric air quality, detailed as follows:

- Measurement points and measurement period Two instances of general atmospheric air quality monitoring (measured 24 hours a day continuously over 7 days). The first measurement was taken during rainy season, between 18-24 July 2019, at 6 locations comprising Pattanavechsuksa School, the staff operation building area, the project airside area, Wat Khiri Pawanaram School, Wat Phala School, Ban Khlong Bang Phai School, and Wat Sa Kaeo School. The second measurement was taken during the dry season, between 3-9 November 2019, at 7 locations, with 1 additional location at Wat Sa Kaeo School (Added according to public opinion in the first hearing, including consideration of the impact from project activities), which is a sensitive area that may be affected by the take-off and landing of aircraft. The details are shown in Table 3.5-1 and Figure 3.5-1 The installation of the tools is shown in Figure 3.5-5

  Measurement index Measured 9 indexes, including 24-hour average TSP, 24-hour average PM10, 24-hour average PM2.5, 1-hour average nitrogen oxide (NO2), 1-hour and 8-hour average carbon monoxide (CO), 3-hour average non-methane hydrocarbon (NMHC), 3-hour average total hydrocarbon (THC), volatile organic compounds (VOCs), wind direction and speed. Details are shown in Table 3.5-8.

Table 3.5-8 Air quality index and analysis method

Index	Analysis method
1. 24-hour average total suspended particulates (TSP)	Gravimetric (High Volume Method) [1/]
2. 24-hour average particulate matter with a diameter of less than 10 microns (PM_{10})	Gravimetric (High Volume Method) [1/]
3. 24-hour average particulate matter with a diameter of less than 2.5 microns ($PM_{2.5}$)	Gravimetric (Low Volume Method)[2/]
4. 1-hour average nitrogen oxide (NO_2)	Chemiluminescence Method [3/]
5. 1-hour average and 8-hour average carbon monoxide (CO)	Non-dispersive Infrared Detection Method (NDIR) [1/]
6. 3-hour average non-methane hydrocarbon (NMCHC)	Total Hydrocarbons Analyzer (FID) Method [4/]
7. Total Hydrocarbons (TCHC) 8. 3-hour average	Total Hydrocarbons Analyzer (FID) Method [4/]
9. Volatile organic compounds (VOCs)	Canister, Gas Chromatography/Mass Spectrometry[5/]
10. Wind speed and wind direction (WS/WD)	Wind Speed and Wind Direction Equipment [4/]

Note : [1/] Announcement of the National Environment Board No. 10 (1995) issued under the National Environmental Quality Promotion and Conservation Act of 1992 Re: Determination of General Atmospheric Air Quality Standards.

[2]/Announcement of the National Environment Board No. 36 (2010) Re: Determination of Standards for PM2.5 Particulates in the General Atmosphere

[3/] Announcement of the National Environment Board No. 33 (2009) Re: Determination of General Atmospheric Nitrogen Dioxide Standards

[4/] U.S. EPA. Method July, 2011

[5/] U.S. EPA Method TO-15

1. Pattanavechsuksa School

2. Staff operations building area

3. Airside Area of Project

4. Wat Khiri Pawanaram School

5. Wat Phala School

6. Ban Khlong Bang Phai School

7. Wat Sa Kaeo School

Figure 3.5-5 Air quality monitoring point, direction and wind speed in the project study area

3.5.3.3 *Study Results*

(1) Secondary data

Meteorological conditions in the project study area

The results of collecting climate statistical data for the 30-year period (1989-2018) from the Sattahip Meteorological Department meteorological stations, which is located near the area of U-Tapao International Airport, has details of meteorological statistics and wind plans for the 30-year period (1989-2018) for Sattahip Meteorological Station shown as follows: Table 3.5-9 and Figure 3.5-6 and can be summarized as follows:

1) Atmospheric pressure

The annual average atmospheric pressure is 1,009.2 hectopascals, ranging from 1,007.0-1,011.9 hectopascals. The difference in daily atmospheric pressure average was 6.34 hectopascals. The maximum observed air pressure was 1,027.9 hectopascals in December, and the minimum observed air pressure was 991.3 hectopascals in October.

2) Temperature

The average temperature throughout the year was 28.2 degrees Celsius. The minimum and maximum temperatures throughout the year were 10.0-38.7 degrees Celsius. The month with the highest average temperature was April, equal to 34.0 degrees Celsius and the month with the lowest average temperature was December, with the temperature measured at 21.2 degrees Celsius.

3) Relative humidity

The average relative humidity throughout the year was 77 percent, ranging from 71-83 percent. The maximum average throughout the year was 90 percent. The minimum average throughout the year was 60.5%. The highest mean relative humidity was 95 percent in October. The lowest relative humidity was 4 percent in December.

4) Cloud volume

The average amount of cloud cover in the sky is 7/10ths with a range of 5.4-8.4/10ths of the sky. The period found to have the highest amount of cloud cover is during the rainy season. In August, there is the most cloud cover in the sky, as much as 8.4/10ths of the sky. The month with the least cloud cover is January, with the amount of clouds equal to 5.4/10ths of the sky.

5) Wind speed and direction

The average wind speed throughout the year is 4.4 knots, ranging from 3.2-5.0 knots. June has the maximum wind speed of 40 knots, with most of the wind direction coming from the southwest.

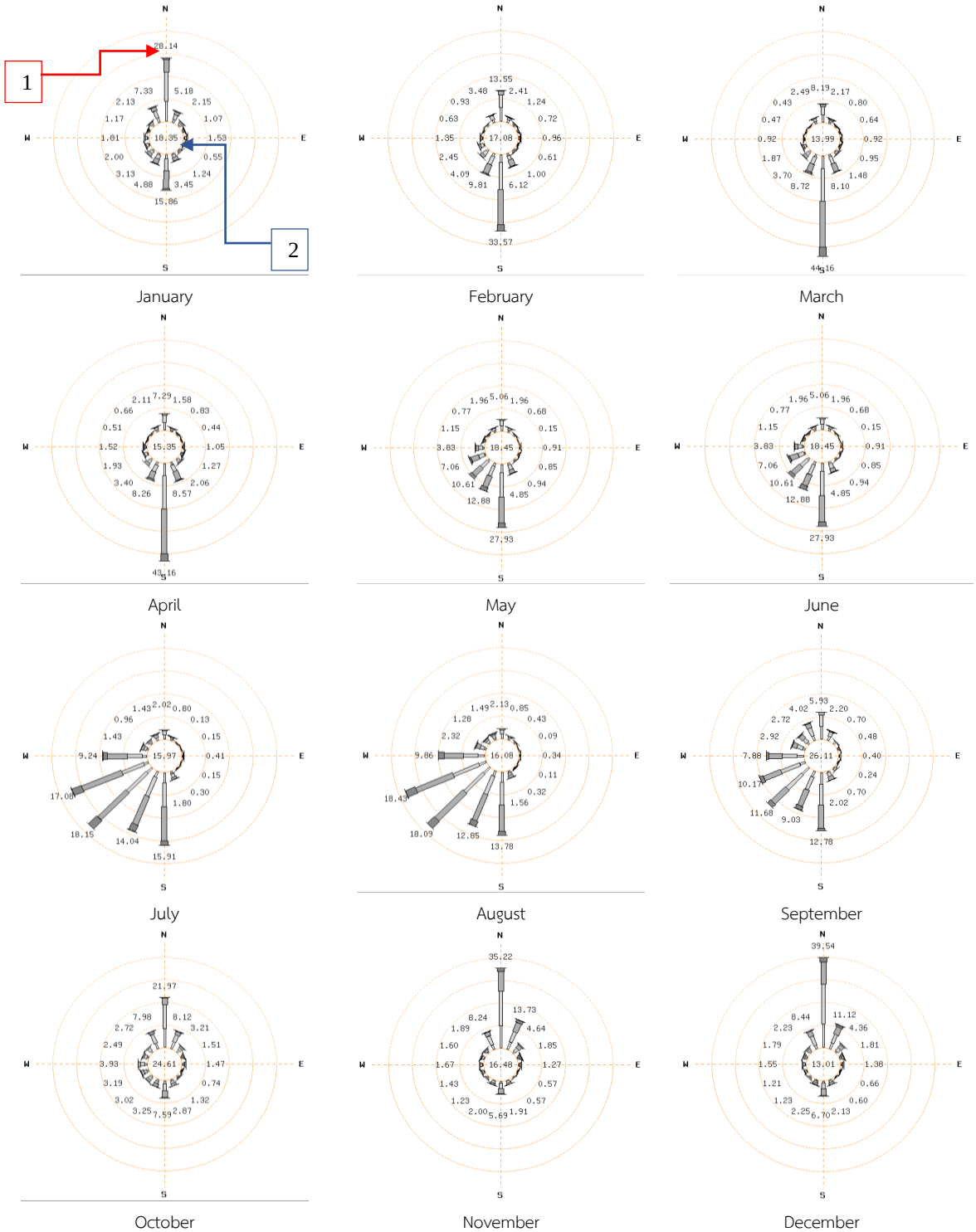
6) Rainfall

The average monthly rainfall is 108.8 millimeters with the average number of rainy days being 10. The average rainfall during the rainy season (May to October) ranges from 156.2-208.8 mm. October is the wettest month with 19 days and an average rainfall of 266.5 mm. December is the month with the least rainfall with 2 days, and an average rainfall of 11.0 mm.

Table 3.5-9 Meteorological statistics in the 30-year period (1989-2018) of the Sattahip Meteorological Station

Information		January	February	March	April	May	June	July	August	September	October	November	December	Annual
Air pressure (Hextopascal)	Average	1,011.9	1,011.6	1,010.5	1,008.8	1,007.4	1,007.0	1,007.1	1,007.2	1,007.7	1,009.0	1,010.3	1,011.7	1,009.2
	Different daily	5.20	4.30	4.40	6.50	7.10	5.70	5.50	5.60	9.60	8.50	7.40	6.30	6.34
	Maximum	1,020.5	1,019.7	1,021.6	1,016.6	1,014.2	1,020.3	1,01.3	1,013.9	1,016.5	1,016.7	1,017.9	1,027.9	1,027.9
	Minimum	1,005.2	1,004.5	1,002.5	1,001.0	1,001.9	999.7	994.8	1,000.6	1,001.0	991.3	1,001.3	1,002.8	991.3
Temperature (degrees Celsius)	Maximum	32.4	32.6	33.0	34.0	33.9	33.5	33.0	33.1	32.8	32.6	33.1	32.8	33.1
	Maximum	36.5	36.5	37.8	38.7	38.7	37.5	37.0	37.2	36.2	36.2	36.9	36.6	38.7
	Minimum average	21.4	23.0	24.9	26.1	26.1	26.1	25.7	25.7	25.0	23.9	22.7	21.2	24.3
	Minimum	13.2	13.6	17.6	10.0	18.4	21.7	19.1	19.8	21.5	18.0	16.0	11.2	10.0
	Average	26.3	27.4	28.7	29.8	29.8	29.5	29.1	29.0	28.3	27.5	27.2	26.3	28.2
Relative humidity (Percentage)	Average	75	76	77	76	78	77	77	77	81	83	76	71	77
	Maximum	91	91	90	89	90	89	89	89	93	95	90	87	90
	Minimum average	54	58	62	62	64	63	64	63	66	65	56	50	60.5
	Minimum	15	16	20	14	33	33	37	16	19	14	12	4	4
Cloudiness (1-10)	Average	5.4	5.6	6.0	6.3	7.6	8.1	8.2	8.4	8.3	7.7	6.2	5.6	7.0
Wind speed (knots)	Direction	N	S	S	S	S	SW	SW	SW	SW	N	N	N	-
	Average wind	3.8	4.4	4.9	4.8	4.5	4.8	5.0	4.9	3.8	3.2	4.0	4.3	4.4
	Maximum wind	29.0	21.0	29.0	38.0	37.0	40.0	31.0	38.0	35.0	32.0	28.0	32.0	40.0
Rainfall (mm)	Average	40.1	23.8	63.5	91.1	165.8	142.1	112.1	95.1	234.7	266.5	59.6	11.0	1,305.4
	Number of rainy	4.4	3.3	5.7	7.3	12.9	13.3	13.3	14.0	17.1	19.0	6.3	2.2	118.8
	Maximum per day	59.7	38.3	101.5	120.0	156.2	160.3	57.5	72.8	125.9	208.8	80.1	28.4	208.8
Number of days with	clouds	1.8	1.1	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.2	0.1	0.4	4.0
	Fog	13.2	10.8	6.3	5.9	1.1	0.9	0.9	0.9	0.7	5.6	10.8	15.3	72.4
	Hail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Thunderstorms	0.4	0.8	2.1	3.2	6.7	4.1	3.1	2.2	6.7	9.0	2.5	0.6	41.4
	Storms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note : Sattahip Meteorological Station, code 48477, latitude 12 degrees, 41 minutes north, longitude 100 degrees 59 minutes east, 16 meters above mean sea level.
Source: Department of Meteorology, 2019



Note: 1 means the number at the arm-end of the flow chart, i.e. the percentage frequency of wind in each direction.
2 means the middle number of the flow chart, i.e. the percentage frequency for calmness.

Source : Department of Meteorology, 2019

Figure 3.5-6 30-year period wind plan (1989-2018) Sattahip Meteorological Station

Air quality near project study area

From the review of the situation report and air quality in Thailand during the years 2014-2018 of the Pollution Control Department, it was found that there were 3 air quality monitoring stations nearby the study area of the project, name ly Map Ta Phut Subdistrict Health Promotion Hospital, Rayong Provincial Agriculture Office and Rayong Agronomy Research Center. The air

quality was measured with 6 indexes, namely: 24-hour average PM2.5, 24-hour average PM10, 1-hour average sulfur dioxide, 1-hour average nitrogen dioxide, 1-hour average and 8-hour average carbon monoxide (details shown in Figure 3.5-7 and Table 3.5-10), which can be summarized as follows:

1) Map Ta Phut Subdistrict Health Promotion Hospital

24-hour average for PM2.5 in 2018 ranged 0.007-0.098 milligrams per cubic meter. Most of the measurement results are in the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter, except 5 days during the dry season (out of 155 measurement days), or 3.23 percent, that exceeded the specified standard.

24-hour average for PM10 from 2014-2018 ranged 0.012-0.178 milligrams per cubic meter. Most of the measurement results are within the general atmospheric air quality standards for PM10 according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.12 milligrams per cubic meter, except 31 days during the dry season (out of 1,292 measurement days), or 2.40 percent, that exceeded the specified standard.

1-hour average for sulfur dioxide is in the range of 0-0.125 parts per million, which is in the standard for 1-hour sulfur dioxide in the general atmosphere values according to Notification No. 21 of the National Environment Board (2001) which requires values to not exceed 0.30 parts per million.

1-hour average for nitrogen dioxide is in the range of 0-0.089 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0-7.4 parts per million and 8-hour average carbon monoxide is in the range of 0-4.18 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

2) Rayong Provincial Agriculture Office

24-hour average for PM2.5 from 2014-2018 ranged 0.004-0.087 milligrams per cubic meter. Most of the measurement results are in the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter, except 96 days during the dry season (out of 1,658 measurement days), or 5.79 percent, that exceeded the specified standard.

24-hour average for PM10 from 2014-2018 ranged 0.008-0.110 milligrams per cubic meter. Most of the measurement results are in the standard for 24-hour average PM10 according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.12 milligrams per cubic meter.

1-hour average for sulfur dioxide is in the range of 0-0.027 parts per million, which is in the standard for 1-hour sulfur dioxide in the general atmosphere values according to Notification No. 21 of the National Environment Board (2001) which requires values to not exceed 0.30 parts per million.

1-hour average for nitrogen dioxide is in the range of 0-0.107 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0-4.1 parts per million and 8-hour average carbon monoxide is in the range of 0-3.04 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3) Agronomy Research Center

24-hour average for PM2.5 in 2018 ranged 0.004-0.069 milligrams per cubic meter. Most of the measurement results are in the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for PM10 from 2014-2018 ranged 0.006-0.129 milligrams per cubic meter. Most of the measurement results are in the standard for PM10 in the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.12 milligrams per cubic meter, except 14 days during the dry season (out of 778 measurement days), or 1.80 percent, that exceeded the specified standard.

Draft Version

1-hour average for sulfur dioxide is in the range of 0-0.296 parts per million, which is in the standard for 1-hour sulfur dioxide in the general atmosphere values according to Notification No. 21 of the National Environment Board (2001) which requires values to not exceed 0.30 parts per million.

1-hour average for nitrogen dioxide is in the range of 0-0.103 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0-4.9 parts per million and 8-hour average carbon monoxide is in the range of 0-2.32 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

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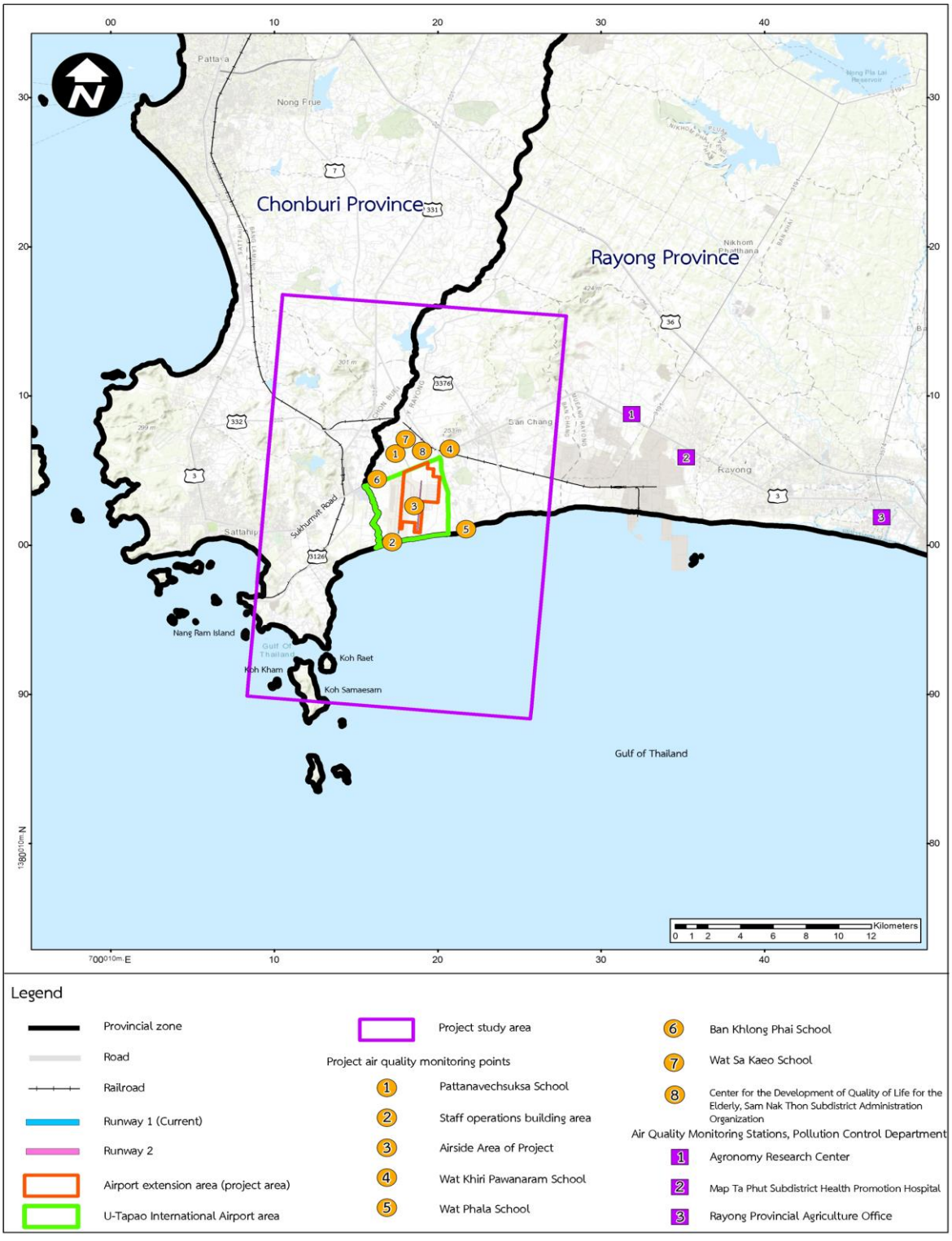


Figure 3.5-7 Air quality monitoring points near the project area of the Pollution Control Department

Table 3.5-10 Air quality data in the vicinity of the project study area during the years 2014-2018

Monitoring station	Year of measurement	24-hour average PM2.5 (mg/m3)	PM10 24-hour average (mg/mm3)	1-hour average sulfur dioxide (ppm)	1-hour average nitrogen dioxide (NO2) (ppm)	1-hour average carbon monoxide (CO) (ppm)	8-hour average carbon monoxide (CO) (ppm)
Health Promotion Hospital, Map Ta Phut Subdistrict, Mueang District, Rayong	Year 2014	-	0.016-0.117	0-0.125	0-0.089	0-3.9	0-2.61
	Year 2015	-	0.012-0.139	0-0.093	0-0.063	0-3.2	0.05-2.84
	Year 2016	-	0.012-0.105	0-0.115	0-0.082	0–7.4	0.03-4.18
	Year 2017	-	0.014-0.128	0-0.061	0-0.055	0-4.7	0.14-2.08
	Year 2018	0.007-0.098	0.022-0.178	0-0.098	0-0.074	0-1.68	0-1.39
Min-Max values		0.007-0.098	0.012-0.178	0-0.125	0-0.089	0–7.4	0-4.18
Rayong Provincial Agriculture Office Station, Mueang District, Rayong	Year 2014	0.004-0.074	0.009-0.079	0.001-0.022	0.001-0.093	0.1-4.1	0.14-3.04
	Year 2015	0.006-0.087	0.014-0.110	0–0.027	0-0.084	0.2-3.4	0.29-2
	Year 2016	0.005-0.082	0.008-0.106	0–0.022	0-0.083	0-3.1	0-2.19
	Year 2017	0.006-0.066	0.014-0.088	0-0.018	0-0.089	0-2.9	0.09-2.43
	Year 2018	0.004-0.075	0.013-0.118	0-0.019	0-0.107	0-2.9	0-2.01
Min-Max values		0.004-0.087	0.008-0.110	0–0.027	0-0.107	0-4.1	0-3.04
Agronomy Research Center Mueang District, Rayong	Year 2014	-	0.011-0.129	0-0.296	0-0.056	0-1.98	0.05-1.16
	Year 2015	-	0.009-0.112	0-0.055	0-0.069	0-4.9	0-2.32
	Year 2016	-	0.014-0.126	0-0.054	0-0.103	0-3.4	0-1.95
	Year 2017	-	0.006-0.096	0-0.055	0-0.075	0-3	0-2.17
	Year 2018	0.004-0.069	0.009-0.097	0-0.055	0-0.062	0-2	0-1.01
Min-Max values		0.004-0.069	0.006-0.129	0-0.296	0-0.103	0–4.9	0–2.32
Standard		0.05[1/]	0.12[2/]	0.30[3/]	0.17[4/]	30[5/]	9[5/]

Note : underlined means that the standard value is exceeded

(-) means there is no report in the database

[1/]Announcement of the National Environment Board No. 36 (2010) Re: Determination of Standards for PM2.5 Particulates in the General Atmosphere

[2/]Announcement of the National Environment Board No. 24 (2004) Re: Determination of General Atmospheric Air Quality Standards

[3/]Announcement of the National Environment Board No. 21 (2010) Re: Determination of Standards for 1-Hour Sulfur Dioxide in the General Atmosphere

[4/]Announcement of the National Environment Board No. 33 (2009) Re: Determination of General Atmospheric Nitrogen Dioxide Standards

[5/]Announcement of the National Environment Board No. 10 (1995) Re: Determination of General Atmospheric Air Quality Standards

Source : Annual air quality data 2014-2018, Office of Air Quality and Noise Management, Pollution Control Department

(2) Primary data

Wind speed and wind direction (WS/WD)

Results from two instances of measuring the direction and speed of wind in the project area. The first measurement was taken during rainy season, between 18-24 July 2019, at 6 locations comprising Pattanavechsuksa School, the staff operation building area, the project airside area, Wat Khiri Pawanaram School, Wat Phala School, Ban Khlong Bang Phai School, and Wat Sa Kaeo School. The second measurement was taken during the dry season, between 3-9 November 2019, at 7 locations, with 1 additional location at Wat Sa Kaeo School, which was deemed a sensitive area that may be impacted. It was found that all values were within standards at all locations. The measurement results are shown in Table 3.5-11 and Figure 3.5-8 (details are shown in Appendix 3-3) which can be summarized as follows:

1) Pattanavechsuksa School

For wind direction and speed, it was found that during the rainy season, the wind direction mostly comes from the west (W) and west-southwest (WSW) with wind speeds in the range of 0.3-1.9 meters per second. During the dry season, most of the winds come from the east-southeast (ESE) and northeast (NE) with wind speeds in the range of 0.5-1.5 meters per second.

2) Staff operations building area

For wind direction and speed, it was found that during the rainy season, the wind direction mostly comes from west-southwest (WSW) with wind speeds in the range of 1.9-4.3 meters per second. During the dry season, most of the winds come from the south-southeast (SSE) with wind speeds in the range of 2.5-5.5 meters per second.

3) Airside Area of Project

For wind direction and speed, it was found that during the rainy season, the wind direction mostly comes from the west (W) with wind speeds in the range of 0.8-3.8 meters per second. During the dry season, most of the winds come from the east (E) and east-southeast (ESE) with wind speeds in the range of 0.8-2.5 meters per second.

4) Wat Khiri Pawanaram School

For wind direction and speed, it was found that during the rainy season, the wind direction mostly comes from the west (W) and west-southwest (WSW) with wind speeds in the range of 0.4-2.2 meters per second. During the dry season, most of the winds come from the east-northeast (ENE) and east-southeast (ESE) with wind speeds in the range of 0.5-1.7 meters per second.

5) Wat Phala School

For wind direction and speed, it was found that during the rainy season, the wind direction mostly comes from west-southwest (WSW) with wind speeds in the range of 0.3-2.2 meters per second. During the dry season, most of the winds come from the east-northeast (ENE) with wind speeds in the range of 0.5-2.8 meters per second.

6) Ban Khlong Bang Phai School

For wind direction and speed, it was found that during the rainy season, the wind direction mostly comes from the west (W) with wind speeds in the range of 0.3-2.9 meters per second. During the dry season, most of the winds come from the northeast (NE) and east-northeast (ENE) with wind speeds in the range of 0.5-1.8 meters per second.

7) Wat Sa Kaeo School

For wind direction and speed, it was found that during the dry season, most of the winds come from the east-northeast (ENE) with wind speeds in the range of 1.0-2.4 meters per second.

Table 3.5-11 The measurement of direction and wind speed results in the project study area

Measurement points	Measurement period	Dates of measurement	Average wind speed (m/s)	Wind direction Mostly
1. Pattanavechsuksa School	First time - rainy season	18 July 2019	0.5-1.4	W
		19 July 2019	0.3-1.7	W
		20 July 2019	0.4-1.8	WSW, W
		21 July 2019	0.4-2.0	W
		22 July 2019	0.3-1.7	WSW
		23 July 2019	0.3-1.5	WSW
		24 July 2019	0.3-1.9	WSW

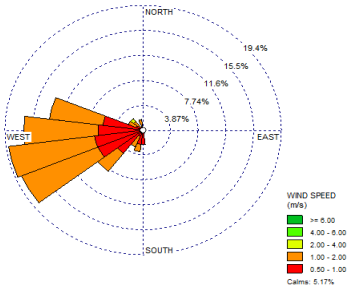
Table 3.5-11 The measurement of direction and wind speed results in the project study area

Measurement points	Measurement period	Dates of measurement	Average wind speed (m/s)	Wind direction Mostly
	Second time - dry season	3 November 2019	0.5-1.2	ENE
		4 November 2019	0.6-1.5	NE
		5 November 2019	0.6-1.3	ESE
		6 November 2019	0.5-1.3	ESE
		7 November 2019	0.5-1.4	SE
		8 November 2019	0.6-1.3	NNE, NE, ESE
		9 November 2019	0.6-1.4	ENE, NE, E
2. Staff operations building area	First time - rainy season	18 July 2019	2.1-3.4	WSW, W
		19 July 2019	2.0-3.9	SW
		20 July 2019	2.0-4.3	SW
		21 July 2019	2.0-3.3	WSW
		22 July 2019	2.2-3.7	WSW
		23 July 2019	1.9-3.4	SW
		24 July 2019	1.9-3.4	WSW
	Second time - dry season	3 November 2019	2.8-4.5	SE
		4 November 2019	2.5-5.0	ESE
		5 November 2019	2.9-5.5	SE
		6 November 2019	2.6-4.2	SSE
		7 November 2019	2.9-4.8	ESE
	Second time - dry season	8 November 2019	2.8-4.6	SSE
		9 November 2019	2.7-4.6	SSE
3. Airside Area of Project	First time - rainy season	18 July 2019	1.8-3.3	W
		19 July 2019	0.8-3.8	W
		20 July 2019	1.6-3.8	W
		21 July 2019	2.0-3.8	SW, W
		22 July 2019	1.6-3.7	WNW
		23 July 2019	1.8-3.7	WSW
		24 July 2019	1.7-3.8	SW
		3 November 2019	1.3-2.2	ESE
	Second time - dry season	4 November 2019	0.8-2.4	E
		5 November 2019	1.3-2.4	E, ESE
		6 November 2019	1.3-2.5	E
		7 November 2019	1.2-2.5	ESE
		8 November 2019	1.2-2.5	E
		9 November 2019	1.2-2.5	E, ESE
4. Wat Khiri Pawanaram School	First time - rainy season	18 July 2019	0.8-1.7	W
		19 July 2019	0.4-2.2	WSW, W
		20 July 2019	0.6-2.1	WSW
		21 July 2019	0.6-2.1	W
		22 July 2019	0.4-1.8	W
		23 July 2019	0.7-1.9	WSW
		24 July 2019	0.4-2.0	WSW
	Second time - dry season	3 November 2019	0.8-1.4	ESE
		4 November 2019	0.5-1.7	ENE
		5 November 2019	0.8-1.6	ENE, E, ESE
		6 November 2019	0.6-1.6	NNE
		7 November 2019	0.5-1.5	ENE, ESE
		8 November 2019	0.7-1.4	ESE
		9 November 2019	0.5-1.5	ENE

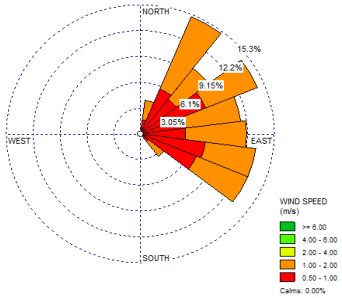
Table 3.5-11 The measurement of direction and wind speed results in the project study area

Measurement points	Measurement period	Dates of measurement	Average wind speed (m/s)	Wind direction Mostly
5. Wat Phala School	First time - rainy season	18 July 2019	0.3-1.4	W, WSW
		19 July 2019	0.3-1.8	WSW
		20 July 2019	0.4-1.9	WSW
		21 July 2019	0.3-1.5	SW, SSW
		22 July 2019	0..3-1.7	SW
	First time - rainy season	23 July 2019	0.3-1.7	NW, WNW
		24 July 2019	0.5-2.2	W
	Second time - dry season	3 November 2019	0.8-1.9	ENE
		4 November 2019	0.6-2.4	ESE
		5 November 2019	0.7-2.8	ENE
		6 November 2019	0.6-2.3	ENE
		7 November 2019	0.6-2.5	SE
		8 November 2019	0.5-2.5	ENE
		9 November 2019	1.2-2.5	SE
6. Ban Khlong Bang Phai School	First time - rainy season	18 July 2019	0.3-2.4	W
		19 July 2019	0.3-2.4	WSW
		20 July 2019	0.4-2.8	W
		21 July 2019	0.5-2.9	W
		22 July 2019	0.5-2.2	SW
		23 July 2019	0.3-2.2	SW
		24 July 2019	0.3-2.2	W
	Second time - dry season	3 November 2019	0.6-1.7	ENE
		4 November 2019	0.5-1.6	E
		5 November 2019	0.6-1.8	NE
		6 November 2019	0.6-1.8	ENE, NE, E
		7 November 2019	0.6-1.6	ENE
		8 November 2019	0.5-1.6	NE
		9 November 2019	0.5-1.6	NE
7. Wat Sa Kaeo School	Second time - dry season	3 November 2019	1.3-2.2	ENE
		4 November 2019	1.1-2.4	NNE
		5 November 2019	1.1-2.2	E
		6 November 2019	1.0-2.1	NE
		7 November 2019	1.1-1.9	ENE
		8 November 2019	1.1-2.4	ENE
		9 November 2019	1.1-2.3	E

Source : United Analyst and Engineering Consultants Co., Ltd.,
(Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

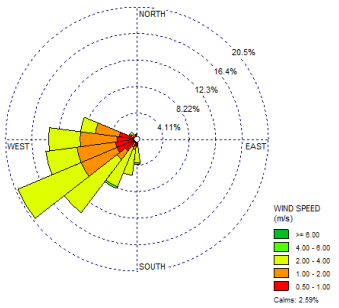


First time - rainy season

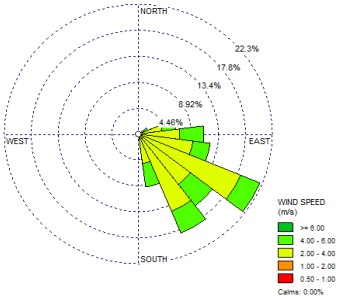


Second time - dry season

1. Pattanavechsuksa School

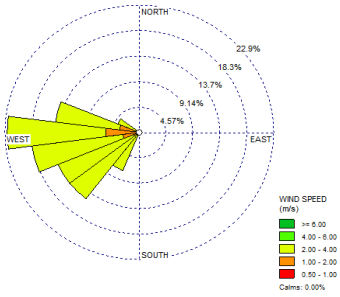


First time - rainy season

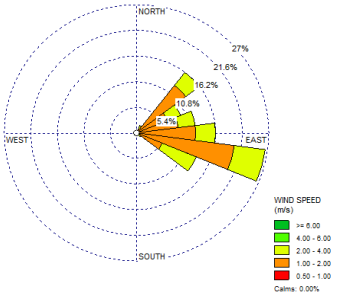


Second time - dry season

2. Staff operations building area

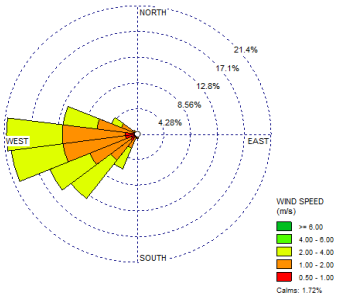


First time - rainy season

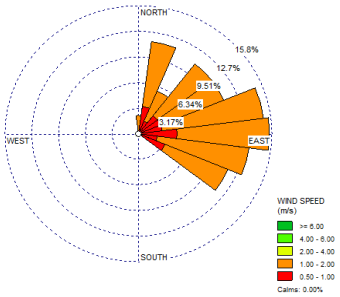


Second time - dry season

3. Airside Area of Project



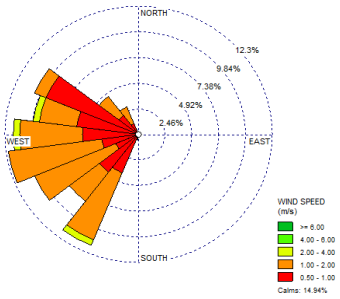
First time - rainy season



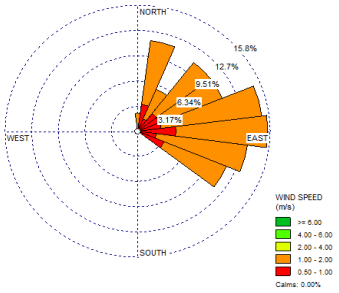
Second time - dry season

4. Wat Khiri Pawanaram School

Figure 3.5-8 Wind direction and speed plan in the project study area

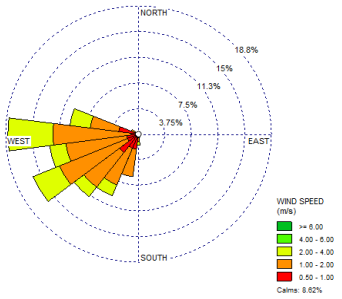


First time - rainy season

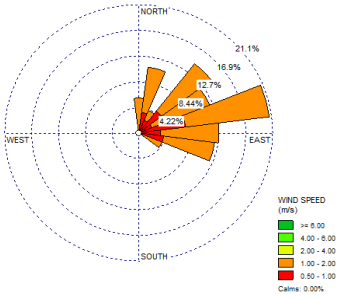


Second time - dry season

5. Wat Phala School



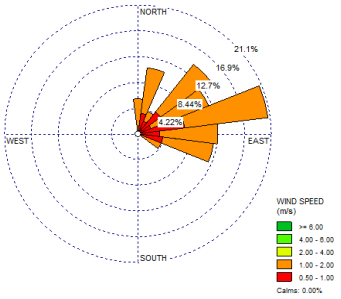
First time - rainy season



Second time - dry season

6. Ban Khlong Bang Phai School

-



First time - rainy season

Second time - dry season

7. Wat Sa Kaeo School

Notes: The rainy season between 18-24 July 2019
The dry season between 3-9 November 2019
Wat Sa Kaeo School took only 1 measurement during the dry season.

Figure 3.5-8 Wind direction and speed plan in the project study area

General Atmospheric Air Quality

Two instances of general atmospheric air quality monitoring in the project area. The first measurement was taken during rainy season, between 18-24 July 2019, at 6 locations comprising Pattanavechsuksa School, the staff operation building area, the project airside area, Wat Khiri Pawanaram School, Wat Phala School, Ban Khlong Bang Phai School, and Wat Sa Kaeo School. The second measurement was taken during the dry season, between 3-9 November 2019, at 7 locations, with 1 additional location at Wat Sa Kaeo School, which was deemed a sensitive area that may be impacted. It was found that all values were within standards at all locations. The details of the measurement results are shown in Table 3.5-12 and Table 3.5-13 (details are shown in Appendix 3-3) which can be summarized as follows:

1) Pattanavechsuksa School

- Rainy season

24-hour average for TSP ranged 0.026-0.065 milligrams per cubic meter and 24-hour average for PM10 ranged 0.011-0.026 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.002-0.008 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0005-0.0081 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 1.06-1.96 parts per million and 8-hour average carbon monoxide is in the range of 1.40-1.72 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.65-1.36 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.72-3.05 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

- Dry season

24-hour average for TSP ranged 0.065-0.142 milligrams per cubic meter and 24-hour average for PM10 ranged 0.032-0.064 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.018-0.040 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0020-0.0129 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0.66-1.64 parts per million and 8-hour average carbon monoxide is in the range of 1.08-1.39 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.68-1.35 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.67-2.63 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

2) Staff operations building area

- Rainy season

24-hour average for TSP ranged 0.032-0.074 milligrams per cubic meter and 24-hour average for PM10 ranged 0.013-0.028 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.004-0.008 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide has values less than 0.0004-0.0019 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0.66-1.36 parts per million and 8-hour average carbon monoxide is in the range of 0.73-1.24 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.76-1.38 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.71-2.97 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, ben zene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

- Dry season

24-hour average for TSP ranged 0.035-0.083 milligrams per cubic meter and 24-hour average for PM10 ranged 0.024-0.058 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.016-0.034 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0004-0.0090 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0.81-1.23 parts per million and 8-hour average carbon monoxide is in the range of 0.85-1.14 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.83-1.37 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.66-2.63 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

3) Airside Area of Project

- Rainy season

24-hour average for TSP ranged 0.023-0.045 milligrams per cubic meter and 24-hour average for PM10 ranged 0.010-0.017 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.003-0.007 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0004-0.0103 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0.88-1.18 parts per million and 8-hour average carbon monoxide is in the range of 0.90-1.13 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million.

3-hour average for non-methane hydrocarbon is in the range of 0.69-1.25 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.60-2.81 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

- Dry season

24-hour average for TSP ranged 0.034-0.081 milligrams per cubic meter and 24-hour average for PM10 ranged 0.019-0.050 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.014-0.038 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0013-0.0048 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0.84-1.27 parts per million and 8-hour average carbon monoxide is in the range of 0.93-1.17 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.66-1.24 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.60-2.49 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

4) Wat Khiri Pawanaram School

- Rainy season

24-hour average for TSP ranged 0.035-0.051 milligrams per cubic meter and 24-hour average for PM10 ranged 0.013-0.022 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 had values less than 0.002-0.008 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0040-0.0130 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 1.10-1.52 parts per million and 8-hour average carbon monoxide is in the range of 1.19-1.43 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.79-1.55 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.74-2.98 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

- Dry season

24-hour average for TSP ranged 0.031-0.071 milligrams per cubic meter and 24-hour average for PM10 ranged 0.017-0.042 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.006-0.030 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0007-0.0133 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0.98-1.40 parts per million and 8-hour average carbon monoxide is in the range of 1.08-1.32 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.81-1.25 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.85-2.54 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

5) Wat Phala School

- Rainy season

24-hour average for TSP ranged 0.024-0.044 milligrams per cubic meter and 24-hour average for PM10 ranged 0.011-0.026 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.003-0.007 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0015-0.0071 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0.96-1.54 parts per million and 8-hour average carbon monoxide is in the range of 1.11-1.45 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.69-1.19 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.66-2.82 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

- Dry season

24-hour average for TSP ranged 0.069-0.089 milligrams per cubic meter and 24-hour average for PM10 ranged 0.030-0.053 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.017-0.037 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0006-0.0094 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 1.00-1.43 parts per million and 8-hour average carbon monoxide is in the range of 1.12-1.37 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.79-1.30 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.87-2.59 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

6) Ban Khlong Bang Phai School

- Rainy season

24-hour average for TSP ranged 0.028-0.039 milligrams per cubic meter and 24-hour average for PM10 ranged 0.016-0.023 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.002-0.007 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0069-0.0424 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0.75-1.24 parts per million and 8-hour average carbon monoxide is in the range of 0.84-1.13 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.72-1.47 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.72-2.93 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

- Dry season

24-hour average for TSP ranged 0.035-0.074 milligrams per cubic meter and 24-hour average for PM10 ranged 0.025-0.053 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.016-0.034 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0004-0.0064 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0.77-1.28 parts per million and 8-hour average carbon monoxide is in the range of 0.83-1.14 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.78-1.37 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.77-2.97 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

7) Wat Sa Kaeo School

- Dry season

24-hour average for TSP ranged 0.035-0.089 milligrams per cubic meter and 24-hour average for PM10 ranged 0.024-0.053 milligrams per cubic meter, which are within the general atmospheric air quality standards according to Notification No. 24 of the National Environment Board (2004) which requires values to not exceed 0.33 and 0.12 milligrams per cubic meter, respectively.

24-hour average for PM2.5 ranged 0.016-0.039 milligrams per cubic meter, which are within the standard for PM2.5 in the general atmosphere according to Notification No. 36 of the National Environment Board (2010) which requires values to not exceed 0.05 milligrams per cubic meter.

24-hour average for nitrogen dioxide is in the range of 0.0012-0.0096 parts per million, which is in the standard for 1-hour nitrogen dioxide in the general atmosphere values according to Notification No. 33 of the National Environment Board (2009) which requires values to not exceed 0.17 parts per million.

1-hour average for carbon monoxide is in the range of 0.85-1.28 parts per million and 8-hour average carbon monoxide is in the range of 0.93-1.18 parts per million, which is in the general atmospheric air quality standards according to Notification No. 10 of the National Environment Board (1995) which requires values to not exceed 30 parts per million and 9 parts per million respectively.

3-hour average for non-methane hydrocarbon is in the range of 0.90-1.25 parts per million. Currently there is no standard measurements.

3-hour average total hydrocarbon is in the range of 1.81-2.52 parts per million. Currently there is no standard measurements.

Volatile organic compounds are relatively low which are in the surveillance values for volatile organic compounds in the general atmosphere within 24 hours, according to the Notification of the Pollution Control Department (2009) which set 19 types of surveillance values for volatile organic compounds including: acetaldehyde, acrolein, acrylonitrile, benzene, benzyl chloride, 1,3-butadiene, bromomethane, carbon tetrachloride, chloroform, 1,2-dibromoethane, 1,4-dichlorobenzene, 1,2-dichloroethane, dichloromethane, 1,2-dichloropropane, 1,4-dioxane tetrachloroethylene, 1,1,2,2-tetrachloroethane Trichloro-ethylene and vinyl chloride. Carbon disulfide is within the general atmospheric carbon disulfide standard according to the Notification of the National Environment Board (2012). For other Volatile Organic Compounds, at present, Thailand has not set a standard to control them.

Table 3.5-12 Results of general atmospheric air quality measurements in the project study area

Measurement points	Measurement period	Dates of measurement	Total suspended particulate 24-hour average (mg/mm3)	24-hour average PM10 (mg/m3)	24-hour average PM2.5 (mg/m3)
1. Pattanavechsuksa School	First time - rainy season	18-19 July 2019	0.047	0.020	0.005
		19-20 July 2019	0.056	0.016	0.006
		20-21 July 2019	0.026	0.011	0.005
		21-22 July 2019	0.051	0.021	0.002
		22-23 July 2019	0.056	0.017	0.006
		23-24 July 2019	0.065	0.026	0.007
		24-25 July 2019	0.064	0.026	0.008
	Min-Max values		0.026-0.065	0.011-0.026	0.002-0.008
	Second time - dry season	3-4 November 2019	0.065	0.032	0.018
		4-5 November 2019	0.119	0.063	0.037
		5-6 November 2019	0.142	0.058	0.040
		6-7 November 2019	0.098	0.049	0.027
		7-8 November 2019	0.108	0.052	0.031
		8-9 November 2019	0.119	0.064	0.037
		9-10 November 2019	0.122	0.060	0.034
	Min-Max values		0.065-0.142	0.032-0.064	0.018-0.040
2. Staff operations building area	First time - rainy season	18-19 July 2019	0.059	0.024	0.004
		19-20 July 2019	0.074	0.028	0.006
		20-21 July 2019	0.072	0.026	0.004
		21-22 July 2019	0.033	0.013	0.004
		22-23 July 2019	0.054	0.023	0.008
		23-24 July 2019	0.044	0.020	0.006
		24-25 July 2019	0.032	0.014	0.007
	Min-Max values		0.032-0.074	0.013-0.028	0.004-0.008
		3-4 November 2019	0.035	0.024	0.016

Table 3.5-12 Results of general atmospheric air quality measurements in the project study area

Measurement points	Measurement period	Dates of measurement	Total suspended particulate 24-hour average (mg/mm3)	24-hour average PM10 (mg/m3)	24-hour average PM2.5 (mg/m3)
	Second time - dry season	4-5 November 2019	0.064	0.054	0.034
		5-6 November 2019	0.064	0.052	0.033
		6-7 November 2019	0.043	0.033	0.021
		7-8 November 2019	0.048	0.038	0.026
		8-9 November 2019	0.083	0.058	0.032
		9-10 November 2019	0.058	0.044	0.027
	Min-Max values		0.035-0.083	0.024-0.058	0.016-0.034
3. Area of Project Airside	First time - rainy season	18-19 July 2019	0.027	0.013	0.003
		19-20 July 2019	0.045	0.015	0.004
		20-21 July 2019	0.025	0.011	0.003
		21-22 July 2019	0.023	0.010	0.005
		22-23 July 2019	0.026	0.016	0.007
		23-24 July 2019	0.027	0.017	0.006
		24-25 July 2019	0.028	0.015	0.007
	Min-Max values		0.023-0.045	0.010-0.017	0.003-0.007
	Second time - dry season	3-4 November 2019	0.034	0.019	0.014
		4-5 November 2019	0.065	0.032	0.022
		5-6 November 2019	0.081	0.050	0.038
		6-7 November 2019	0.055	0.030	0.024
		7-8 November 2019	0.051	0.035	0.028
		8-9 November 2019	0.075	0.048	0.036
		9-10 November 2019	0.062	0.039	0.031
	Min-Max values		0.034-0.081	0.019-0.050	0.014-0.038
4. Wat Khiri Pawanaram School	First time - rainy season	18-19 July 2019	0.043	0.017	0.006
		19-20 July 2019	0.040	0.016	0.008

Table 3.5-12 Results of general atmospheric air quality measurements in the project study area

Measurement points	Measurement period	Dates of measurement	Total suspended particulate 24-hour average (mg/mm3)	24-hour average PM10 (mg/m3)	24-hour average PM2.5 (mg/m3)
		20-21 July 2019	0.039	0.013	0.008
		21-22 July 2019	0.035	0.014	0.006
		22-23 July 2019	0.047	0.021	<0.002
		23-24 July 2019	0.051	0.022	0.006
		24-25 July 2019	0.048	0.020	0.005
	Min-Max values		0.035-0.051	0.013-0.022	<0.002-0.008
	Second time - dry season	3-4 November 2019	0.031	0.017	0.006
		4-5 November 2019	0.054	0.030	0.010
		5-6 November 2019	0.064	0.041	0.009
		6-7 November 2019	0.041	0.021	0.007
		7-8 November 2019	0.051	0.030	0.024
		8-9 November 2019	0.071	0.042	0.030
		9-10 November 2019	0.062	0.036	0.029
	Min-Max values		0.031-0.071	0.017-0.042	0.006-0.030
5. Wat Phala School	First time - rainy season	18-19 July 2019	0.043	0.021	0.003
		19-20 July 2019	0.044	0.026	0.007
		20-21 July 2019	0.042	0.021	0.004
		21-22 July 2019	0.038	0.024	0.004
		22-23 July 2019	0.044	0.026	0.005
		23-24 July 2019	0.029	0.018	0.007
		24-25 July 2019	0.024	0.011	0.006
	Min-Max values		0.024-0.044	0.011-0.026	0.003-0.007
	Second time - dry season	3-4 November 2019	0.069	0.030	0.017
		4-5 November 2019	0.076	0.049	0.036
		5-6 November 2019	0.085	0.053	0.037

Table 3.5-12 Results of general atmospheric air quality measurements in the project study area

Measurement points	Measurement period	Dates of measurement	Total suspended particulate 24-hour average (mg/mm3)	24-hour average PM10 (mg/m3)	24-hour average PM2.5 (mg/m3)
		6-7 November 2019	0.075	0.043	0.030
		7-8 November 2019	0.076	0.041	0.030
		8-9 November 2019	0.089	0.051	0.035
		9-10 November 2019	0.075	0.043	0.026
	Min-Max values		0.069-0.089	0.030-0.053	0.017-0.037
6. Ban Khlong Bang Phai School	First time - rainy season	18-19 July 2019	0.029	0.019	0.006
		19-20 July 2019	0.029	0.018	0.002
		20-21 July 2019	0.034	0.016	0.006
		21-22 July 2019	0.028	0.016	0.005
		22-23 July 2019	0.035	0.022	0.005
		23-24 July 2019	0.039	0.023	0.007
		24-25 July 2019	0.033	0.017	0.004
	Min-Max values		0.028-0.039	0.016-0.023	0.002-0.007
	Second time - dry season	3-4 November 2019	0.035	0.025	0.016
		4-5 November 2019	0.059	0.049	0.031
		5-6 November 2019	0.063	0.053	0.031
		6-7 November 2019	0.074	0.035	0.024
		7-8 November 2019	0.058	0.047	0.029
		8-9 November 2019	0.066	0.053	0.034
		9-10 November 2019	0.060	0.040	0.033
	Min-Max values		0.035-0.074	0.025-0.053	0.016-0.034
7. Wat Sa Kaeo School	Second time - dry season	3-4 November 2019	0.035	0.024	0.016
		4-5 November 2019	0.080	0.049	0.036
		5-6 November 2019	0.089	0.053	0.039
		6-7 November 2019	0.054	0.033	0.026
		7-8 November 2019	0.058	0.037	0.028
		8-9 November 2019	0.074	0.046	0.035

Table 3.5-12 Results of general atmospheric air quality measurements in the project study area

Measurement points	Measurement period	Dates of measurement	Total suspended particulate 24-hour average (mg/mm3)	24-hour average PM10 (mg/m3)	24-hour average PM2.5 (mg/m3)
		9-10 November 2019	0.066	0.043	0.033
	Min-Max values		0.035-0.089	0.024-0.053	0.016-0.039
Standard			0.33[1/]	0.12[1/]	0.05[2/]

Note : [1/] Announcement of the National Environment Board No. 24 (2004) Re: Determination of General Atmospheric Air Quality Standards
[2/]Announcement of the National Environment Board No. 36 (2010) Re: Determination of Standards for PM2.5 Particulates in the General Atmosphere
Source : United Analyst and Engineering Consultants Co., Ltd. (Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

Draft Version

Table 3.5-12 Results of general atmospheric air quality measurements in the project study area

Measurement points	Measurement period	Date of sample collection	Results of measurements				
			Nitrogen dioxide 1-hour average (ppm)	Carbon monoxide 1-hour average (ppm)	Carbon monoxide 8-hour average (ppm)	3-hour average non-methane hydrocarbon (NMHC) (ppm)	Total hydrocarbon gas 3-hour average (ppm)
1. Pattanavechsuksa School	First time - rainy season	18 July 2019	0.0008-0.0026	1.45-1.79	1.53-1.72	0.81-1.36	1.99-2.82
		19 July 2019	0.0008-0.0072	1.11-1.96	1.44-1.68	0.66-0.92	1.75-2.04
		20 July 2019	0.0006-0.0081	1.27-1.74	1.40-1.59	0.65-0.95	1.74-1.87
		21 July 2019	0.0005-0.0056	1.34-1.63	1.43-1.55	0.73-0.95	1.72-2.05
		22 July 2019	0.0009-0.0080	1.06-1.88	1.48-1.72	0.72-0.88	1.73-1.94
		23 July 2019	0.0008-0.0054	1.28-1.69	1.42-1.57	0.88-1.31	1.88-2.90
		24 July 2019	0.0008-0.0061	1.34-1.67	1.43-1.59	0.87-1.35	1.94-3.05
	Min-Max values		0.0005-0.0081	1.06-1.96	1.40-1.72	0.65-1.36	1.72-3.05
	Second time - dry season	3 November 2019	0.0033-0.0112	1.04-1.50	1.23-1.39	0.82-1.32	1.88-2.52
		4 November 2019	0.0026-0.0095	0.87-1.62	1.14-1.35	0.68-1.03	1.67-2.12
		5 November 2019	0.0029-0.0129	0.93-1.48	1.08-1.27	0.72-1.35	1.71-2.54
		6 November 2019	0.0031-0.0095	0.99-1.43	1.10-1.24	0.86-1.19	1.95-2.51
		7 November 2019	0.0020-0.0077	0.66-1.64	1.14-1.39	0.79-1.26	1.77-2.27
		8 November 2019	0.0046-0.0065	0.91-1.41	1.11-1.27	0.87-1.35	1.90-2.63
		9 November 2019	0.0043-0.0071	0.94-1.42	1.11-1.30	0.90-1.33	1.91-2.46
	Min-Max values		0.0020-0.0129	0.66-1.64	1.08-1.39	0.68-1.35	1.67-2.63
2. Staff operations building area	First time - rainy season	18 July 2019	<0.0004-0.0010	0.76-1.24	0.79-1.11	0.88-0.96	1.71-1.86
		19 July 2019	<0.0004-0.0014	0.69-0.87	0.75-0.85	0.76-1.02	1.76-1.88
		20 July 2019	0.0007-0.0016	0.66-0.87	0.73-0.85	0.92-1.03	1.96-2.05
		21 July 2019	<0.0004-0.0013	0.80-1.19	0.83-1.12	0.90-1.11	2.00-2.10
		22 July 2019	0.0004-0.0019	1.03-1.36	1.05-1.24	0.95-1.14	1.93-2.03
		23 July 2019	0.0004-0.0018	1.00-1.14	1.02-1.11	1.00-1.38	2.18-2.97
		24 July 2019	0.0004-0.0018	1.03-1.21	1.05-1.15	0.90-1.36	1.94-2.79
	Min-Max values		<0.0004-0.0019	0.66-1.36	0.73-1.24	0.76-1.38	1.71-2.97
	Second time - dry season	3 November 2019	0.0007-0.0053	0.97-1.23	0.99-1.08	0.87-1.00	1.66-1.96
		4 November 2019	0.0007-0.0052	0.91-1.13	0.97-1.06	0.83-1.01	1.77-2.00
		5 November 2019	0.0011-0.0048	0.81-0.98	0.85-0.96	0.95-1.07	1.99-2.38
		6 November 2019	0.0004-0.0048	0.88-1.12	0.94-1.05	0.89-1.14	1.93-2.23
		7 November 2019	0.0004-0.0066	0.98-1.20	1.00-1.14	0.95-1.16	1.82-2.26
		8 November 2019	0.0006-0.0090	0.90-1.15	1.01-1.05	1.02-1.34	2.13-2.58
		9 November 2019	0.0004-0.0056	0.94-1.12	0.99-1.07	1.00-1.37	2.12-2.63
	Min-Max values		0.0004-0.0090	0.81-1.23	0.85-1.14	0.83-1.37	1.66-2.63

Subject to changes and approval by the Government of Thailand

Table 3.5-12 Results of general atmospheric air quality measurements in the project study area

Measurement points	Measurement period	Date of sample collection	Results of measurements				
			Nitrogen dioxide 1-hour average (ppm)	Carbon monoxide 1-hour average (ppm)	Carbon monoxide 8-hour average (ppm)	3-hour average non-methane hydrocarbon (NMHC) (ppm)	Total hydrocarbon gas 3-hour average (ppm)
3. Airside Area of Project	First time - rainy season	18 July 2019	0.0007-0.0094	0.88-1.03	0.90-0.99	0.84-1.06	1.89-2.06
		19 July 2019	0.0006-0.0085	0.88-0.97	0.90-0.95	0.69-0.94	1.88-2.06
		20 July 2019	0.0004-0.0050	0.88-1.01	0.90-0.98	0.84-0.97	1.74-2.20
		21 July 2019	<0.0004-0.0045	1.01-1.18	1.03-1.13	0.70-0.85	1.60-1.81
		22 July 2019	0.0015-0.0103	1.00-1.17	1.01-1.12	0.73-0.86	1.73-1.85
		23 July 2019	0.0008-0.0077	0.95-1.07	0.98-1.03	0.79-1.19	1.83-2.81
		24 July 2019	0.0008-0.0070	0.91-1.14	0.94-1.08	0.83-1.25	1.81-2.74
	Min-Max values		0.0004-0.0103	0.88-1.18	0.90-1.13	0.69-1.25	1.60-2.81
	Second time - dry season	3 November 2019	0.0015-0.0047	0.92-1.10	0.97-1.04	0.83-1.14	1.97-2.19
		4 November 2019	0.0013-0.0045	0.99-1.27	1.07-1.17	0.72-0.95	1.88-2.17
		5 November 2019	0.0016-0.0048	0.97-1.20	1.02-1.13	0.88-1.00	1.88-2.31
		6 November 2019	0.0013-0.0045	0.89-1.23	0.94-1.15	0.66-0.85	1.60-1.86
		7 November 2019	0.0013-0.0044	0.85-1.14	0.95-1.07	0.71-0.86	1.81-2.20
		8 November 2019	0.0017-0.0040	0.84-1.07	0.93-1.00	0.77-1.21	1.92-2.49
		9 November 2019	0.0023-0.0048	0.91-1.16	1.03-1.08	0.86-1.24	1.83-2.47
	Min-Max values		0.0013-0.0048	0.84-1.27	0.93-1.17	0.66-1.24	1.60-2.49
4. Wat Khiri Pawanaram School	First time - rainy season	18 July 2019	0.0045-0.0122	1.28-1.52	1.34-1.42	0.79-0.94	1.84-2.01
		19 July 2019	0.0050-0.0119	1.22-1.44	1.32-1.38	1.01-1.22	1.99-2.83
		20 July 2019	0.0055-0.0130	1.24-1.44	1.29-1.38	0.85-1.22	1.94-2.65
		21 July 2019	0.0061-0.0130	1.28-1.49	1.35-1.43	1.01-1.40	2.14-2.98
		22 July 2019	0.0050-0.0123	1.21-1.49	1.30-1.42	0.82-1.55	2.02-2.90
		23 July 2019	0.0040-0.0123	1.19-1.47	1.26-1.31	0.82-1.00	1.88-2.10
		24 July 2019	0.0046-0.0093	1.10-1.44	1.19-1.34	0.82-1.01	1.74-1.89
	Min-Max values		0.0040-0.0130	1.10-1.52	1.19-1.43	0.79-1.55	1.74-2.98
	Second time - dry season	3 November 2019	0.0007-0.0110	1.19-1.34	1.26-1.30	0.87-1.18	2.01-2.26
		4 November 2019	0.0011-0.0072	1.14-1.34	1.21-1.26	0.81-1.06	1.91-2.24
		5 November 2019	0.0018-0.0133	1.11-1.34	1.18-1.27	0.93-1.25	1.92-2.54
		6 November 2019	0.0032-0.0117	1.15-1.40	1.23-1.32	0.82-1.07	2.06-2.28
		7 November 2019	0.0027-0.0077	1.10-1.35	1.19-1.30	0.82-1.10	1.87-2.14
		8 November 2019	0.0039-0.0123	1.06-1.32	1.15-1.21	0.88-1.14	1.85-2.32
		9 November 2019	0.0036-0.0126	0.98-1.33	1.08-1.24	0.85-1.11	1.89-2.30
	Min-Max values		0.0007-0.0133	0.98-1.40	1.08-1.32	0.81-1.25	1.85-2.54

Table 3.5-12 Results of general atmospheric air quality measurements in the project study area

Measurement points	Measurement period	Date of sample collection	Results of measurements				
			Nitrogen dioxide 1-hour average (ppm)	Carbon monoxide 1-hour average (ppm)	Carbon monoxide 8-hour average (ppm)	3-hour average non-methane hydrocarbon (NMHC) (ppm)	Total hydrocarbon gas 3-hour average (ppm)
5. Wat Phala School	First time - rainy season	18 July 2019	0.0015-0.0055	1.09-1.54	1.20-1.45	0.73-0.84	1.66-2.03
		19 July 2019	0.0028-0.0052	0.96-1.35	1.14-1.25	0.71-1.11	2.03-2.68
		20 July 2019	0.0025-0.0053	0.96-1.34	1.11-1.26	0.69-1.00	1.89-2.82
		21 July 2019	0.0033-0.0071	1.09-1.42	1.19-1.31	0.92-1.07	2.04-2.40
		22 July 2019	0.0024-0.0058	1.03-1.48	1.23-1.43	0.82-1.06	1.74-2.15
		23 July 2019	0.0022-0.0047	1.11-1.42	1.23-1.33	0.76-1.07	1.75-2.33
		24 July 2019	0.0025-0.0052	1.05-1.45	1.18-1.31	0.91-1.19	1.93-2.81
	Min-Max values		0.0015-0.0071	0.96-1.54	1.11-1.45	0.69-1.19	1.66-2.82
	Second time - dry season	3 November 2019	0.0006-0.0094	1.16-1.41	1.21-1.37	0.85-0.97	1.87-2.31
		4 November 2019	0.0013-0.0049	1.03-1.32	1.19-1.23	0.85-1.24	1.92-2.58
		5 November 2019	0.0012-0.0082	1.05-1.34	1.15-1.25	0.79-1.13	2.11-2.36
		6 November 2019	0.0014-0.0063	1.19-1.36	1.26-1.27	1.01-1.15	2.12-2.37
		7 November 2019	0.0014-0.0030	1.04-1.43	1.23-1.37	0.94-1.19	2.11-2.51
		8 November 2019	0.0013-0.0071	1.13-1.39	1.21-1.26	0.84-1.18	1.94-2.34
		9 November 2019	0.0014-0.0054	1.00-1.34	1.12-1.25	1.04-1.30	2.16-2.59
	Min-Max values		0.0006-0.0094	1.00-1.43	1.12-1.37	0.79-1.30	1.87-2.59
6. Ban Khlong Bang Phai School	First time - rainy season	18 July 2019	0.0069-0.0361	0.96-1.07	1.00-1.04	0.84-0.98	1.87-2.05
		19 July 2019	0.0179-0.0305	0.92-1.17	0.96-1.13	0.96-1.42	2.09-2.86
		20 July 2019	0.0201-0.0405	0.94-1.12	0.98-1.07	0.90-1.47	1.87-2.93
		21 July 2019	0.0193-0.0400	1.01-1.18	1.02-1.13	0.72-0.86	1.72-2.03
		22 July 2019	0.0134-0.0347	0.90-1.24	0.98-1.07	0.81-0.97	1.99-2.05
		23 July 2019	0.0087-0.0424	0.85-1.04	0.91-0.94	0.76-0.96	1.76-1.99
		24 July 2019	0.0073-0.0283	0.75-1.19	0.84-1.05	0.81-0.93	1.78-2.04
	Min-Max values		0.0069-0.0424	0.75-1.24	0.84-1.13	0.72-1.47	1.72-2.93
	Second time - dry season	3 November 2019	0.0028-0.0062	0.93-1.11	1.00-1.08	0.82-1.07	1.94-2.20
		4 November 2019	0.0027-0.0056	0.97-1.21	1.02-1.14	0.92-1.24	2.01-2.67
		5 November 2019	0.0026-0.0057	0.89-1.28	0.98-1.08	0.91-1.37	1.97-2.97
		6 November 2019	0.0018-0.0064	0.86-1.05	0.92-0.95	0.78-1.20	1.99-2.46
		7 November 2019	0.0034-0.0062	0.77-1.23	0.83-1.07	0.83-0.99	1.91-2.15
		8 November 2019	0.0024-0.0062	0.93-1.09	1.01-1.04	0.82-0.96	1.77-2.06
		9 November 2019	0.0004-0.0060	0.91-1.15	0.97-1.08	0.79-1.02	1.84-2.22
	Min-Max values		0.0004-0.0064	0.77-1.28	0.83-1.14	0.78-1.37	1.77-2.97

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Table 3.5-12 Results of general atmospheric air quality measurements in the project study area

Measurement points	Measurement period	Date of sample collection	Results of measurements				
			Nitrogen dioxide 1-hour average (ppm)	Carbon monoxide 1-hour average (ppm)	Carbon monoxide 8-hour average (ppm)	3-hour average non-methane hydrocarbon (NMHC) (ppm)	Total hydrocarbon gas 3-hour average (ppm)
7. Wat Sa Kaeo School	Second time - dry season	3 November 2019	0.0027-0.0069	0.97-1.11	1.00-1.07	0.95-1.09	1.96-2.25
		4 November 2019	0.0012-0.0085	0.95-1.16	1.00-1.11	0.96-1.25	1.98-2.52
		5 November 2019	0.0036-0.0096	0.93-1.15	1.01-1.10	1.03-1.21	2.04-2.49
		6 November 2019	0.0033-0.0092	0.85-1.19	0.93-1.12	0.99-1.16	2.10-2.35
		7 November 2019	0.0029-0.0083	1.00-1.28	1.07-1.18	0.98-1.09	2.09-2.24
		8 November 2019	0.0027-0.0092	0.96-1.13	1.02-1.04	0.90-1.13	1.81-2.18
		9 November 2019	0.0033-0.0076	0.85-1.19	0.93-1.12	1.00-1.18	2.10-2.28
	Min-Max values		0.0012-0.0096	0.85-1.28	0.93-1.18	0.90-1.25	1.81-2.52
Standard			0.17[1/]	30[2/]	9[2/]	NA	NA

Notes: NA means no standard is defined

[1/]Announcement of the National Environment Board No. 33 (2009) Re: Determination of General Atmospheric Nitrogen Dioxide Standards

[2/]Announcement of the National Environment Board No. 10 (1995) Re: Determination of General Atmospheric Air Quality Standards

Source : United Analyst and Engineering Consultants Co., Ltd. (Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

Subject to changes and approval by the Government of Thailand

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
1. Pattanavechsuksa School	Acetaldehyde	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	≤860[1/]
	Acetone	micrograms per cubic meter	6.27	6.97	<0.10	9.02	5.22	8.65	7.08	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	0.53	0.36	<0.13	0.95	0.51	0.84	0.66	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	3.74	20.9	5.19	2.73	2.77	18.4	1.10	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	0.75	3.09	<0.19	8.64	<0.19	<0.19	<0.19	≤57[1/]
	Chloromethane	micrograms per cubic meter	2.52	2.20	1.81	1.14	2.61	2.68	2.69	-
	Cyclohexane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	0.56	<0.24	0.40	<0.24	1.58	0.60	0.91	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	1.05	0.54	0.48	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.60	0.40	<0.24	≤1,100[1/]
	Freon-12	micrograms per cubic meter	4.30	4.24	3.72	2.27	6.19	6.14	5.84	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	15.2	2.18	9.85	3.74	4.02	11.9	1.94	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	3.46	4.95	2.42	4.21	159	140	130	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-
	Ethylbenzene	micrograms per cubic meter	1.39	0.99	0.71	1.35	0.42	0.93	0.83	-
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	23.8	71.8	28.3	13.4	1.89	10.7	1.52	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	2.22	2.16	2.25	2.46	<0.11	1.82	1.36	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	0.87	<0.12	2.01	-
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	1.28	<0.12	<0.12	0.74	1.11	1.67	1.30	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	6.10	6.65	7.19	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	0.36	0.36	0.36	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	0.65	0.64	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	5.72	7.03	5.01	11.0	7.59	11.1	13.2	-
	Freon-113	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	1.37	1.42	1.44	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	2.46	2.51	2.23	1.34	2.35	2.40	2.43	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	0.34	<0.20	<0.20	<0.20	0.68	<0.20	0.41	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	0.49	0.41	<0.20	0.43	0.47	0.59	0.42	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	0.47	<0.20	0.38	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	1.23	1.03	0.47	2.24	1.05	1.38	1.14	-
	Ortho-xylene	micrograms per cubic meter	0.32	0.39	<0.17	0.82	<0.17	0.68	0.58	-
2. Staff operations building area	Acetaldehyde	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	≤860[1/]
	Acetone	micrograms per cubic meter	4.98	5.33	3.91	4.62	4.85	6.24	4.75	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	0.45	0.40	0.56	1.92	0.97	0.51	0.36	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	4.15	4.59	5.30	2.08	1.39	3.63	4.00	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	0.91	0.88	<0.25	1.26	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	3.24	1.65	1.03	<0.19	0.59	0.68	0.57	≤57[1/]
	Chloromethane	micrograms per cubic meter	2.34	1.91	2.01	2.02	2.90	2.34	2.68	-
	Cyclohexane	micrograms per cubic meter	0.87	<0.16	<0.16	3.90	<0.16	<0.16	<0.16	-
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.73	0.62	0.70	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.40	0.56	0.57	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	0.59	0.79	≤1,100[1/]
	Freon-12	micrograms per cubic meter	4.06	4.27	4.28	4.11	1.75	12.5	14.8	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	6.66	3.90	3.53	2.78	1.49	3.68	4.34	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	3.04	3.52	2.48	2.70	134	118	68.6	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-
	Ethylbenzene	micrograms per cubic meter	0.61	0.81	0.47	0.78	0.85	2.41	1.82	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	1.63	1.47	5.03	7.19	1.80	2.39	3.19	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	0.99	<0.11	1.30	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	1.04	<0.12	0.85	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	0.56	0.74	0.61	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	4.79	0.55	0.76	<0.27	<0.27	<0.27	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	6.79	9.45	6.84	19.7	14.9	6.85	6.83	-
	Freon-113	micrograms per cubic meter	1.23	<0.30	1.26	0.99	1.40	1.40	<0.30	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	2.47	2.48	2.50	2.47	2.31	2.32	2.39	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	0.46	0.30	0.39	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	0.65	0.61	0.55	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	0.46	1.23	0.59	1.90	1.45	1.62	0.88	-
	Ortho-xylene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	0.61	0.59	0.50	-
3. Airside Area of Project	Acetaldehyde	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	≤860[1/]
	Acetone	micrograms per cubic meter	6.36	22.2	7.05	12.7	6.16	<0.10	4.67	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	2.18	2.91	1.87	2.43	0.68	0.71	0.54	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	4.54	10.5	<0.12	1.83	3.94	3.16	7.95	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	2.03	5.33	2.02	3.19	<0.19	<0.19	3.68	≤57[1/]
	Chloromethane	micrograms per cubic meter	2.29	3.42	2.26	2.81	2.40	2.44	2.37	-
	Cyclohexane	micrograms per cubic meter	4.02	5.22	2.53	3.88	<0.16	1.73	<0.16	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.42	0.48	0.65	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.45	<0.24	0.43	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	0.46	<0.24	≤1,100[1/]
	Freon-12	micrograms per cubic meter	4.27	5.02	4.25	4.18	11.1	12.6	10.8	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	2.82	11.1	2.31	5.12	3.12	4.81	7.38	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	4.59	8.34	6.38	5.68	38.9	48.6	48.5	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-
	Ethylbenzene	micrograms per cubic meter	1.13	7.09	1.92	4.09	0.75	0.59	0.62	-
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	12.3	31.4	7.21	12.0	38.3	41.7	5.49	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	<0.11	3.77	1.50	2.21	0.96	1.26	<0.11	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	7.46	<0.12	3.64	<0.12	<0.12	<0.12	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	17.4	7.65	3.48	5.71	2.34	4.94	0.98	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	4.06	6.75	4.29	-
	Styrene	micrograms per cubic meter	<0.17	1.01	<0.17	<0.17	<0.17	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	<0.27	1.84	2.48	1.03	<0.27	<0.27	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	20.8	63.3	27.6	47.4	9.57	13.7	12.3	-
	Freon-113	micrograms per cubic meter	1.20	1.38	1.27	<0.30	1.37	1.42	1.11	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	2.43	2.87	2.47	2.44	2.35	2.28	2.18	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	0.34	1.39	0.38	0.62	<0.20	<0.20	<0.20	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	1.04	3.31	1.13	1.34	<0.20	0.40	0.45	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	0.77	0.50	0.47	<0.20	<0.20	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	2.82	8.13	3.13	4.71	0.77	0.76	0.97	-
	Ortho-xylene	micrograms per cubic meter	0.98	2.36	1.17	1.61	<0.17	<0.17	0.47	-
4. Wat Khiri Pawanaram	Acetaldehyde	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	≤860[1/]

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
School	Acetone	micrograms per cubic meter	10.7	8.33	4.84	69.8	9.32	40.8	8.26	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	1.91	1.87	<0.13	0.67	0.44	0.53	0.50	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	1.76	1.66	<0.12	0.93	23.4	52.7	13.2	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	3.74	3.86	<0.19	1.77	7.65	20.2	<0.19	≤57[1/]
	Chloromethane	micrograms per cubic meter	2.58	<0.08	1.70	2.14	2.61	2.79	3.05	-
	Cyclohexane	micrograms per cubic meter	4.26	3.19	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.71	0.60	0.81	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.53	0.60	0.41	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	0.44	0.36	≤1,100[1/]
	Freon-12	micrograms per cubic meter	4.40	3.99	3.27	3.90	9.81	9.68	14.6	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	Dichloromethane (methylene chloride)	micrograms per cubic meter	5.33	7.74	0.62	1.16	16.5	32.2	10.1	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	6.21	4.73	1.71	3.91	61.7	54.6	82.7	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-
	Ethylbenzene	micrograms per cubic meter	8.87	12.4	0.26	0.35	1.73	2.80	0.96	-
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	8.35	18.4	3.05	9.04	38.5	7.16	6.64	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	2.31	<0.11	<0.11	<0.11	<0.11	2.86	<0.11	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	1.94	<0.12	0.84	1.47	<0.12	<0.12	-
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	7.77	4.40	0.55	2.05	1.24	1.79	0.97	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	4.30	4.32	6.64	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	0.62	<0.017	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	0.57	0.61	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	0.81	1.51	<0.27	<0.27	0.64	1.50	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	45.2	32.7	2.50	3.53	14.7	22.7	8.87	-
	Freon-113	micrograms per cubic meter	<0.30	<0.30	0.95	<0.30	1.37	1.38	1.55	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	2.58	2.35	1.98	2.34	2.26	2.34	2.60	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	0.67	0.64	<0.20	<0.20	0.31	0.55	0.33	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	1.53	1.75	<0.20	<0.20	0.59	0.86	0.57	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	0.33	0.37	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	8.05	8.83	<0.35	0.65	1.57	2.64	1.25	-
	Ortho-xylene	micrograms per cubic meter	1.83	2.32	<0.17	<0.17	0.66	0.70	0.55	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
5. Wat Phala School	Acetaldehyde	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	≤860[1/]
	Acetone	micrograms per cubic meter	12.2	9.78	5.83	7.98	5.07	9.64	4.40	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	<0.13	<0.13	0.63	0.72	0.47	1.14	0.79	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	0.69	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	<0.12	36.3	<0.12	3.02	17.9	32.6	1.41	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	0.66	0.97	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	0.47	7.18	<0.19	<0.19	1.54	16.9	<0.19	≤57[1/]
	Chloromethane	micrograms per cubic meter	1.98	2.11	2.17	2.74	2.47	2.76	2.58	-
	Cyclohexane	micrograms per cubic meter	0.49	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.78	0.80	0.95	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.46	0.71	0.65	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	0.88	0.42	≤1,100[1/]
	Freon-12	micrograms per cubic meter	3.80	4.05	4.23	4.29	11.8	18.6	12.5	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	2.36	19.8	1.67	1.78	12.9	22.2	1.97	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	2.85	7.74	5.17	8.87	49.1	40.5	50.8	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-
	Ethylbenzene	micrograms per cubic meter	0.60	1.44	0.96	0.61	0.54	2.85	2.35	-
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	2.39	31.5	<0.14	1.62	43.3	50.3	55.4	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	<0.11	<0.11	1.39	<0.11	<0.11	<0.11	<0.11	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	0.65	<0.12	<0.12	<0.12	<0.12	2.59	<0.12	-
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	1.14	0.92	<0.12	1.55	1.22	2.72	1.51	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	3.89	9.14	6.68	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	0.68	0.64	0.81	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	1.24	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	8.42	11.4	6.43	6.22	6.91	16.0	14.9	-
	Freon-113	micrograms per cubic meter	1.12	1.19	1.25	<0.30	1.42	1.26	<0.30	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	2.30	2.39	2.53	2.49	2.38	2.58	2.30	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	0.43	0.56	0.43	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	<0.20	0.36	<0.20	0.46	0.63	0.89	0.94	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	0.40	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	0.57	1.46	1.11	1.44	0.89	2.83	2.21	-
	Ortho-xylene	micrograms per cubic meter	<0.17	0.51	0.34	0.52	0.49	1.10	0.78	-
6. Ban Khlong Bang Phai School	Acetaldehyde	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	≤860[1/]
	Acetone	micrograms per cubic meter	6.77	5.45	6.65	9.34	4.87	5.62	3.43	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	0.84	0.64	1.01	0.99	0.67	<0.13	0.60	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	0.62	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	26.3	17.2	14.9	58.3	3.69	5.22	7.84	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	15.8	2.49	3.37	9.67	0.71	0.86	0.87	≤57[1/]
	Chloromethane	micrograms per cubic meter	2.64	2.25	2.19	2.10	2.68	2.64	2.62	-
	Cyclohexane	micrograms per cubic meter	<0.16	<0.16	0.70	<0.16	<0.16	<0.16	<0.16	-
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.95	0.70	0.56	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.66	0.66	0.53	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	0.45	0.62	0.45	≤1,100[1/]
	Freon-12	micrograms per cubic meter	4.33	4.32	4.09	4.39	14.4	14.0	17.1	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	16.1	9.07	8.20	30.1	2.53	3.27	7.54	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	10.8	7.63	10.1	21.2	56.1	52.6	68.1	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-
	Ethylbenzene	micrograms per cubic meter	0.91	0.82	1.37	0.92	0.74	0.52	0.61	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	19.3	11.5	17.3	76.3	36.2	1.60	3.76	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	<0.11	<0.11	<0.11	2.11	2.14	2.52	2.18	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	1.50	1.73	1.94	4.60	1.04	0.69	<0.12	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	5.71	3.11	4.45	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	0.49	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	0.74	0.77	0.61	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	4.30	2.67	0.56	0.82	<0.27	<0.27	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	6.51	6.63	6.79	10.4	5.78	3.12	4.64	-
	Freon-113	micrograms per cubic meter	1.26	1.22	<0.30	<0.30	1.47	1.47	1.45	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-

Table 3.5-13 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the rainy season between 18-25 July 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			July 2019.							
			18-19	19-20	20-21	21-22	22-23	23-24	24-25	
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	2.50	2.51	2.40	2.42	2.46	2.51	2.41	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	0.52	0.33	0.30	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	0.37	0.53	0.75	<0.20	0.77	0.49	0.30	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	1.41	1.32	1.80	1.43	1.26	0.72	0.80	-
	Ortho-xylene	micrograms per cubic meter	0.53	<0.17	0.86	0.68	0.33	0.34	0.37	-

Note : (-) means no standard is defined

[1/]Pollution Control Department Announcement Re: Determination of Surveillance Values for Volatile Organic Compounds in the General Atmosphere within 24 Hours.

[2/]Announcement of the National Environment Board (2012) Re: Determination of General Atmospheric Carbon Disulfide Standards

Source : United Analyst and Engineering Consultants Co., Ltd. (Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
1. Pattanavechsuksa School	Acetaldehyde	micrograms per cubic meter	75.3	35.7	10.5	2.18	5.56	13.3	<0.07	≤860[1/]
	Acetone	micrograms per cubic meter	59.2	50.0	80.7	10.4	9.71	9.10	9.97	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	0.79	0.44	0.81	0.87	0.89	0.92	0.83	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	1.05	0.90	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	<0.19	<0.19	<0.19	<0.19	1.11	<0.19	<0.19	≤57[1/]
	Chloromethane	micrograms per cubic meter	2.74	1.76	<0.08	1.74	2.07	1.76	1.95	-
	Cyclohexane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	≤1,100[1/]
	Freon-12	micrograms per cubic meter	2.64	1.62	2.73	2.59	2.79	2.61	2.71	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	0.56	0.29	<0.16	0.78	0.81	0.76	0.73	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	2.03	1.36	2.04	2.01	2.09	1.89	1.91	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	1.44	1.35	2.63	1.93	2.01	2.06	1.59	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	16.5	11.3	<0.08	<0.08	<0.08	<0.08	<0.08	-
	Ethylbenzene	micrograms per cubic meter	0.51	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	<0.11	2.68	2.70	<0.11	2.20	10.4	<0.11	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	2-Pentanone	micrograms per cubic meter	<0.14	1.43	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	3.33	2.27	3.80	<0.15	1.94	<0.15	1.83	-
	Freon-113	micrograms per cubic meter	0.59	<0.30	0.60	0.60	<0.30	<0.30	<0.30	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	1.31	0.79	1.38	1.35	1.40	1.30	1.40	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	-
	Ortho-xylene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
2. Staff operations building area	Acetaldehyde	micrograms per cubic meter	26.2	13.1	32.8	<0.07	10.3	<0.07	8.62	≤860[1/]
	Acetone	micrograms per cubic meter	10.1	14.0	11.8	15.1	13.0	13.0	16.2	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	0.56	0.62	0.54	0.88	0.72	0.77	0.65	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	<0.19	29.7	<0.19	<0.19	<0.19	<0.19	<0.19	≤57[1/]
	Chloromethane	micrograms per cubic meter	1.78	1.74	1.82	2.01	1.57	1.79	2.05	-
	Cyclohexane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	≤1,100[1/]
	Freon-12	micrograms per cubic meter	2.78	2.56	2.69	2.87	2.26	2.76	<0.20	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	0.60	<0.16	0.54	0.54	0.54	0.54	0.54	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	1.41	2.00	1.26	1.88	1.50	1.75	2.29	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	5.67	2.85	1.87	1.73	1.98	1.77	120	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	<0.08	<0.08	74.3	76.0	56.6	<0.08	-
	Ethylbenzene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	<0.14	3.63	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	2.95	16.1	5.11	3.18	1.47	2.48	<0.11	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	<0.15	2.89	1.05	1.36	1.52	1.46	2.79	-
	Freon-113	micrograms per cubic meter	0.67	0.67	0.67	<0.30	<0.30	0.61	0.64	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	1.36	1.28	1.36	1.49	1.14	1.41	1.51	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	-
	Ortho-xylene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
3. Area of Project Airside	Acetaldehyde	micrograms per cubic meter	11.4	49.1	59.1	9.16	13.9	<0.07	23.6	≤860[1/]
	Acetone	micrograms per cubic meter	27.9	28.2	47.7	25.3	38.8	37.2	1.18	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	1.02	1.34	1.28	0.88	1.67	<0.13	0.93	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	2.08	<0.19	<0.19	39.7	<0.19	<0.19	<0.19	≤57[1/]
	Chloromethane	micrograms per cubic meter	1.87	2.50	2.45	2.02	<0.08	1.97	1.88	-
	Cyclohexane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	≤1,100[1/]
	Freon-12	micrograms per cubic meter	2.48	2.48	2.48	2.75	0.42	2.71	2.90	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	0.77	0.64	<0.16	0.87	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	1.41	1.63	1.56	3.22	1.95	1.83	1.82	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	2.50	3.74	3.22	16.9	<0.14	1.70	2.13	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	<0.08	<0.08	132	57.4	212	158	-
	Ethylbenzene	micrograms per cubic meter	0.35	<0.17	<0.17	1.52	0.96	<0.17	<0.17	-
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	<0.11	1.20	4.36	<0.11	<0.11	<0.11	<0.11	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	<0.12	9.17	<0.12	<0.12	<0.12	<0.12	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	<0.12	<0.12	<0.12	1.70	<0.12	1.12	<0.12	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	6.44	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	<0.27	<0.27	<0.27	0.70	<0.27	<0.27	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	2.24	2.91	3.23	16.6	2.99	4.11	1.37	-
	Freon-113	micrograms per cubic meter	0.64	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	1.29	1.34	1.33	1.31	1.03	1.43	1.51	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	<0.35	<0.35	<0.35	2.72	0.77	<0.35	<0.35	-
	Ortho-xylene	micrograms per cubic meter	<0.17	<0.17	<0.17	1.29	0.28	<0.17	<0.17	-
4. Wat Khiri Pawanaram	Acetaldehyde	micrograms per cubic meter	34.1	35.2	53.7	7.48	<0.07	25.2	20.0	≤860[1/]

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
School	Acetone	micrograms per cubic meter	14.8	67.9	19.7	13.2	12.1	13.5	13.9	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	1.40	1.73	1.98	0.67	0.93	0.98	4.61	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	≤57[1/]
	Chloromethane	micrograms per cubic meter	2.12	2.69	2.22	1.91	1.91	1.76	2.09	-
	Cyclohexane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-Dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	≤1,100[1/]
	Freon-12	micrograms per cubic meter	1.75	<0.20	2.59	2.83	2.93	2.82	2.58	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	0.71	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	0.73	0.90	0.99	<0.16	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Dichloromethane (methylene chloride)	micrograms per cubic meter	1.54	2.67	1.83	3.25	3.45	3.22	1.87	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	3.59	79.7	1.86	2.06	2.37	1.59	1.80	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	4.23	5.24	120	146	184	<0.08	-
	Ethylbenzene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	2.59	2.12	2.06	6.96	6.15	11.3	<0.11	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	0.56	<0.12	<0.12	<0.12	<0.12	<0.12	1.00	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	2.21	6.12	3.73	2.23	2.60	<0.15	5.71	-
	Freon-113	micrograms per cubic meter	<0.30	0.79	<0.30	<0.30	0.81	0.93	<0.30	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	0.87	1.64	1.26	1.53	1.59	1.59	1.30	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	-
	Ortho-xylene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
5. Wat Phala School	Acetaldehyde	micrograms per cubic meter	49.7	50.0	38.3	30.0	35.1	40.0	15.9	≤860[1/]
	Acetone	micrograms per cubic meter	21.1	24.3	30.9	19.7	26.8	24.0	14.1	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	0.71	0.64	0.94	0.93	0.81	0.83	1.29	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	0.71	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	≤57[1/]
	Chloromethane	micrograms per cubic meter	1.89	1.54	1.93	1.97	2.04	2.11	1.93	-
	Cyclohexane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	≤1,100[1/]
	Freon-12	micrograms per cubic meter	2.79	1.87	2.93	2.84	3.07	<0.20	2.75	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	0.76	<0.16	0.90	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	1.38	1.12	1.57	2.35	2.50	2.92	2.66	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	2.02	1.36	<0.14	2.21	16.4	39.7	2.73	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	7.51	10.4	148	66.8	57.6	8.00	-
	Ethylbenzene	micrograms per cubic meter	<0.17	<0.17	<0.17	0.83	<0.17	0.84	<0.17	-
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	<0.11	<0.11	1.65	<0.11	4.94	<0.11	3.96	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	7.22	<0.09	<0.09	<0.09	<0.09	<0.09	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	2.16	2.07	2.17	2.50	3.19	3.11	3.63	-
	Freon-113	micrograms per cubic meter	0.95	<0.30	<0.30	0.99	0.93	<0.30	<0.30	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	1.60	0.95	1.63	1.63	1.64	1.43	1.41	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	-
	Ortho-xylene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
6. Ban Khlong Bang Phai School	Acetaldehyde	micrograms per cubic meter	30.9	10.3	35.6	8.02	27.4	20.8	16.4	≤860[1/]
	Acetone	micrograms per cubic meter	84.9	135	64.4	9.57	11.0	16.1	12.7	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	0.66	0.73	3.73	0.70	0.95	1.05	1.61	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	<0.12	<0.12	3.87	<0.12	<0.12	<0.12	<0.12	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	<0.19	<0.19	1.95	<0.19	0.66	43.8	<0.19	≤57[1/]
	Chloromethane	micrograms per cubic meter	2.39	2.00	2.47	1.71	2.02	2.25	3.38	-
	Cyclohexane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	≤1,100[1/]
	Freon-12	micrograms per cubic meter	2.69	2.62	<0.20	2.47	2.79	2.94	2.86	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	0.60	0.47	<0.16	0.60	<0.16	<0.16	0.54	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	1.76	1.80	3.70	1.83	2.25	3.33	2.24	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	1.87	1.99	17.1	2.70	14.1	10.4	4.18	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	<0.08	<0.08	5.28	<0.08	13.5	23.2	<0.08	-
	Ethylbenzene	micrograms per cubic meter	<0.17	<0.17	0.85	<0.17	<0.17	1.54	1.18	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	1.04	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	3.29	6.97	<0.11	3.62	3.82	2.84	<0.11	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	3.46	3.34	6.55	1.16	4.55	15.7	15.1	-
	Freon-113	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	0.57	<0.30	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	1.37	1.31	1.23	1.24	1.25	1.35	1.39	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	<0.35	<0.35	1.14	<0.35	<0.35	3.40	1.16	-
	Ortho-xylene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
7. Wat Sa Kaeo School	Acetaldehyde	micrograms per cubic meter	45.8	42.1	52.4	14.4	10.2	11.1	14.9	≤860[1/]
	Acetone	micrograms per cubic meter	19.3	85.7	65.0	11.7	16.9	13.1	14.2	-
	Acetonitrile	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Acrolein	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤0.55[1/]
	Acrylonitrile	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤10[1/]
	Benzene	micrograms per cubic meter	1.36	1.53	1.39	0.72	0.79	<0.13	0.83	≤7.6[1/]
	Benzyl chloride	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤12[1/]
	Bromodichloromethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	-
	Bromoform	micrograms per cubic meter	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	-
	Bromomethane	micrograms per cubic meter	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	≤190[1/]
	1,3-Butadiene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	≤5.3[1/]
	Normal-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	1-butanol	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	Carbon disulfide	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	≤100[2/]
	Carbon tetrachloride	micrograms per cubic meter	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	≤150[1/]
	Chlorobenzene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Chloroethane	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Chloroform	micrograms per cubic meter	<0.19	<0.19	<0.19	<0.19	17.8	<0.19	<0.19	≤57[1/]
	Chloromethane	micrograms per cubic meter	1.85	2.24	1.95	1.91	1.87	1.95	1.83	-
	Cyclohexane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Cyclopentane	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	1,2-dibromoethane	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	≤370[1/]
	1,2-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,3-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-
	1,4-Dichlorobenzene	micrograms per cubic meter	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	≤1,100[1/]
	Freon-12	micrograms per cubic meter	2.36	2.69	2.43	2.52	2.92	<0.20	2.74	-
	1,1-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	1,2-Dichloroethane	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	≤48[1/]
	1,1-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Sis-1,2-Dichloroethene	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Dichloromethane (methylene chloride)	micrograms per cubic meter	1.51	1.75	1.72	1.53	2.04	1.88	1.84	≤210[1/]
	1,2-Dichloropropane	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	≤82[1/]
	Sis-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Trans-1,3-Dichloropropene	micrograms per cubic meter	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	-
	Freon-114	micrograms per cubic meter	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	-
	Freon-22	micrograms per cubic meter	1.77	3.38	1.68	1.84	3.85	34.2	1.83	-
	1,4-Dioxane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	≤860[1/]
	Ethanol	micrograms per cubic meter	10.4	12.5	11.2	<0.08	8.90	3.95	<0.08	-
	Ethylbenzene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	0.79	<0.17	<0.17	-
	Hexanal	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Hexane	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Hexanone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Isobutene	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	Isoprene	micrograms per cubic meter	<0.11	<0.11	<0.11	2.86	5.94	5.92	5.01	-
	Isopropyl alcohol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Methacrolein	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Methanol	micrograms per cubic meter	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
	Methyl Butyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Ethyl Ketone	micrograms per cubic meter	<0.12	<0.12	5.50	<0.12	<0.12	<0.12	<0.12	-

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	
	Methyl Iodide	micrograms per cubic meter	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
	Methyl Isobutyl Ketone	micrograms per cubic meter	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	-
	Methyl Tert-Butyl Ether	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Methyl Vinyl Ketone	micrograms per cubic meter	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	-
	Pentanal	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Pentane	micrograms per cubic meter	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	-
	2-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	3-Pentanone	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Propanel	micrograms per cubic meter	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	-
	1-Propanol	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
	Propylene	micrograms per cubic meter	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	-
	Styrene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-
	1,1,2,2-Tetrachloroethane	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤83[1/]
	Tetrachloroethylene (tetrachloroethene)	micrograms per cubic meter	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	≤400[1/]
	Toluene	micrograms per cubic meter	3.33	4.17	3.63	2.14	7.94	3.54	<0.15	-
	Freon-113	micrograms per cubic meter	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-
	1,2,4-trichlorobenzene	micrograms per cubic meter	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	-
	1,1,1-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	1,1,2-Trichloroethene	micrograms per cubic meter	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	-
	Trichloroethylene (trichloroethene)	micrograms per cubic meter	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	<0.21	≤130[1/]
	Freon-11	micrograms per cubic meter	1.21	1.33	1.20	1.35	1.45	1.36	1.36	-
	1,2,3-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,2,4-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	1,3,5-Trimethylbenzene	micrograms per cubic meter	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
	Vinyl acetate	micrograms per cubic meter	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	-
	Vinyl chloride	micrograms per cubic meter	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	≤20[1/]
	Meta, para-xylene	micrograms per cubic meter	<0.35	<0.35	<0.35	<0.35	1.68	<0.35	<0.35	-
	Ortho-xylene	micrograms per cubic meter	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	-

Note: (-) means no standard is defined

Table 3.5-14 The results of the measurement of volatile organic compounds (VOCs) in the atmosphere during the dry season between 3- 10 November 2019

Measurement points	Monitoring Index	Unit	Date of sample collection							Standard
			November 2019.							
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	

[1/]Pollution Control Department Announcement Re: Determination of Surveillance Values for Volatile Organic Compounds in the General Atmosphere within 24 Hours.

[2/]Announcement of the National Environment Board (2012) Re: Determination of General Atmospheric Carbon Disulfide Standards

Source: United Analyst and Engineering Consultants Co., Ltd. (Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

3.5.4 Topography conditions

3.5.4.1 *Scope of Study*

This study collects data on topographical features from secondary data sources and various related reports used as a basis for assessing the potential impact of the project.

3.5.4.2 *Study Methods*

Collect relevant information, including:

- Collect topographical feature information of Rayong province from the 4-year development plan of Rayong Province (2018-2021).
- Collect topographical feature information of Phala subdistrict from the 4-year local development plan, Phala Subdistrict Municipality (2018-2021).
- Collect topography conditions information for the project area from the Full Version of Complete Feasibility Study Master Plan for U-Tapao Airport Development Project and Surrounding Areas, Rayong (December 2018).

3.5.4.3 *Study Results*

(1) Topographical features of Rayong

The topographical features of Rayong. The coastal plain is formed by sediment deposition in the area of the Rayong Basin and the alternating slopes of hills and mountains is characterized by undulating high and low peaks. There are 2 mountain ranges, namely Khao Chamao in the east with a height above sea level of 1,035 meters and the mountain ranges around the middle of the province forming a long line from Mueang Rayong District up to the north until the border of the province are a smaller mountain range called Khao Khun In, Khao Chom Hae, and Khao Wong Chang. There is a short river which originates from the Chanthaburi Mountain Range and the Banthat Mountain Range flowing into the Gulf of Thailand. The main rivers are the Bang Pakong River, Chanthaburi River, Rayong River. The coastline features beautiful beaches and small islands lined along the coast. It is an important tourism resource of the country.

Rayong Province is on the eastern coast of Thailand, between the 12–13 degrees north latitude and 101–102 degrees east latitude. The area is approximately 3,552 square kilometers, or about 2,220,000 rai, and is about 179 kilometers east of Bangkok and has the following connected districts:

North, connected to Nong Yai District, Bo Thong District, Sriracha District, Chonburi Province.

South, connected to the Gulf of Thailand coast, about 100 kilometers long.

East, connected to Na Yai Am District, Kaeng Hang Maeo District, Chanthaburi Province.

West, connected to Sattahip District, Bang Lamung District, Chonburi Province.

(2) Topographical features of U-Tapao International Airport area

U-Tapao International Airport is located in Phala Subdistrict, Ban Chang District, Rayong Province, with a surrounding area of approximately 12,689 rai (including military usage areas and the Promotion Zone: Eastern Aerotropolis) 13 meters above sea level, located to the southeast of Bangkok, approximately 190 kilometers from Bangkok and approximately 30 kilometers distance from Pattaya, which is an important tourist destination of ASEAN. The terrain of the municipality is flat, adjacent to the sea and mountains, most of the area is sandy loam. Phala Subdistrict Municipality in the southwest of Ban Chang District. It is a bout 9 kilometers from Ban Chang District and 33 kilometers from Rayong Province, with the following connected districts:

North connected to Ban Chang Municipality.

East connected to Ban Chang Subdistrict Municipality.

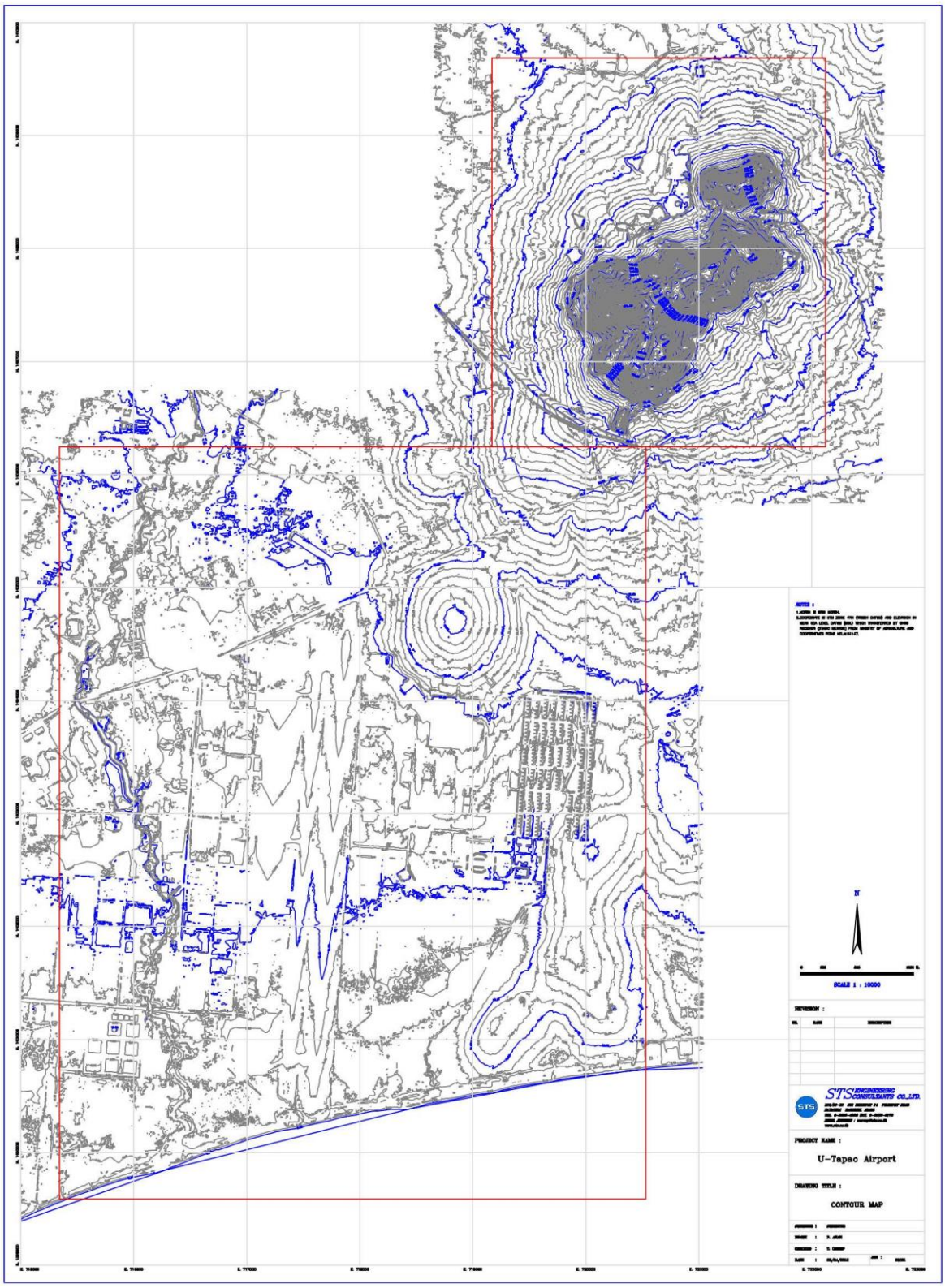
South connected to the Gulf of Thailand coast, approximately 8 kilometers long.

West connected to Phlu Ta Luang Subdistrict Administrative Organization.

(3) Topography conditions of the area for development

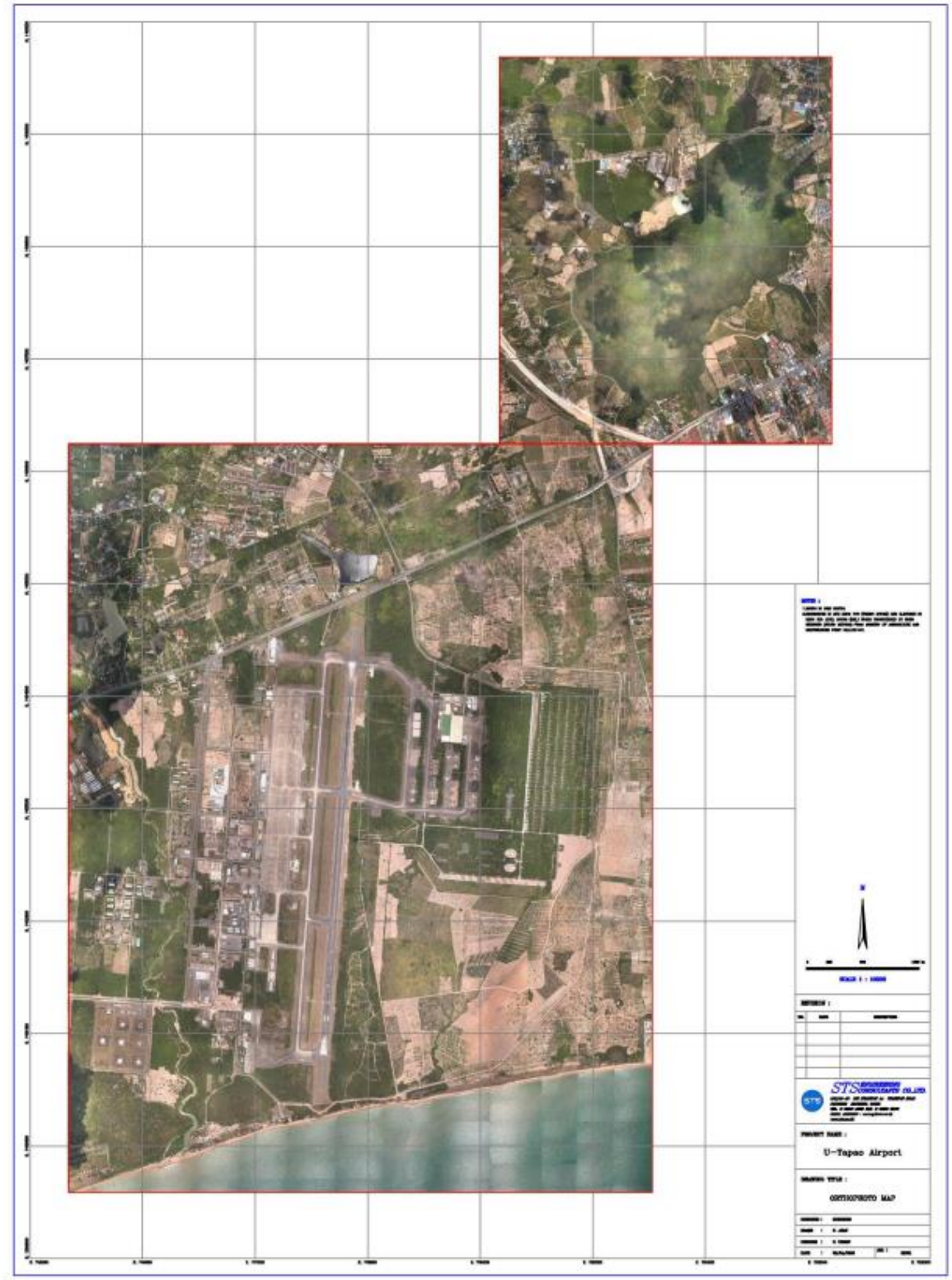
The area for the development of U-Tapao International Airport (extension) is located on the east Runway 1. The area for aircraft operations must have an appropriate surface level, with a slope in the range of 1 percent in order to comply with the requirements of the International Civil Aviation Organization (ICAO) and Runway Threshold Level defined by the Obstacle Limitation planning.

According to the Feasibility Study Master Plan for U-Tapao Airport Development Project and Surrounding Areas, Rayong, with the Airborne Lidar Survey covering 45 square kilometers, conducted on 19 April 2018 in the airport area and hills to the northeast of U-Tapao Airport, the results of the topography conditions survey found that the area within the airport has increased elevation from the southwest to the northeast. The topographic map surveyed with Lidar technology is shown in Figure 3.5-9 and Figure 3.5**-10**. From the survey, it can be determined that there is a wide waterway that crosses the project area from southwest to northeast and there are some areas with small hills. The waterways are shown as shown in FigureFigure **3.5-11**. This is a waterway that is caused by the movement of surface water according to topography conditions that is steeped in the north and sloped into the south and are only waterways within the airport. They are not public waterways connected to the outside the airport in any way because this area is related to the movement of aircraft. This area is designed to be completely re-leveled to conform to the level of runways and taxiways, as well as an incline not exceeding 1.5% in accordance with the International Civil Aviation Organization (ICAO) standards.



Source: Full Version of Complete Feasibility Study Master Plan for U-Tapao Airport Development Project and Surrounding Areas, Rayong
Surveyed on 19 April 2018

Figure 3.5-9 Map showing the topography conditions of the project site surveyed by LIDAR method



Source: Full Version of Complete Feasibility Study Master Plan for U-Tapao Airport Development Project and Surrounding Areas, Rayong
Surveyed on 19 April 2018

Figure 3.5-10 Image of topography conditions at the location of the project site surveyed by LIDAR method

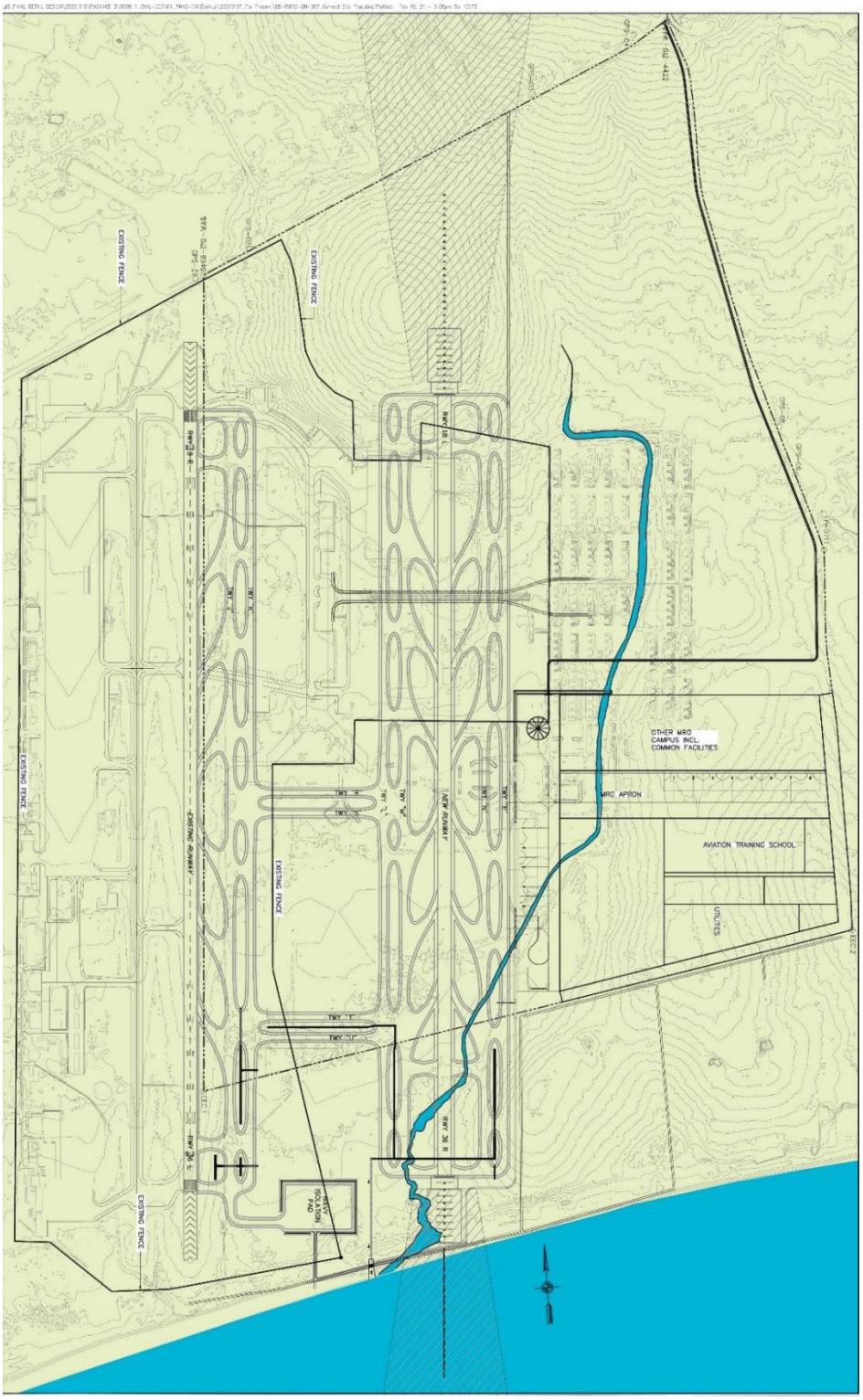


Figure 3.5-11 Current water conditions in the area where the taxiway and runway underpass will be built

3.5.5 Geology and earthquakes

3.5.5.1 *Scope of Study*

Study of geology, geomorphology and earthquakes that may cause impacts and limitations to the project.

3.5.5.2 *Study Methods*

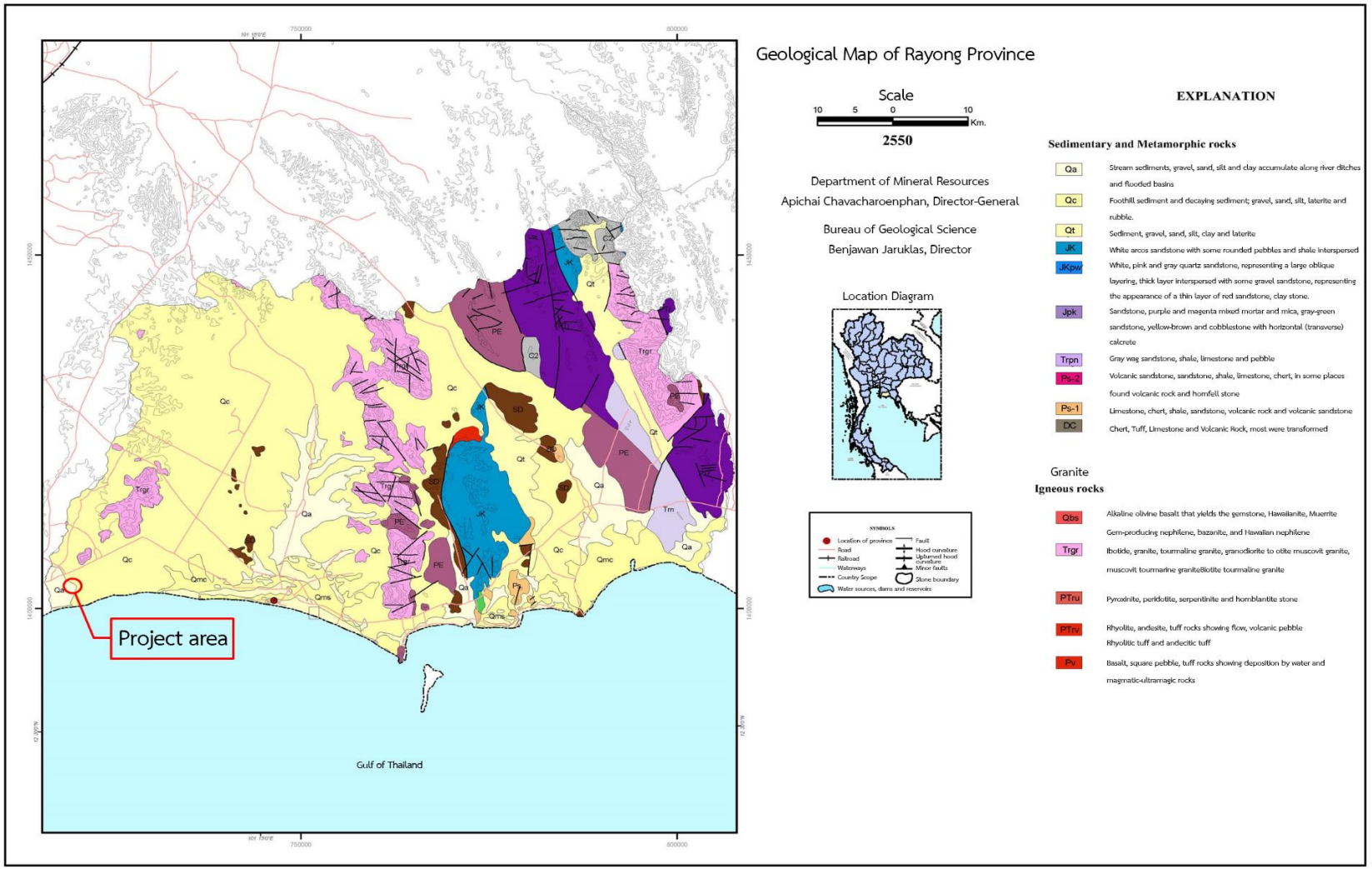
Collect relevant information, including:

- Collect information on geological features and earthquakes of Rayong Province in Thailand during 2013-2017 from the Department of Mineral Resources.
- Statistics of earthquakes affecting Thailand during the years 2013-2017 from the Department of Meteorology.

3.5.5.3 *Study Results*

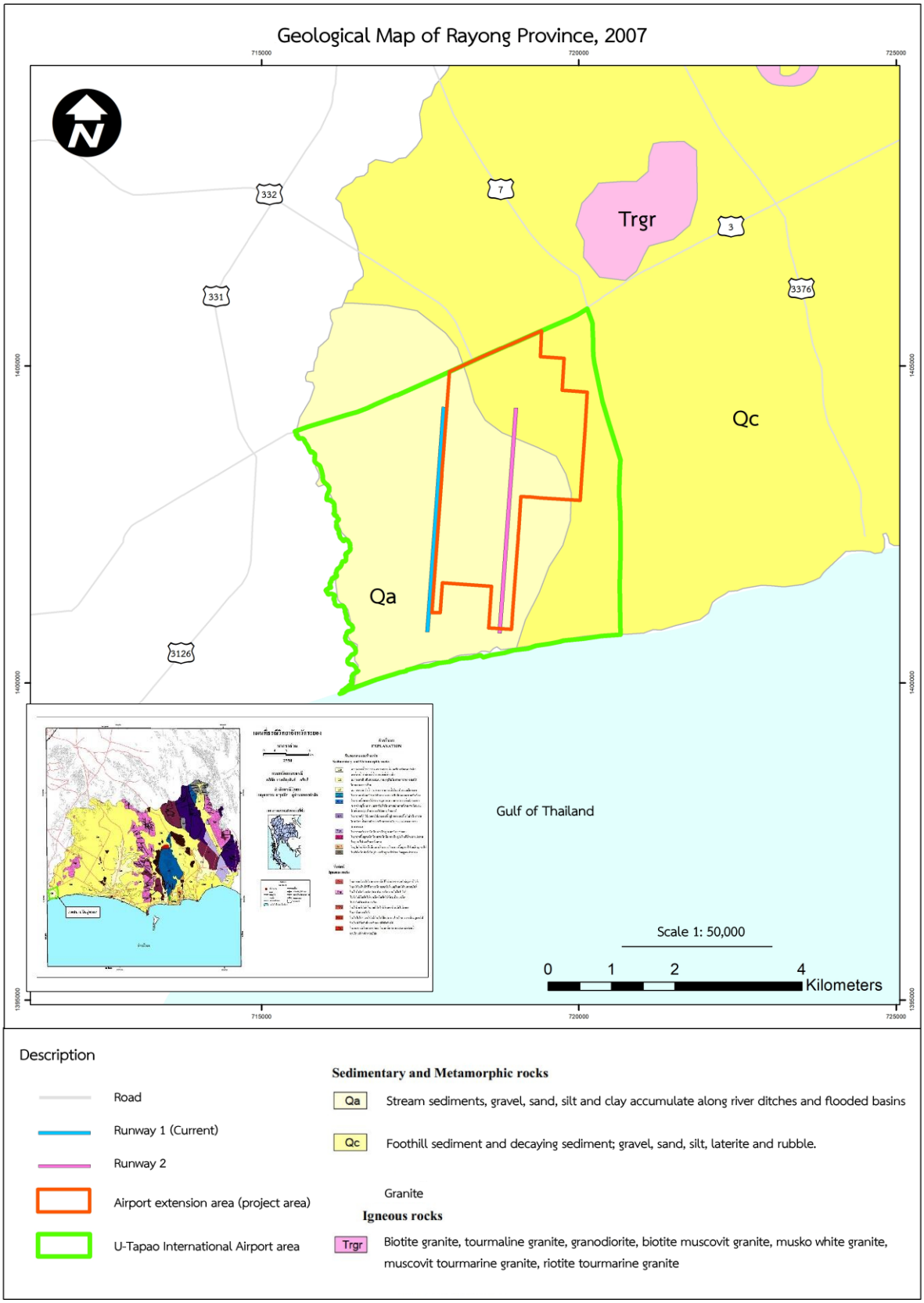
(1) Geological characteristics of Rayong province

The nature of the land and area of Rayong province has shown geological evidence that it has been through the geological process for more than 360 million years until it has appeared in its current configuration with mountainous areas, rocky areas, flatlands, coastal areas, and island areas. These are supported by hard rock from 360 million years until the current sediment, including sedimentary rock, metamorphic rock, igneous rock and loose sediment. Details are shown in Figure 3.5-13 and in the zoomed image showing the geological features of the project area in Figure 3.5-13



Source: Department of Mineral Resources, 2007. Sourced from http://www.dmr.go.th/download/pdf/Central_East/rayong.pdf on 7 October 2021

Figure 3.5-12 Geological Map of Rayong Province



Source: Adapted by expanding from the Geological Map of the Department of Mineral Resources, 2021

Figure 3.5-13 Zoomed image showing the geological features of the project area

The geological features of each terrain are different. Especially in mountainous areas, there are hard rock formations that can be seen in both metamorphic, sedimentary and igneous rocks that vary in age from the Carboniferous period (approximately 286-360 million years old) to the Tertiary period (66.4 million years old), rocky areas, river lagoons and lowland areas caused by the accumulation of sediment. Most of the island areas are metamorphic rock. In the Gulf of Thailand, beach sediment is deposited by seawater. In this regard, 75% of Rayong's area is supported by sedimentary, metamorphic and unconsolidated sediment. There are 5 categories of sedimentary and metamorphic rocks and 6 categories of unconsolidated sediment. Sedimentary rocks are formed by the accumulation and sedimentation of rubble, soil, sand that has broken off or has been leached from the original rock by natural causes such as water, wind, glaciers, or sea water carrying sediments to deposit in the basin. Most deposited sediments are compacted together. Whereas, metamorphic rocks are formed by the transformation of the original rocks which were sedimentary, igneous and metamorphic rocks, under the influence of heat or pressure or both. Metamorphism causes the formation of mineral grains or new minerals. (Source: Region Classification for Geological and Mineral Resources Management, Rayong Province, 2008 and Department of Mineral Resources, Ministry of Natural Resources and Environment).

There are 2 types of rock formations in the project area (as shown in FigureFigure **3.5-13**) namely

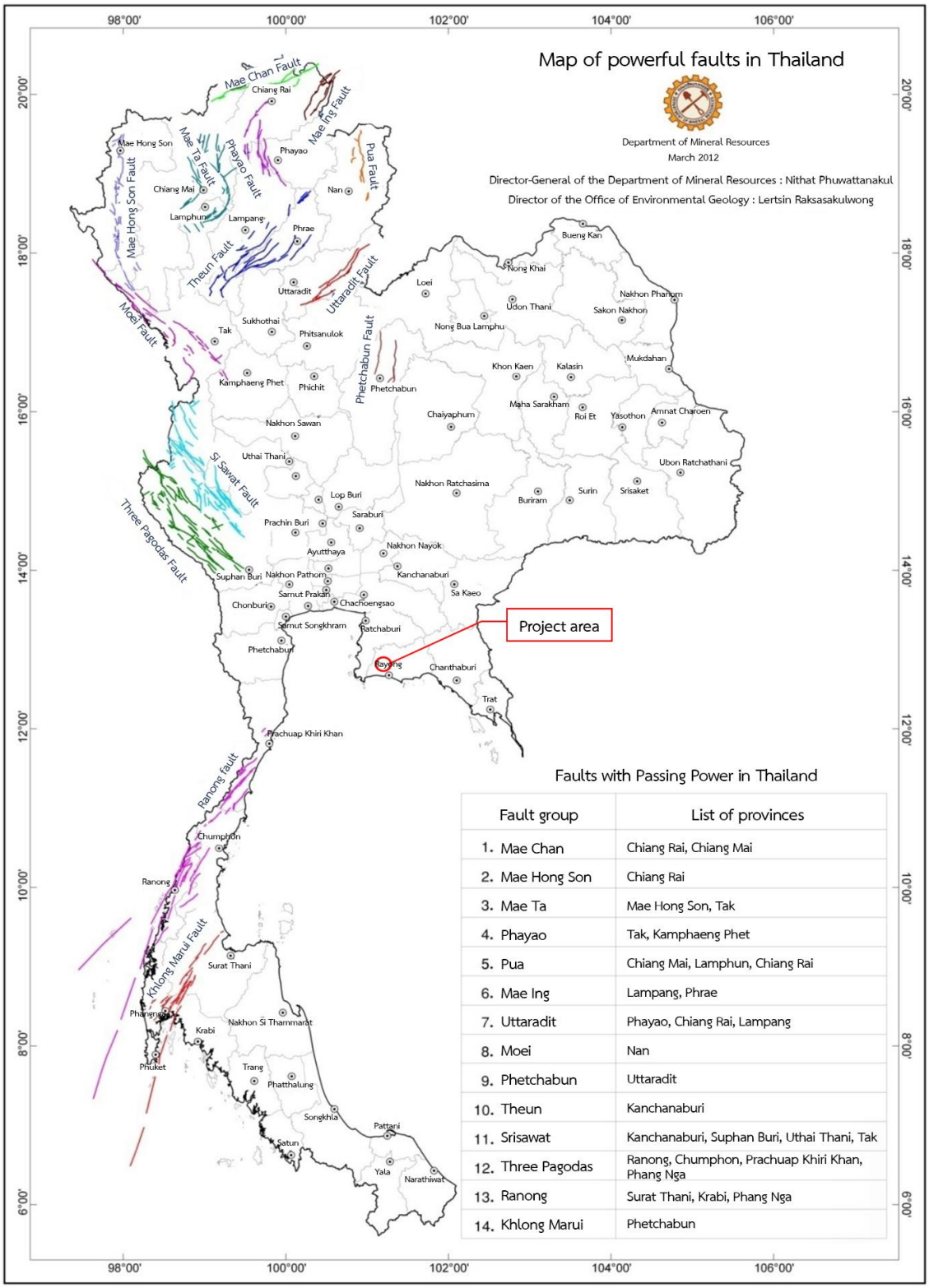
1. Sediment (Qa) : Gravel, sand, silt and clay

2. Fixed sediment and foothill sediments (Qc): Weathered granite, sand, silt, rubble, laterite and Terrarosa soil

(2) earthquakes

Earthquakes that result in tremors in Thailand are caused by two types of earthquake sources, namely, earthquake sources from external faults in the region of Myanmar, southern China, Lao People's Democratic Republic, Andaman Sea, and earthquake sources from domestic faults, which are mostlyin the western part of the country, such as the Three Pagodas Fault, Si Sawat Fault and the Ranong Fault, etc., details as shown in Figure 3.5-14.

According to the statistics of the earthquakes that affected Thailand between 2013 and 2017 as shown inTable 3.5-15 indicated that the center of the earthquakes that affected Thailand was between 2.2 and 6.8 on the Richter scale, which, according to the map of the Thai map of earthquake-prone areas, as shown inFigure 3.5-15, indicated that Rayong Province and the project's study areas had no active faults, and were categorized as earthquake-prone area level 1 equivalent to 3-4 on the Mercalli intensity scale, meaning an intensity that can be sensed by people on high-rise buildings (minor risk, but there might be some damage).



Source: Department of Mineral Resources, March 2012.

Figure 3.5-14 Powerful fault lines in Thailand.

Table 3.5-15 Statistics of earthquakes affecting Thailand during the years 2013-2017

Day, Month, Year	Center	Size/Severity (Richter)	Log an incident
7 February 2013	Myanmar (21.10N , 99.85E)	4.3	Shaking felt at the Mae Sai District Office, Chiang Rai.
2 March 2013	Thung Fai Subdistrict, Mueang District, Lampang Province (18.36N, 99.56E)	3.4	Shaking felt at Ton Fai Subdistrict, Phichai Subdistrict Ton Thongchai Subdistrict, Lampang Province
5 April 2013	Mae Win Subdistrict, Mae Wang District, Chiang Mai Province (18.64N, 98.72E)	2.9	Shaking felt at Mae Wang District, Hang Dong District. Muang District, Chiang Mai Province
11 April 2013	Myanmar (18.96N , 7.68E)	5.1	Shaking felt in Mae Hong Son Province
7 May 2013	Myanmar (20.70N , 99.84E)	5.4	Shaking felt at the Mae Sai District, Mueang District, Chiang Rai Province
1 June 2013	Thung Pee Subdistrict, Mae Wang District, Chiang Mai Province (18.61N, 98.74E)	3.1	Shaking felt at Mae Wang District, San Pa Dong District, Chiang Mai Province
2 July 2013	North of Sumatra, Indonesia (4.64N, 96.56E)	6.0	Shaking felt in Phuket Province, Phang Nga Province and high-rise buildings in Bangkok
1 August 2013	Mae Puem Subdistrict, Mueang District, Phayao Province (19.29N, 99.84E)	3.7	Shaking felt at Mae Chai District, Phayao Province
20 September 2013	Mae Chan District, Chiang Rai Province (20.23N, 99.95E)	2.4	Shaking felt at the Mae Sai District Office, Chiang Rai.
11 October 2013	Thung Luang Subdistrict, Phrao District, Chiang Mai Province (19.32N, 99.24E)	4.1	Shaking felt at San Sai Subdistrict, Phrao District, Chiang Rai Province
1 December 2013	Champa Wai Subdistrict, Mueang District, Phayao Province (19.04N, 99.96E)	3.2	Shaking felt at Dok Khamtai District, Phayao Province
21 March 2014	Nicobar Islands, India (7.64N, 94.21E)	6.4	Shaking felt at Mueang District, Phuket Province
5 May 2014	Dongmada Subdistrict, Mae Lao District, Chiang Rai Province (19.75N, 99.69E)	6.3	Shaking felt in Chiang Rai Province, Phrae Province, Mae Hong Son Province, Uttaradit Province, Phitsanulok Province, Chiang Mai Province and high-rise buildings in Bangkok
24 May 2014	Na Noi District, Nan Province (18.40N, 100.77E)	3.6	Shaking felt at Nai Wiang Subdistrict, Mueang District, Nan Province
24 October 2014	Dok Khamtai District, Phayao Province (19.10N, 100.09E)	3.6	Shaking felt at Dok Khamtai District, Phayao Province
6 December 2014	Yunnan, China (23.29N, 100.29E)	5.9	Shaking felt in Chiang Rai Province, Chiang Mai Province and Bangkok
19 January 2015	Wiang Mok Subdistrict, Thoen District, Lampang Province (17.50N, 99.35E)	2.8	Shaking felt at Thoen District, Lampang Province
20 February 2015	Phang Nga Bay, south of Koh Yao Yai, Koh Yao District, Phang Nga Province (7.87N, 98.57E)	4.0	Shaking felt at Muang District, Kathu District, Thalang District, Phuket Province, Koh Yao Yai, Phang Nga Province

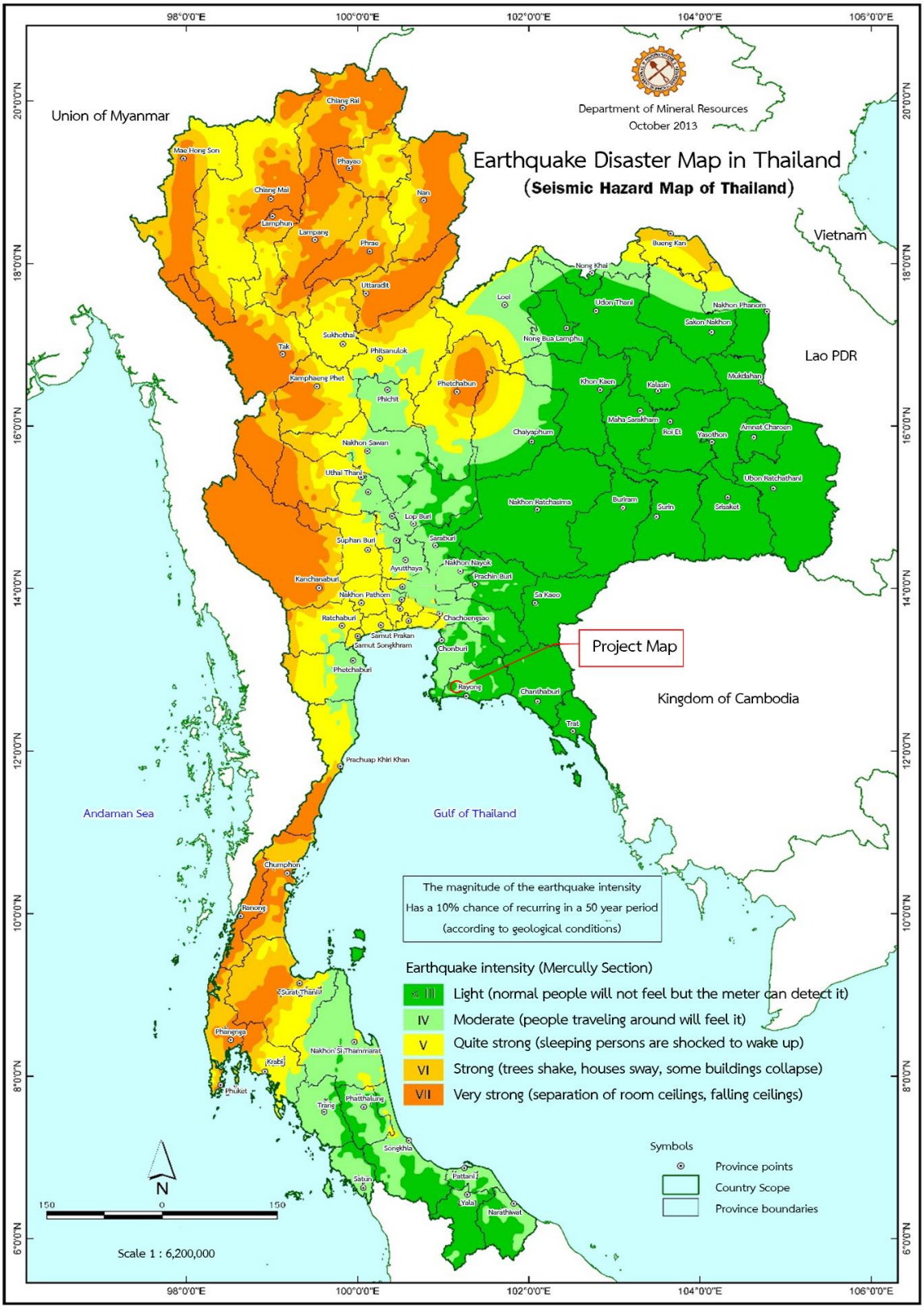
Table 3.5-15 Statistics of earthquakes affecting Thailand during the years 2013-2017

Day, Month, Year	Center	Size/Severity (Richter)	Log an incident
25 March 2015	Off the east coast of Phuket Province (7.89N, 98.52E)	3.8	Shaking felt at Muang District, Kathu District, Thalang District, Phuket Province, Koh Yao Yai, Phang Nga Province
6 May 2015	In the sea in the area of Ko Yao District, Phang Nga Province (7.85N, 98.54E)	4.6	Shaking felt in Phang Nga Province, Phuket Province and Krabi Province.
7 May 2015	In the sea in the area of Ko Yao District, Phang Nga Province (7.84N, 98.51E)	4.5	Shaking felt in Phang Nga Province, Phuket Province and Krabi Province.
24 May 2015	Myanmar (20.56N, 99.02E)	5.1	Shaking felt in the area of Chiang Mai, Chiang Rai and Mae Hong Son provinces
14 July 2015	Prangple Subdistrict, Sangkhlaburi District, Kanchanaburi (15.01N, 98.47E)	4.8	Shaking felt in the area of Sangkhlaburi District, Thong Pha Phum District, Kanchanaburi Province
16 August 2015	Phan District, Chiang Rai Province (19.62N, 99.73E)	3.0	Shaking felt in the area of Mueang Phan Subdistrict Phan District, Chiang Rai Province
20 August 2015	Sangkhlaburi District, Kanchanaburi Province (15.00N, 98.42E)	4.5	Shaking felt in Thong Pha Phum District, Sangkhlaburi District, Kanchanaburi Province
7 October 2015	Mae Suai Subdistrict, Mae Suai District, Chiang Rai Province (19.68N, 99.57E)	2.4	Shaking felt around Mae Suai District, Chiang Rai Province
8 November 2015	Nicobar Islands, India (6.79N, 94.50E)	6.2	Shaking felt at Mueang District, Phuket Province, Takuapa District, Phang Nga Province, Mueang District, Surat Thani Province, Mueang District, Krabi Province
16 November 2015	Phan District, Chiang Rai Province (19.62N, 99.70E)	2.2	Shaking felt in the area of Phan District, Chiang Rai Province
6 January 2016	Mae Ho Subdistrict, Mae Sariang District, Mae Hong Son Province (18.20N, 98.06E)	3.5	Shaking felt at Mae Sariang District, Mae Hong Son Province.
10 January 2016	Nong Bua Subdistrict, Mueang Kanchanaburi District, Kanchanaburi (14.08N, 99.47E)	2.3	Shaking felt at Mueang District, Kanchanaburi Province
31 March 2016	In the sea near Koh Yao Yai, Phang Nga Province (7.92N, 98.54E)	2.4	Shaking felt at Koh Yao Yai District, Phang Nga Province
18 June 2016	In the sea near Koh Yao Yai, Phang Nga Province (7.99N, 98.52E)	3.1	Shaking felt at Koh Yao Yai District, Phang Nga Province
24 August 2016	Myanmar (21.06N, 94.45E)	6.8	Shaking felt in the area of Chiang Mai Province, Chiang Rai and Bangkok
14 October 2016	Pak Chong District, Nakhon Ratchasima Province (14.69N, 101.38E)	3.0	Shaking felt in the area of Pak Chong District, Nakhon Ratchasima Province
29 October 2016	Myanmar (17.35N, 97.86E)	4.5	Shaking felt in the area of Mueang Tak District, Mae Sot District, Tha Song Yang District, Tak Province

Table 3.5-15 Statistics of earthquakes affecting Thailand during the years 2013-2017

Day, Month, Year	Center	Size/Severity (Richter)	Log an incident
7 December 2016	North of Sumatra, Indonesia (5.32N, 96.07E)	6.5	Shaking felt in the area of Krabi Province, Songkhla Province and Phuket Province
8 January 2017	Umphang District, Tak Province (16.10N, 98.70E)	3.9	Shaking felt in the area of Umphang District, Tak Province
15 January 2017	Chomthong District, Chiang Mai Province (18.56N, 98.52E)	4.2	Shaking felt in the area of Mae Hong Son Province and Chiang Mai Province
6 April 2017	Lang Suan District, Chumphon Province (10.03N, 99.16E)	2.9	Shaking felt in the area of Lang Suan District, Chumphon Province
18 April 2017	Myanmar (20.71N, 100.12E)	5.1	Shaking felt in the area of Mueang District, Mae Chan District, Mae Sai District, Chiang Saen District, Chiang Rai Province
22 April 2017	Na Noi District, Nan Province (18.35N, 100.87E)	3.9	Shaking felt at Na Noi District, Wiang Sa District Nan Province

source: Statistics of earthquakes affecting Thailand, Bureau of Earthquake Surveillance, Meteorological Department
Retrieved from http://www.seismology.tmd.go.th/earthquakestat.html, Retrieved 7 June 2019



Source: Department of Mineral Resources, October 2013

Figure 3.5-15 Map of earthquake-prone areas in Thailand

3.5.6 Soil resources

3.5.6.1 *Scope of Study*

Study soil conditions, subsidence in the project area, and surrounding areas that may cause impacts and pose limitations on the project.

3.5.6.2 *Study Methods*

Collect and review secondary data, including:

- Soil resource data in the study area from the Land Development Department, 2016
- Report on the results of the soil stratification survey in U-Tapao International Airport. (The results of the soil mechanism and geological survey)
- Collect technical data on geologic features from the Full Version of Complete Feasibility Study Master Plan for U-Tapao Airport Development Project and Surrounding Areas, Rayong (December 2018)

3.5.6.3 *Study Results*

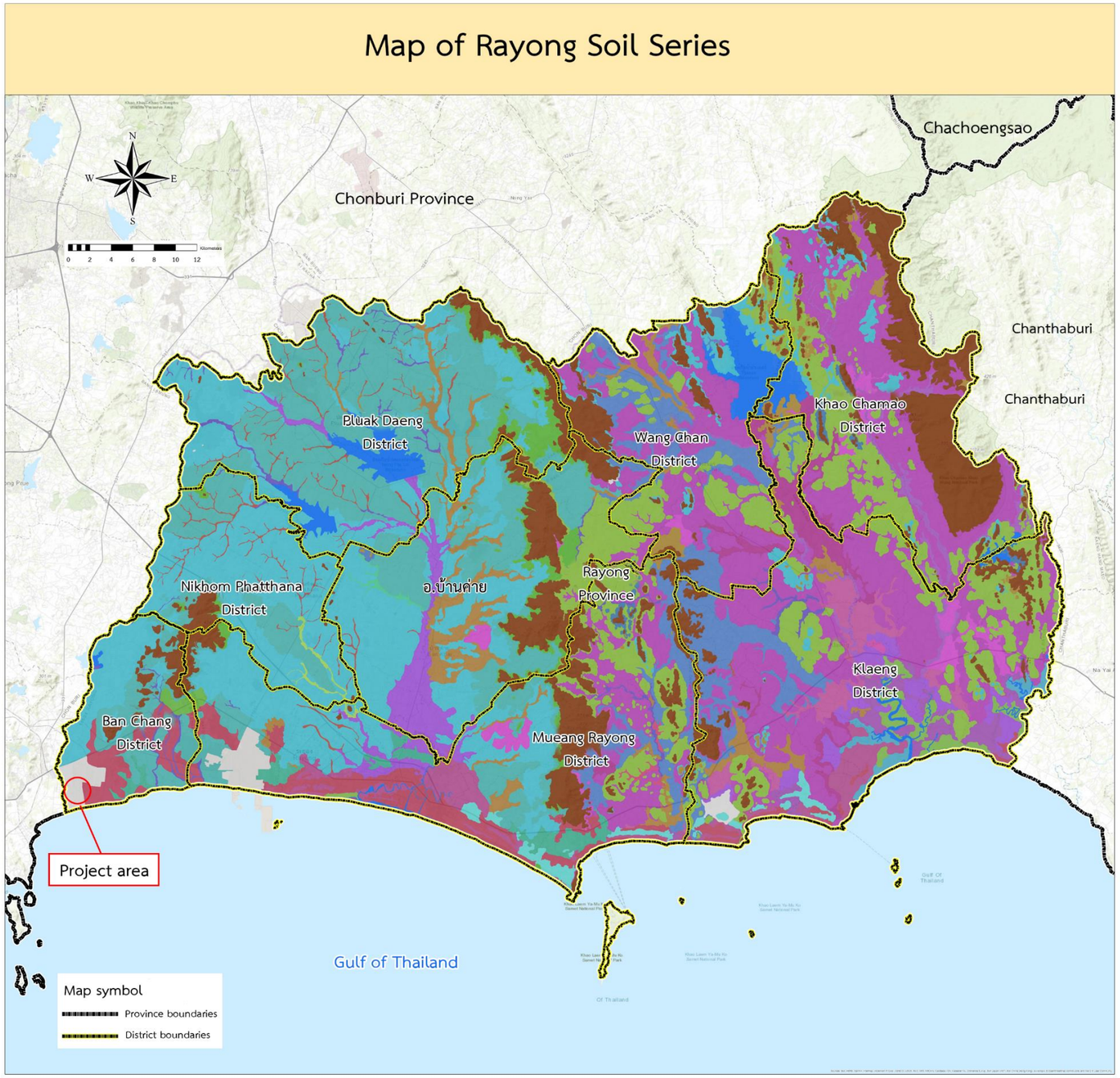
(1) The soil conditions of Rayong province

The project is located in the area of Ban Chang, Rayong. From the examination of the Land Development Department's soil collection data, 2016, it was found that Ban Chang District was classified in the high ground of damp soil area of the 43rd soil group, covering an area of about 70,644 rai, or 3.18 percent of the area as shown in Figure 3.5-*16*Rayong soil as follows:

Features: Very deep sandy soil caused by sediment in waterways or sea dunes. Such sandy soils have fragments of shells mixed in, with grayish to white or brownish gray or yellow in color, ranging from slightly acidic to basic, of good soil drainage but low in fertility.

Soil properties: Such soil group belongs in high rainfall areas, such as the southern, eastern regions or coastal areas, deriving from sand sediment on the shorelines or decaying sand in place or decaying coarse materials that are relocated and deposit. The sedimentation has mostly smooth surface or with wavy slope pattern found mostly on the beach, sand dunes or in slope area at the foot of a hill. The soil formation is deep with excessive drainage, the soil belongs to the sandy soil group, gray, light brown or yellow in color, with low fertility. Such soil is moderately acidic to neutral. If found in coastal sand dunes the soil may have shell fragments mixed in and is slightly acidic to moderately basic.

Problem: The soil is excessively sandy with low water retention. Plants constantly show signs of dehydration in sandy soil which also offers low fertility.



Description of the map unit

Symbols		Area (rai)	Percentage
6	Soil series 6	25,968	1.17
10	Soil series 10	679	0.03
12	Soil series 12	15,995	0.72
13	Soil series 13	9,347	0.42
16	Soil series 16	21,882	0.99
17	Soil series 17	60,186	2.71
18	Soil series 18	63,612	2.86
22	Soil series 22	2,535	0.11
22hi	Soil series 22 located on the hill	1,737	0.08
23	Soil series 23	35,079	1.58
24	Soil series 24	18,106	0.81
26	Soil series 26	24,875	1.12
32	Soil series 32	20,550	0.93
34	Soil series 34	338,240	15.24
34gm	Soil series 34 with gray dots	33,225	1.50
35	Soil series 35	325,194	14.65
35b	Soil series 35 with an embankment	311	0.01
39	Soil series 39	107,986	4.86
39gm	Soil series 39 with gray dots	1,711	0.08
40	Soil series 40	363,105	16.36
40b	Soil series 40 with an embankment	< 1	0.00
41	Soil series 41	3,719	0.17
42	Soil series 42	13,117	0.59
43	Soil series 43	70,644	3.18
45	Soil series 45	220,286	9.92
47	Soil series 47	9	0.00
48	Soil series 48	1,680	0.08
50	Soil series 50	37,245	1.68
51	Soil series 51	16,133	0.73
53	Soil series 53	4,804	0.22
55	Soil series 55	18	0.00
56	Soil series 56	27,816	1.25
59	Soil series 59	17,081	0.77
60	Soil series 60	13,533	0.61
62	Soil series 62	248,691	11.20
ML	Miscellaneous area	21,501	0.97
W	Water area	53,400	2.40
	Total	2,220,000	100.00

Soil Survey and Soil Resource Research Division
Department of Land Development
Ministry of Agriculture and Cooperatives

Source: Soil Resource Survey and Research Division, Land Development Department, 2020 , Thailand's Soil Map by Province at 1:25,000 scale from http://oss101.ldd.go.th/soilr/Main%20050164%20Soil%20Group.html searched on 21 October 2021

Figure 3.5□16 Rayong soil map

(2) Soil conditions in project area

The project area is located in part of Phala Subdistrict, Ban Chang District, Mueang Rayong District, Rayong Province, and Bang Lamung District, Sattahip District, Chonburi Province. Details are shown in Table 3.5-**16** and Figure 3.5-**17** Soil groups found in project

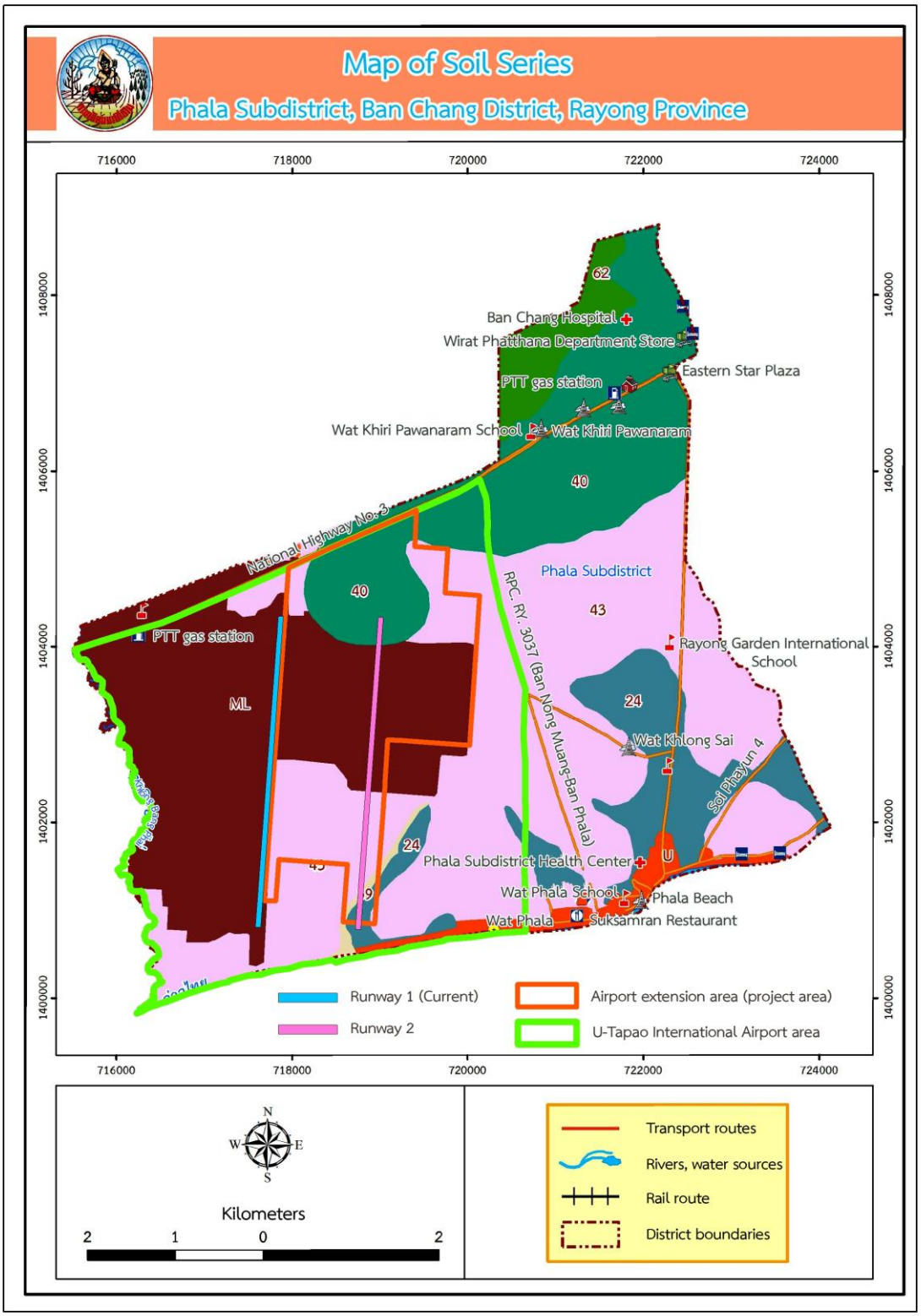
Table 3.5-16 Data on soil group in the project area

Soil group	Description
24	Features: Clay soil group's formation ranges from deep to very deep, deriving from sediment in waterways or fine textured parent materials, resulting in highly acidic soil that has good to moderately good drainage with low fertility. Soil properties: This soil group is found in the high rainfall areas, such as the southern and eastern regions. The soil originated from parent materials that decayed in place or decaying fine-textured materials that are transported and deposited elsewhere. Parent materials include igneous rock, sedimentary rock or metamorphic rock, commonly found in upland area. The deep formation of such soil, which has good drainage, takes the shape of wavy pattern up to the hilly area. The soil belongs to clay soil group, brown, yellow or red in color, is highly to moderately acidic. Problem: The soil has low fertility if found in slope areas as the soil is mixed with sand and therefore is prone to erosion unless property managed.
40	Features: This sandy soil group has a layer of organic matters at the depth of 100 centimeters from the surface, and is slightly to moderately acidic. Good drainage in the layers of soil that have moderately good to rather poor drainage, with low fertility. Soil properties: This soil group is commonly found in old beaches or coastal sand dunes, deriving from sediment on the shorelines in high ground with smooth to slope wavy surface, with formation that is moderately deep down to the organic layer. The soil has moderately good drainage, and is composed of high mixture of sand, dark gray in color on top of white sandy layer and bottom soil where at the depth of 50-100 cm. layers of organic matters, iron particles or humus are found, and is dark brown or red in color. Such layers of organic matters are bonded densely and have low fertility, with highly to moderately acidic in nature. Problem: The soil has very low fertility and rather sandy that offers little nutrients. Plants grown on this soil often show signs of nutrient deficiency. In dry season, the dense layers dry up and harden making it impossible for roots of plants to penetrate while in rainy season, such layers become waterlogged.
43	Features: This thin topsoil group mixed with gravel, rock fragments or stones is highly acidic with good to moderately good drainage and low fertility. Soil properties: This soil group is found in the high rainfall areas, such as the southern and eastern regions. The soil originated from parent materials that decayed in place or decaying fine-textured materials that are transported and deposited elsewhere. Parent material is mostly sedimentary rock. Such soil group is commonly found in high ground with wavy pattern up to the hilly area. This soil belongs to the loose soil or soil mixed with gravel, rock fragments with pebbles at the depth of 50 cm, with good drainage. Most of the gravel and pebbles are rounded in shape or rock fragments with iron deposits, light brown, yellow or red in color, with highly to moderately acidic property. Problem: This thin topsoil mixed with gravel, rock fragments or pebbles at the depth of 50 cm. from the surface is found in some areas with gravel, rock fragments or pebbles scattering in the topsoil that offers low fertility, if found in slope area, is prone to erosion.
59	Features: This loose coarse or fine textured soil originating from waterborne sedimentary soil, whose formation consists of layers of different soil textures depending on compositions of sediment, with highly to moderately acidic property, poor to rather poor drainage. Soil properties: This soil group is found in the lowlands or the bottom of hills or valleys with flat to relatively flat surface. The soil group is a mixture of several types of soil deriving from waterborne sediments in waterways. The soils have rather poor to poor drainage, with different characteristics and properties in terms of texture,

Table 3.5-16 Data on soil group in the project area

Soil group	Description
	color, formation depth, but they have highly to moderately acidic property, with a mixture of gravel and rock fragments. Problem: -
ML	Features: Modified Land/Filled-up Areas Soil Properties: - Problem: -

Source: Land Development Department, 2016 Searched from http://gisinfo.ldd.go.th/cd_search_land_map.html on 20 October 2021



Source: Land Development Department, 2016 Searched from http://gisinfo.ldd.go.th/cd_search_land_map.html on 20 October 2021

Figure 3.5-17 Soil groups found in project area

(3) Technical geologic features in the project area

Data on the technical survey of geologic features in the project area indicates that the original soil level in the project area had been altered from the south side near the coastal area at +2 meters from the mean sea level (MSL) gradually rising to +40 MSL in the north side, with low-lying rocky hills scattering in the north, east, and southeast of the area.

The drilling orientation for soil survey required 14 boreholes and 4 test wells spread throughout the project area. The results of drilling to explore the topsoil indicate the original soil or filled-up soil of the area consists mostly of clay down to approximately 2 meters, below which the next layer of soil was identified as Alluvial/Colluvial/Resi Deposits which consist of

- Loamy soil to moderately dense clay or fine textured clay to moderately dense sandy soil
- mixture of clay and moderately to highly dense sandy soil
- Moderate to very dense clay to coarse sand
- Very dense decomposed granite layer

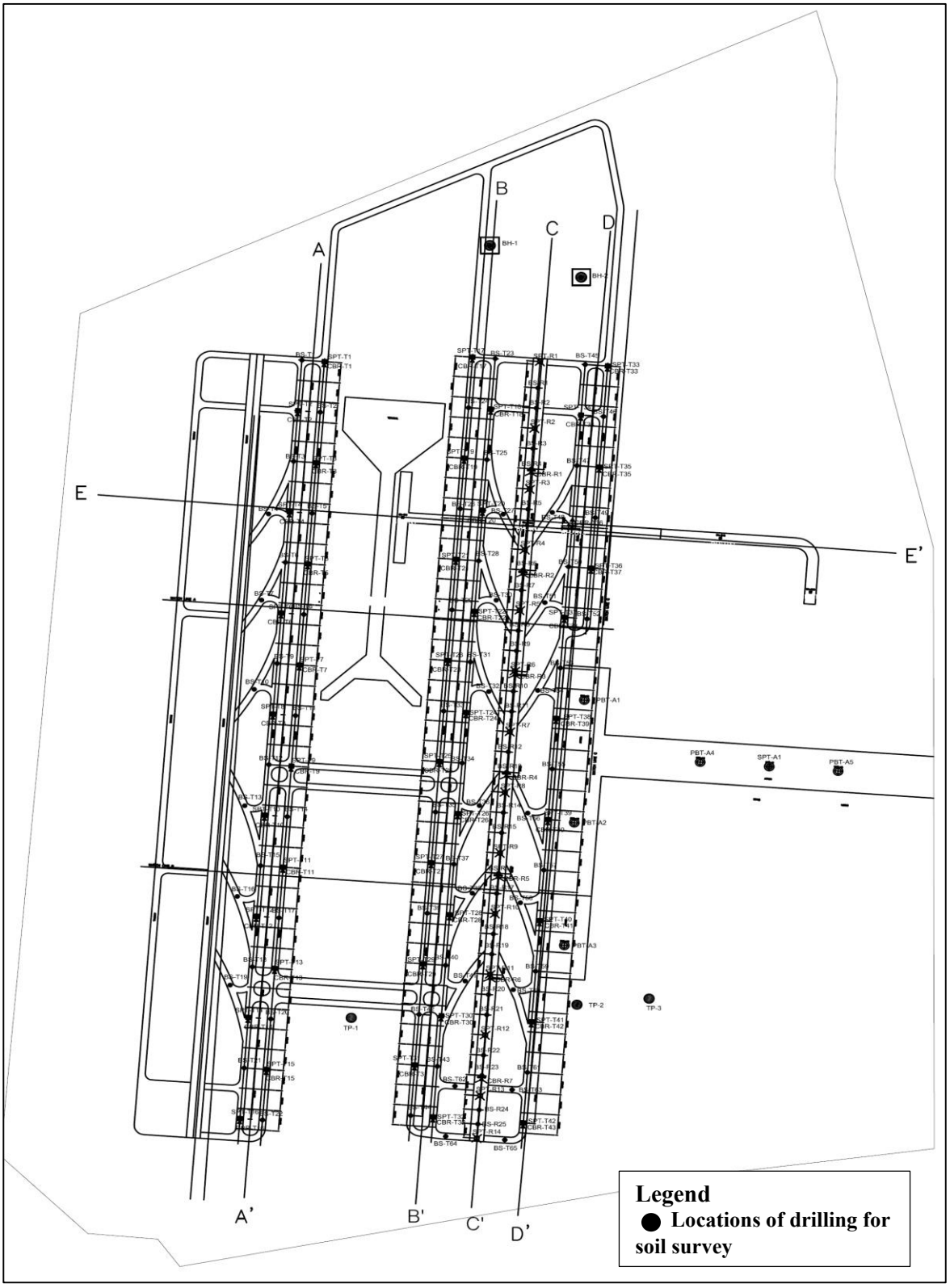
The average hardness levels of Alluvial/Colluvial/Resi Deposits sedimentation layer increase at greater depth from the surface and become hardest when approaching the layer of decomposed rock. It is highly likely that the hard or rather hard core of decomposed granite rock may be covered with layers of densely packed claystone/sand layers.

In the rock formation consisting of moderately to slightly decomposed granite rock, it was found in 6 bore holes that the deep rock formation was detected at +26.92 MSL (at a depth of 9.3 meters from surface at the rocky hill in the north of the project) down to -18.14 meters MSL (at a depth of 28 meters from surface of the bore hole in the middle of the project area).

At the remaining 8 bore holes, when drilling down approximately 22 to 30 meters from the original soil surface level to the sedimentation layer, it was found to be sufficiently dense, and there was no need to dig deeper into the rock formations below. This indicates that the depths of the decomposed granite rock formations varied greatly. (Source: Full Version of Complete Feasibility Study Master Plan for U-Tapao Airport Development Project and Surrounding Areas, Rayong, December 2018).

(4) Soil stratification in the Runway and Taxiway 2 area

Results of the drilling for soil stratification survey based on the report of soil mechanics and geologic features in the Runway and Taxiway 2 area on 6 July 2019. The locations of drilling for soil survey in Runway and Taxiway 2 area as shown in Figure 3.5-**18**. The summary of the soil stratification in Runway 2 area as shown in Table 3.5-**17** and Figure 3.5-*19* and soil stratification in Taxiway 2 area as shown in Table 3.5-**18**and Figure 3.5-*20* toFigure 3.5-**21**



Source: Soil Mechanics and Geological Survey Report, Outsourcing of Design, Study, Survey and Construction Design for Runway and Taxiway 2 Project, 2019

Figure 3.5-18 Locations of drilling for soil survey

Table 3.5-17 Summary of soil stratification at the bore holes of Runway 2

Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Runway 2 area					
BS-R1	2.50	0.0-1.5	Dense Silty Sand	Brown	SM
		1.5-5.0	Loose Silty Sand	Brown	SM
		5.0-5.5	Medium Dense Silty Sand	Brown	SM
BS-R3	1.10	0.0-3.0	Medium Dense to Dense Silty Sand	Brown	SM
		3.0-5.0	Very Loose to Loose Silty Sand (Very Loose to Loose Silty Sand)	Brown	SM
		5.0-5.5	Dense Clayey Sand Dense Sandy Clay	Brown	SC
BS-R4	1.80	0.0-2.0	Loose Silty Sand	Brown	SM
		2.0-5.5	Medium Dense to Dense Silty Sand	Brown and Brownish Grey	SM
BS-R5	1.50	0.0-0.3	Medium Dense to Very Dense Silty Sand	Brown and Brownish Grey	SM
		3.0-5.0	Loose Silty Sand	Brown and Grey	SM
		5.0-5.5	Dense Silty Sand	Grey	SM
BS-R6	2.50	0.0-2.0	Dense Silty Sand	Brown	SM
		2.0-4.0	Loose Silty Sand	Brown and Grey	SM
		4.0-5.5	Medium Dense Silty Sand	Greyish Brown and Grey	SM, SC
BS-R8	2.40	0.0-1.5	Medium Dense to Dense Silty Sand	Brown	SM, SP-SM
BS-R9	2.50	0.0-4.0	Medium Dense Silty Sand	Brown	SM
		4.0-5.5	Loose Silty Sand	Brown	SP-SM SM
BS-R10	2.00	0.0-3.0	Medium Dense Silty Sand	Brown	SM
		3.0-4.0	Very Loose Silty Sand	Brown	SM
		4.0-5.5	Medium Dense Silty Sand Medium Dense Silty Sand	Brown and Grey	SM
BS-R11	1.40	0.0-5.5	Medium Dense to Dense Silty Sand	Brown and Grey	SM
BS-R12	1.50	0.0-4.0	Very Loose to Loose Silty Sand	Brown	SM
		4.0-5.5	Medium Dense Silty Sand	Brown to Greyish Brown	SM
BS-R13	1.50	0.0-2.0	Medium Dense Silty Sand	Brown	SM
			Very Loose to Loose Silty Sand	Brown	SM
			Medium Dense to Dense Silty Sand	Brown	SM
BS-R14	1.30	0.0-2.0	Loose Silty Sand	Brown	SM
		2.0-5.0	Medium Dense to Very Dense Silty Sand	Brown and Brownish Grey	SM
BS-R15	2.10	0.0-2.0	Loose Silty Sand	Dark Brown	SM
		2.0-5.0	Medium Dense to Very Dense Silty Sand	Greyish Brown	SM
BS-R16	2.00	0.0-3.0	Very Loose Silty Sand	Brown and Brownish Grey	SM
		3.0-5.5	Medium Dense to Dense Silty Sand	Brown and Brownish Grey	SM
BS-R17	2.40	0.0-2.0	Medium Dense Silty Sand	Brown	SM
		2.0-3.0	Loose Silty Sand	Brown	SM

Table 3.5-17 Summary of soil stratification at the bore holes of Runway 2

Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Runway 2 area					
		3.0-5.5	Dense to Very Dense Silty Sand	Brown and Greyish Brown	SM
BS-R18	2.10	0.0-5.5	Dense to Very Dense Silty Sand	Brown and Greyish Brown	SM
BS-R19	1.50	0.0-2.0	Medium Dense Silty Sand	Brown	SM
		2.0-4.0	Loose Silty Sand	Brown	SM
		4.0-5.5	Medium Dense to Dense Silty Sand	Greyish Brown	SC
BS-R20	2.00	0.0-3.0	Very Loose to Loose Silty Sand	Brown	SM
		3.0-5.5	Medium Dense to Dense Clayey Sand (Medium Dense to Dense Clayey Sand)	Brown	SM
BS-R21	2.00	0.0-3.0	Very Loose Silty Sand	Brown	SM
		3.0-5.5	Medium Dense to Very Dense Silty Sand	Brown and Grey	SM
BS-R22	2.40	0.0-5.5	Medium Dense to Very Dense Silty Sand	Brown to Greyish Brown	SM
BS-R23	N.A.	0.0-5.0	Medium Dense to Very Dense Silty Sand	Brown	SM, SC
		5.0-5.5	Very Stiff Clay	Greyish Brown	CL
BS-R24	2.00	0.0-4.0	Loose Silty Sand	Brown	SM
		4.0-5.5	Medium Dense to Dense Silty Sand	Brown	SM, SC
BS-R25	1.90	0.0-2.0	Medium Dense Silty Sand	Brown	SM
		2.0-5.5	Stiff to Very Stiff Clay Stiff to Very Sliff Clay	Brown and Grey	CL
SPT-R7	2.30	0.0-3.0	Medium Dense to Dense Silty Sand (Medium Dense to Dense Silty Sand)	Brown	SM
		3.0-4.0	Loose Silty Sand	Dark Brown	SM
		4.0-10.5	Medium Dense to Very Dense Silty Sand	Brown to Greyish Brown	SM
SPT-R8	N.A.	0.0-3.0	Loose Silty Sand	Reddish Brown	SM
		3.0-10.5	Medium Dense Silty Sand Medium Dense Silty Sand	Light Grey and Reddish Brown to Brown	SM
SPT-R9	2.00	0.0-2.0	Medium Dense Silty Sand Medium Dense Silty Sand	Brown	SM
		2.0-4.0	Loose Silty Sand	Brown	SM
		4.0-10.5	Medium Dense to Dense Silty Sand	Brown and Grey	SM
SPT-R10	1.30	0.0-10.5	Medium Dense to Dense Silty Sand	Grey	SM
SPT-R11	1.40	0.0-10.5	Medium Dense to Dense Silty Sand	Grey	SM
SPT-R13	1.00	0.0-5.0	Medium Dense Silty Sand	Reddish Brown to Brown and Grey	SM
		5.0-6.0	Medium Stiff Sandy layer (Medium Stiff Sandy layer)	Grey	CL
		6.0-10.5	Medium Stiff Sandy Clay (Medium Stiff Sandy Clay)	Reddish Brown to Brown and Grey	CL
SPT-R14	1.50	0.0-2.0	Loose Silty Sand	Brown	SM
		2.0-3.0	Medium Dense Silty Sand	Brown	SM
		3.0-5.0	Loose Silty Sand	Brown	SM
		5.0-7.0	Medium Dense to Dense Silty Sand	Brown and Grey	SM

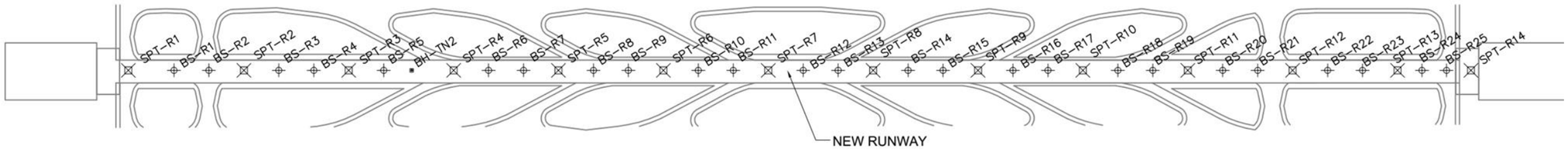
Table 3.5-17 Summary of soil stratification at the bore holes of Runway 2

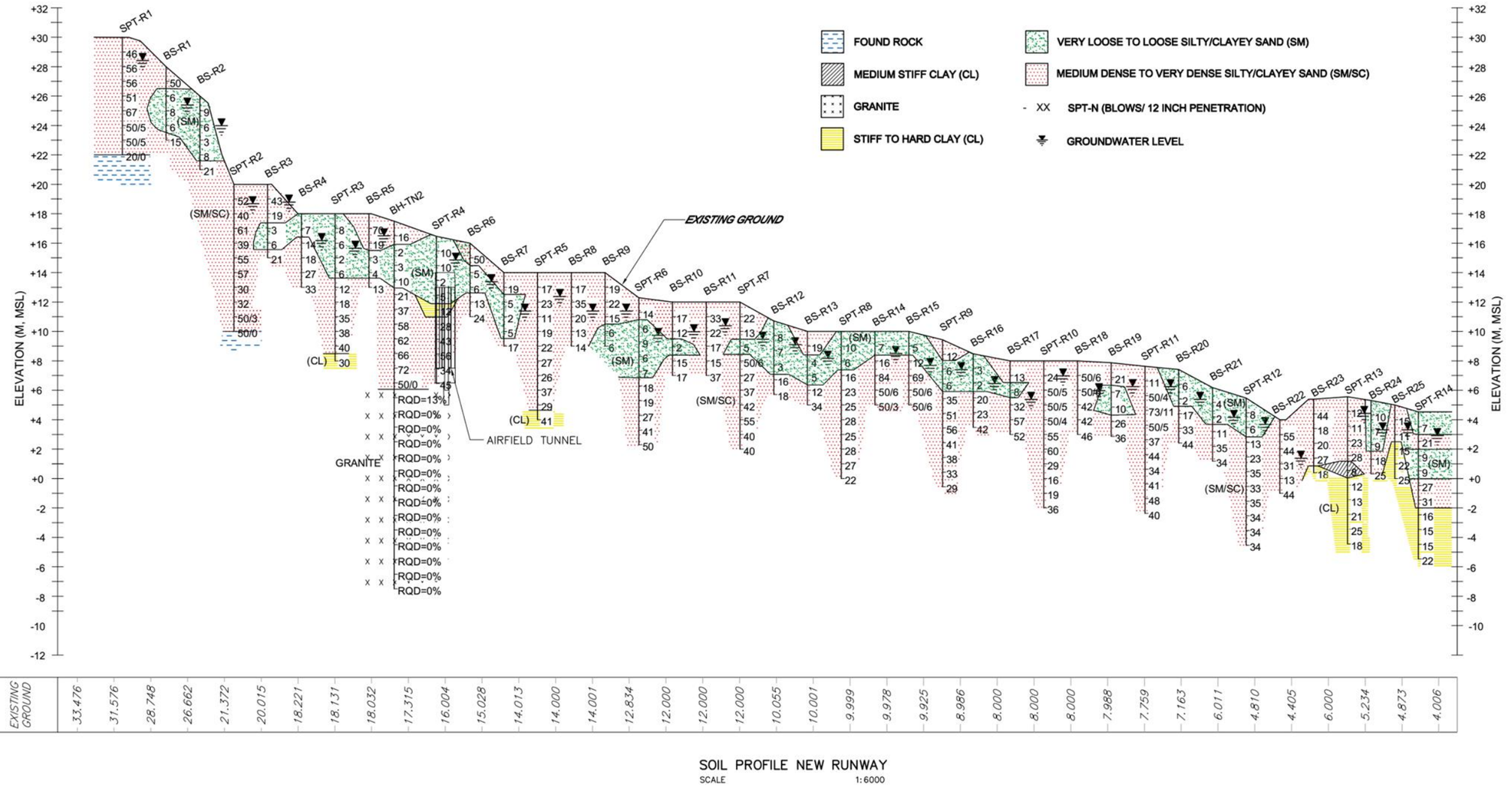
Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Runway 2 area					
		7.0-10.5	Medium Stiff Sandy Clay (Medium Stiff Sandy Clay)	Light Brown to Reddish Brown	CL
BH-1	1.50	0.0-12.0	Medium Dense to Very Dense Silty Sand. The rock face was found at a depth of 12.0 meters from the opening of the borehole.	Brown	SM
BH-2	1.50	0.0-19.0	Medium Dense to Very Dense Silty Sand. The rock face was found at a depth of 19.0 meters from the opening of the borehole.	Brown and Grey	SP-SM, SM, SC

Note: * Unified Soil Classification System (USCS)

The groundwater level in the borehole is summarized in the table. Measurements were taken 24 hours after drilling was completed.

Source: Soil Mechanics and Geological Survey Report, 2019, Outsourcing of Design, Study, Survey and Construction Design for Runway and Taxiway 2 Project





SOIL PROFILE NEW RUNWAY
SCALE 1:6000

Source : Soil Science and Geological Survey Report, Outsourcing, Study, Survey and Design Construction of the Runway and Taxiway 2 Project, 2019

Figure 3.5-19 Characteristics of the soil layer around the exploration borehole of Runway 2

Table 3.5-18 Summary of soil layer characteristics at the exploration borehole of the Taxiway 2

Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Taxiway 2 area					
BS-T1	2.00	0.0-5.5	Medium Dense to Dense Silty Sand	Brown to Greyish Brown	SM
BS-T2	1.20	0.0-4.0	Loose Silty Sand	Brown	SM
		4.0-5.5	Medium Dense to Dense Silty Sand	Brown	SM, SC
BS-T3	2.00	0.0-2.0	Medium Dense Silty Sand	Brown	SM
		2.0-3.0	Loose Silty Sand	Brown	SM
		30.5.5	Medium Dense to Dense Silty Sand	Greyish Brown	SM, SC
BS-T4	2.00	0.0-2.0	Dense to Very Dense Silty Sand (Dense to Very Dense Silty Sand)	Brown	SM
		2.0-1.0	Loose Silty Sand	Brown	SM
		4.0-5.5	Medium Dense Silty Sand	Grey	SM
BS-T5	1.40	0.0-2.0	Medium Dense Silty Sand	Brown	SP-SM
		2.0-4.0	Loose Silty Sand	Brown	SM
		4.0-5.5	Medium Dense to Dense Clayey Sand (Medium Dense to Dense Clayey Sand)	Brown	SC
BS-T6	2.5	0.0-5.5	Dense to Very Dense Silty Sand (Dense to Very Dense Silty Sand)	Brown to Greyish Brown	SM
BS-T7	1.90	0.0-2.0	Medium Dense Silty Sand	Brown	SM
		2.0-3.0	Very Loose Silty Sand	Brown	SM
		3.0-5.5	Medium Dense Silty Sand	Brown	SM
BS-T8	2.10	0.0-4.0	Very Loose Silty Sand	Brown	SM
		4.0-5.5	Medium Dense to Dense Clayey Sand (Medium Dense to Dense Clayey Sand)	Brown and Brownish Grey	SC
BS-T9	1.80	0.0-5.5	Very Loose to Loose Silty Sand Loose to Very Loose Sand	Brown	SM, SC
BS-T10	2.30	0.0-0.2	Dense Silty Sand	Brown	SM
		2.0-3.0	Very Loose Silty Sand (Very Loose Silty Sand)	Brown	SM
		3.0-5.5	Very Loose to Loose Silty Sand Loose to Very Loose Sand	Greyish Brown	SM, SC
BS-T11	N.A.	0.0-5.5	Medium Dense Silty Sand	Brown	SM
BS-T12	2.30	0.0-2.0	Medium Dense Silty Sand	Brown	SM
		2.0-3.0	Very Loose Silty Sand	Brown	SM

Table 3.5-18 Summary of soil layer characteristics at the exploration borehole of the Taxiway 2

Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Taxiway 2 area					
		3.0-5.5	Medium Dense to Dense Clayey Sand (Medium Dense to Dense Clayey Sand)	Brown to Greyish Brown	SC

Table 3.5-18 Summary of soil layer characteristics at the exploration borehole of the Taxiway 2

Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Taxiway 2 area					
BS-T13	1.50	0.0-2.0	Dense Silty Sand	Brown	SM
		2.0-3.0	Loose Silty Sand	Brown	SM
		3.0-5.5	Dense to Very Dense Clayey Sand (Dense to Very Dense Clayey Sand)	Brown to Greyish Brown	SC
BS-T14	1.60	0.0-2.0	Very Dense Sand	Brown	SM
		2.0-4.0	Medium Dense Silty Sand	Brown	SM
		4.0-5.0	Very Stiff Clay	Brown	CL
		5.0-5.5	Dense Clayey Sand (Dense Clayey Sand)	Brown	SC
BS-T15	2.00	0.0-4.0	Medium Dense to Dense Silty Sand	Brown	SM
		4.0-5.0	Very Loose Silty Sand	Brown	SP-SM
		5.0-5.5	Medium Dense Silty Sand	Brown	SM
BS-T16	2.00	0.0-2.0	Medium Dense Silty Sand	Brown to Greyish Brown	SM
		2.0-4.0	Very Loose to Loose Silty Sand (Loose to Very Loose Sand)	Brown	SM
		4.0-5.5	Medium Dense Clayey Sand (Medium Dense Clayey Sand)	Brown to Greyish Brown	SC
BS-T17	2.10	0.0-2.0	Very Loose Silty Sand	Brown	SM
		2.0-5.5	Medium Dense to Dense Silty Sand (Medium Dense to Dense Silty Sand)	Brown	SM, SC
BS-T18	1.90	0.0-0.5	Medium Dense to Dense Silty Sand (Medium Dense to Dense Silty Sand)	Brown	SM, SC
BS-T19	1.90	0.0-5.5	Medium Dense to Dense Silty Sand (Medium Dense to Dense Silty Sand)	Brown	SM
BS-T20	1.60	0.0-5.5	Medium Dense Silty Sand	Brown	SM
BS-T21	1.50	0.0-3.0	Dense Silty Sand	Brown	SM
		3.0-4.0	Loose Silty Sand	Brown	CL
		4.0-5.0	Very Stiff Clay	Brown	SM
		5.0-5.5	Dense Silty Sand	Brown	SM
BS-T22	2.10	0.0-5.5	Medium Dense to Dense Silty Sand (Medium Dense to Dense Silty Sand)	Brown	SM, SC

Table 3.5-18 Summary of soil layer characteristics at the exploration borehole of the Taxiway 2

Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Taxiway 2 area					
BS-T23	N.A.	0.0-3.0	Medium Dense to Dense Silty Sand	Brown	SM
		3.0-4.0	Very Loose Silty Sand	Brown	SP
		4.0-5.5	Medium Dense to Dense Silty Sand	Brown	SP, SM
BS-T25	1.50	0.0-5.0	Medium Dense to Very Dense Silty Sand	Brown to Greyish Brown	SM

Table 3.5-18 Summary of soil layer characteristics at the exploration borehole of the Taxiway 2

Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Taxiway 2 area					
		5.0-5.5	Very Loose Clayey Sand (Very Loose Clayey Sand)	Greyish Brown	SC
BS-T26	2.50	0.0-2.0	Dense Silty Sand	Brown	SM
		2.0-4.0	Very Loose to Loose Silty Sand (Very Loose to Loose Silty Sand)	Brown	SM
		4.0-5.5	Medium Dense to Dense Silty Sand	Brown	SM
BS-T32	2.00	0.0-5.5	Medium Dense to Very Dense Silty Sand	Brown	SM,SC
BS-T33	2.10	0.0-5.0	Medium Dense Silty Sand	Brown	SM
		5.0-5.5	Very Loose Clayey Sand (Very Loose Clayey Sand)	Brown	SC
BS-T34	2.00	0.0-3.0	Medium Dense to Dense Silty Sand	Brown	SM
		3.0-4.0	Very Loose Silty Sand	Greyish Brown	SM
		4.0-5.5	Medium Dense Clayey Sand (Medium Dense Clayey Sand)	Greyish Brown	SC
BS-T35	2.00	0.0-2.0	Medium Dense Silty Sand	Brown	SM
		2.0-3.0	Very Loose Silty Sand	Brown	SM
		3.0-5.5	Medium Dense to Dense Silty Sand	Brown	SM
BS-T36	2.10	0.0-4.0	Very Loose to Loose Silty Sand	Brown and Brownish Grey	SM
		4.0-5.5	Medium Dense to Dense Silty Sand (Medium Dense to Dense Silty Sand)	Brown	SM
BS-T37	1.80	0.0-5.5	Medium Dense to Dense Silky Sand	Brown	SM
BS-T38	2.00	0.0-5.5	Medium Dense to Very Dense Silty Sand	Brown	SM
BS-T39	2.00	0.00-3.0	Very Loose to Loose Silty Sand	Brown	SM
		3.0-5.5	Dense to Very Dense Silty Sand (Dense to Very Dense Silty Sand)	Greyish Brown	SC, SM
BS-T40	1.20	0.0-2.0	Very Loose Silty Sand	Brown	SM
		2.0-4.0	Medium Dense Silty Sand	Brown and Brownish Grey	SM
		4.0-5.0	Hard Clay	Brownish Grey	CL
		5.0-5.5	Very Dense Silty Sand	Grey	SM

Table 3.5-18 Summary of soil layer characteristics at the exploration borehole of the Taxiway 2

Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Taxiway 2 area					
BS-T41	2.00	0.0-3.0	Very Loose to Loose Silty Sand (Very Loose to Loose Silty Sand)	Brown	SM
		3.0-5.5	Medium Dense to Very Dense Clayey/ Silky Sand (Medium Dense to Very Dense Clayey/ Silty Sand)	Greyish Brown and Grey	SC, SM
BS-T42	2.00	0.0-2.0	Medium Dense Silty Sand	Brown	SM
		2.0-3.0	Loose Silty Sand	Brown	SM
BS-T43	1.90	0.0-3.0	Very Loose to Loose Silty Sand (Very Loose to Loose Silty Sand)	Brown	SM, SC
		3.0-5.5	Medium Dense to Dense Silty Sand	Brown	SM
BS-T44	1.90	0.0-3.0	Loose Silty Sand	Brown	SM
		3.0-5.5	Medium Dense to Dense Silty Sand	Grey	SM
BS-T45	2.70	0.0-5.5	Medium Dense to Dense Silty Sand	Brown and Brownish Grey	SM
BS-T54	2.10	0.0-5.5	Medium Dense to Dense Silty Sand	Brown and Brownish Grey	SM, SC
BS-T55	1.50	0.0-5.5	Medium Dense to Dense Silty Sand	Brown	SM
BS-T56	1.50	0.0-2.0	Loose Silty Sand	Brown	SM
		2.0-3.0	Medium Dense Silty Sand	Brown	SM
		3.0-4.0	Loose Silty Sand	Reddish Brown	SM
		4.0-5.5	Dense Silty Sand	Brown to Reddish Brown	SM
BS-T57	2.0	0.0-3.0	Loose Silty Sand	Brown	SM
		3.0-5.5	Medium Dense to Dense Silty Sand	Brown	SM
BS-T58 and BS-T59	2.0 and 3.0	0.0-3.0	Very Loose to Loose Silty Sand	Brown	SM
		3.0-5.5	Medium Dense to Dense Silty Sand	Brown	SM
BS-T60	1.90	0.0-3.0	Very Loose Silty Sand	Brown	SM
BS-T61	1.80	0.0-5.5	Medium Dense Silty Sand	Brown	SM
BS-T62	2.10	0.0-3.0	Medium Dense Silty Sand	Brown	SM
		3.0-4.0	Very Stiff Clay	Brown	CL
		4.0-5.5	Medium Dense Silty Sand	Brown to Greyish Brown	SM

Table 3.5-18 Summary of soil layer characteristics at the exploration borehole of the Taxiway 2

Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Taxiway 2 area					
BS-T63	1.70	0.0-5.0	Medium Dense to Dense Silty Sand	Brown	SM, SC
		5.0-5.5	Stiff Clay	Greyish Brown	CH
BS-T64	2.20	0.0-3.0	Very Loose to Loose Silty Sand	Brown	SM
		3.0-5.5	Medium Dense to Very Dense Silty Sand	Greyish Brown	SM
BS-T65	2.00	0.0-5.5	Medium Dense to Dense Silty Sand	Brown to Reddish Brown	SM
SPT-T1	0.50	0.0-2.0	Dense Silty Sand	Brown	SM
		2.0-4.0	Loose Silty Sand	Brown	SM
		4.0-10.1	Medium Dense to Dense Silty Sand	Brown and Grey	SC, SM
SPT-T2	1.00	0.0-10.5	Medium Dense to Very Dense Silty Sand	Brown and Grey	SC, SM
SPT-T12	2.30	0.0-2.0	Loose Silty Sand	Brown	SM
		2.0-10.0	Medium Dense to Very Dense Silty Sand	Brown to Greyish Brown	SM
SPT-T17	1.00	0.0-10.5	Medium Dense to Very Dense Silty Sand	Reddish Brown	SM
SPT-T24	1.70	0.0-2.0	Dense Silty Sand	Brown	SM
		2.0-5.0	Loose Silty Sand	Brown	SM
		5.0-10.5	Medium Dense to Very Dense Silty Sand	Brown to Greyish Brown	SM, SC
SPT-T25	1.50	0.0-10.5	Medium Dense to Dense Silty Sand	Reddish Brown to Brown and Grey	SM
SPT-T26	2.00	0.0-10.5	Medium Dense to Very Dense Silty Sand	Brown to Greyish Brown	SM, SC
SPT-T29	1.50	0.0-2.0	Very Loose Silty Sand	Brown	SM
		2.0-10.3	Medium Dense to Very Dense Silty Sand	Brown and Grey	SM
SPT-T30	2.10	0.0-2.0	Loose Silty Sand	Dark Brown	SM
		2.0-10.5	Medium Dense to Very Dense Silty Sand	Brown and Grey	SM
SPT-T31	1.20	0.0-10.5	Medium Dense to Dense Silty Sand	Brown to Reddish Brown	SM
SPT-32	1.00	0.0-3.0	Loose Silty Sand	Brown	SM
		3.0-4.0	Medium Dense Silty Sand	Brown	SM
		4.0-5.0	Loose Silty Sand	Brown	SM
		5.0-10.5	Medium Dense to Dense Silty Sand	Brown and Grey	SM
SPT-38	1.50	0.0-3.0	Medium Dense Silty Sand	Brown	SM

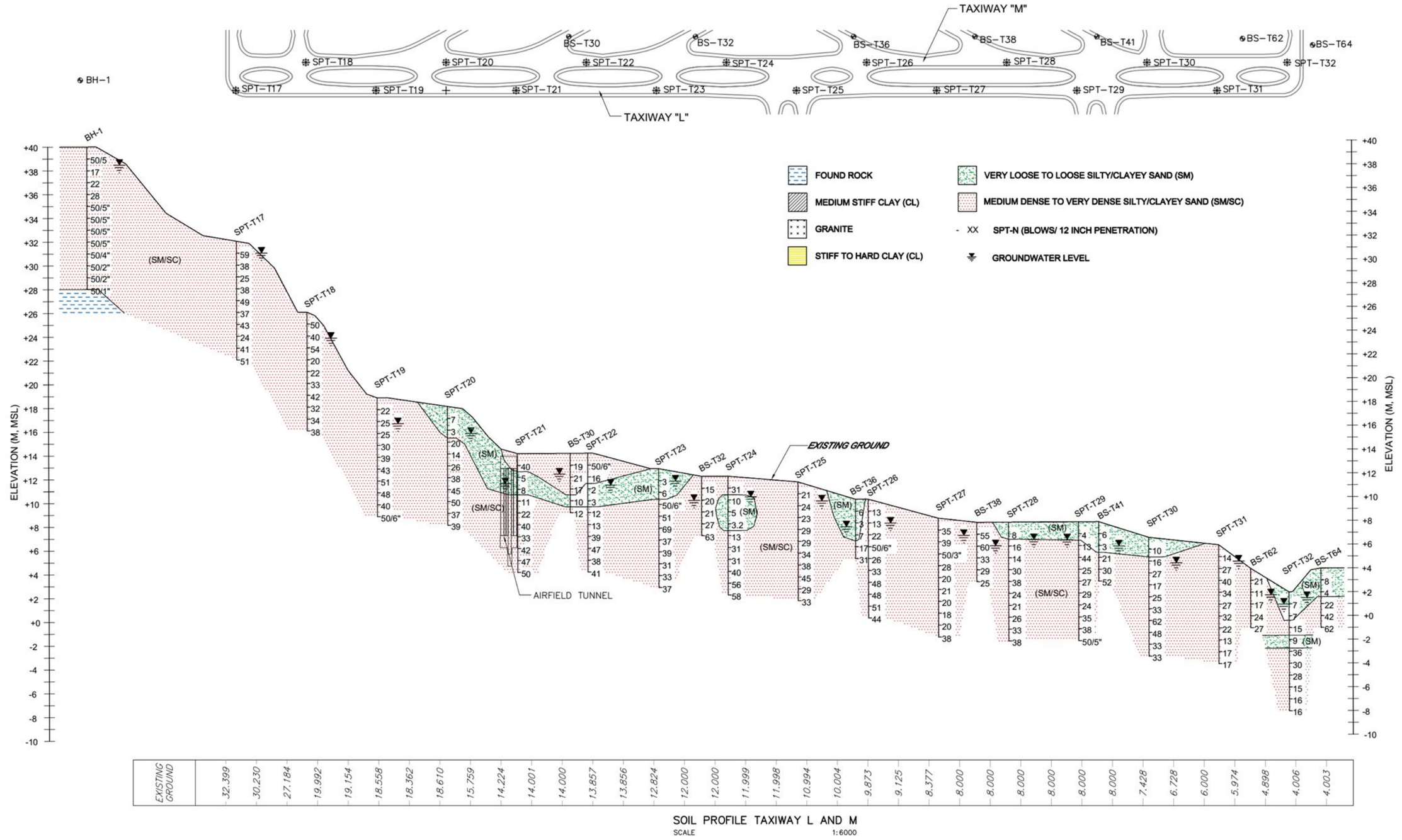
Table 3.5-18 Summary of soil layer characteristics at the exploration borehole of the Taxiway 2

Boreholes	Groundwater level (m)	Depth from surface (m)	Type of layer	Color of the soil	Group Symbol*
Taxiway 2 area					
		3.0-5.0	Loose Silty Sand	Brown	SM
		5.0-10.5	Dense to Very Dense Clayey Sand (Dense to Very Dense Clayey Sand)	Brown to Greyish Brown	SC
SPT-T39	1.50	0.0-2.0	Medium Dense Silty Sand	Brown	SM
		2.0-3.0	Loose Silty Sand	Brown	SM
		3.0-10.5	Medium Dense to Very Dense Silty Sand	Grey and Brown	SM
SPT-T40	1.00	0.0-3.0	Very Loose Silty Sand	Dark Brown	SM
		3.0-10.5	Medium Dense Silty Sand	Grey and Brown	SM
SPT-T42	1.00	0.0-3.0	Very Loose Silty Sand	Dark Brown	SM
		3.0-10.5	Medium Dense Silty Sand	Grey and Brown	SM
		0.0-2.0	Dense Silty Sand	Brown	SM
		2.0-10.5	Stiff to Very Clay	Brown to Reddish Brown	CL

Note : * Soil classification according to the Unified Soil Classification System (USCS) standards.

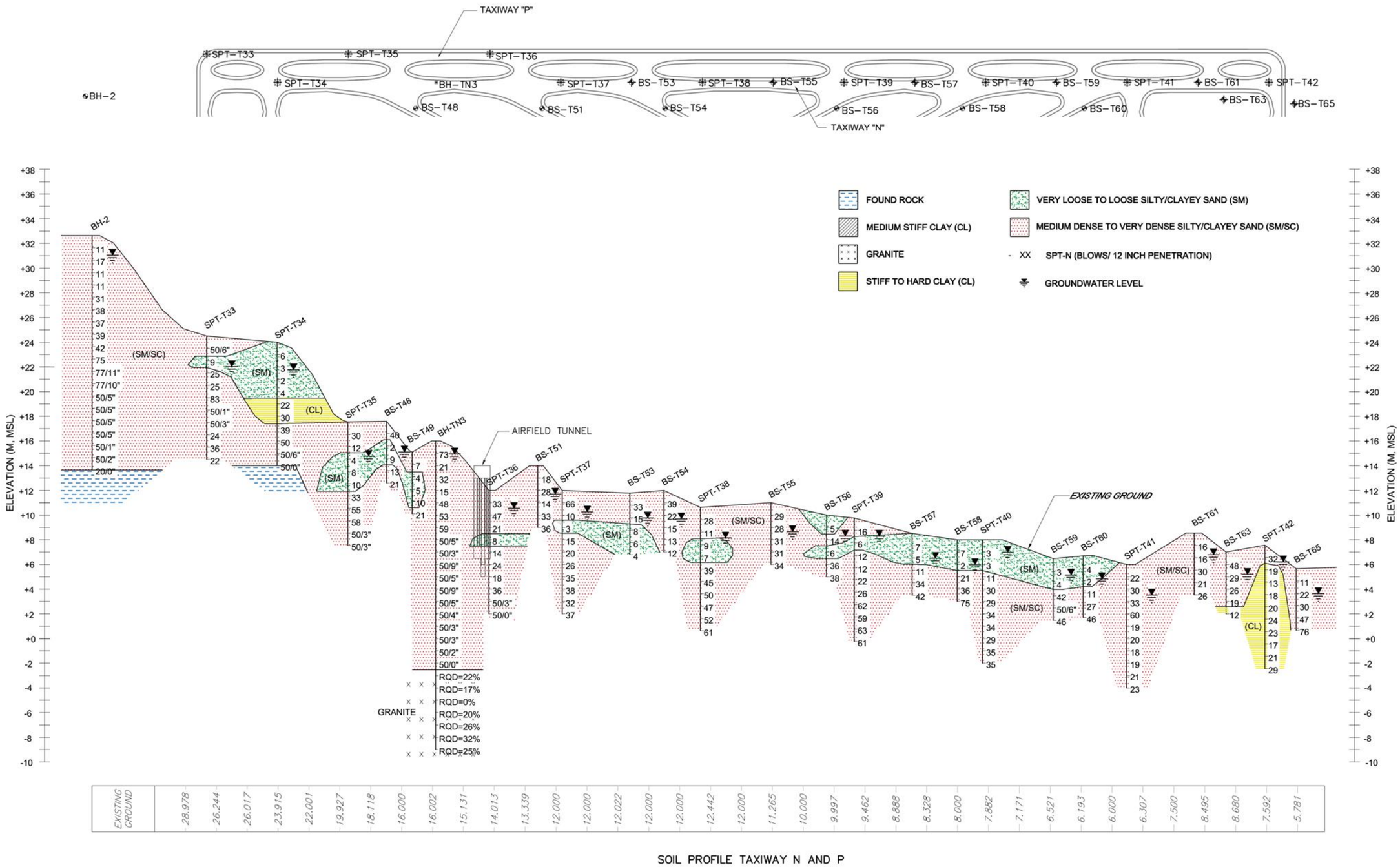
The groundwater level in the borehole is summarized in the table. Measurements were taken 24 hours after drilling was completed.

Source : Soil Science and Geological Survey Report, Outsourcing, Study, Survey and Design Construction of the Runway and Taxiway 2 Project, 2019



Source : Soil Science and Geological Survey Report, Outsourcing, Study, Survey and Design Construction of the Runway and Taxiway 2 Project, 2019

Figure 3.5□20 Characteristics of the soil layer at the exploration borehole of the parallel taxiway to the west of Runway 2



SOIL PROFILE TAXIWAY N AND P

Source : Soil Science and Geological Survey Report, Outsourcing, Study, Survey and Design Construction of the Runway and Taxiway 2 Project, 2019

Figure 3.5-21 Characteristics of the soil layer at the exploration borehole of the parallel taxiway to the east of Runway 2

3.5.7 Surface water hydrology

3.5.7.1 *Scope of Study*

Collect hydrological data in the study area as well as information from relevant secondary sources for use as a basis for assessing the potential impacts of the project.

3.5.7.2 *Study Methods*

Collect relevant secondary data, including:

- Eastern Region's water resource network data, including rivers, canals and flow directions from the Water Crisis Prevention Center, the Department of Water Resources 2018 and the National Hydroinformatics and Climate Data Center, the Hydro and Agro Informatics Institute (Public Organization), 2017 and the 20-year water resource management master plan, 2018-2037) from the National Water Resources Office.
- 30-year rainfall data (1989-2018) from the Meteorological Department
- Data on the water volume in the reservoir of Rayong Province of the irrigation project from countrywide reservoir data, the Royal Irrigation Department 2021
- Hydrological data at the monitoring station in the project area from various relevant agencies, including the Royal Irrigation Department, 2020. The data collected includes runoff and water level, etc.

3.5.7.3 *Study Results*

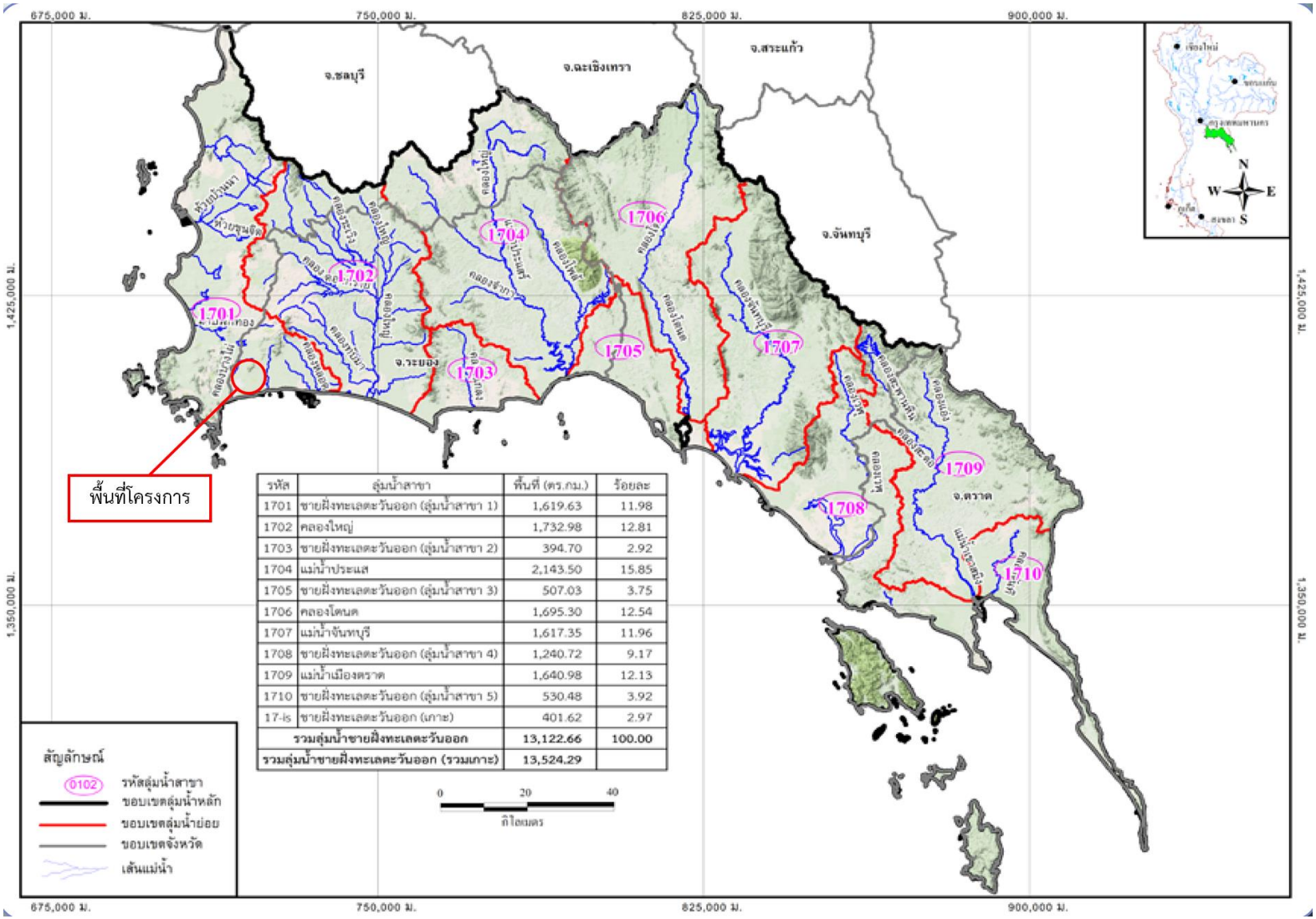
(1) East coast river basins

According to the data collected, the project area is located in the eastern coastal marshland area, which has a river basin area of approximately 13,122.66 square kilometers, covering 5 provinces, namely Chonburi, Rayong, Chanthaburi, Chachoengsao, and Trat, which consist of 10 river basin subdivisions, as shown in Table 3.5-19, with a waterway length of approximately 65 kilometers, at elevation of 0-65 meters MSL, as shown in Figure 3.5-22 The hydrogeology characteristics of the eastern coastal marshland include unconsolidated aquifers, semi-consolidated aquifers and consolidated aquifers totaling 18 types. The area consists mainly of aquifers in sedimentary metamorphic rocks, followed by unconsolidated aquifers of rock fragments at foothill. Details as shown in Table 3.5-20

Table 3.5-19 East Coast River Basin Subdivisions

Sequence No.	River Basin Subdivision	Area (km2)	Percentage
1	East coast (River Basin Subdivision 1)	1,619.63	11.98
2	Khlong Yai	1,732.98	12.81
3	East Coast (River Basin Subdivision 2)	394.70	2.92
4	Prasae River	2.143.50	15.85
5	East Coast (River Basin Subdivision 3)	507.03	3.75
6	Khlong Tanote	1,695.30	12.54
7	Chanthaburi River	1,617.35	11.96
8	East coast (River Basin Subdivision 4)	1.240.72	9.17
9	Mueang Trat River	1.640.98	12.13
10	East Coast (River Basin Subdivision 5)	530.48	3.92
11	East coast (islands)	401.62	2.97
Total east coast river basin		13,122.66	100.00
Total east coast river basin (including islands)		13,524.29	

Source : National Water Resources Office, 2021. Retrieved from http://sonwr.onwr.go.th/wp-content/uploads/2021/07/22-basin-in-thailand.pdf on 21 October 2021.



รหัส	ลุ่มน้ำสาขา	พื้นที่ (ตร.กม.)	ร้อยละ
1701	ชายฝั่งทะเลตะวันออก (ลุ่มน้ำสาขา 1)	1,619.63	11.98
1702	คลองใหญ่	1,732.98	12.81
1703	ชายฝั่งทะเลตะวันออก (ลุ่มน้ำสาขา 2)	394.70	2.92
1704	แม่น้ำประแส	2,143.50	15.85
1705	ชายฝั่งทะเลตะวันออก (ลุ่มน้ำสาขา 3)	507.03	3.75
1706	คลองโตนด	1,695.30	12.54
1707	แม่น้ำจันทบุรี	1,617.35	11.96
1708	ชายฝั่งทะเลตะวันออก (ลุ่มน้ำสาขา 4)	1,240.72	9.17
1709	แม่น้ำเมืองตราด	1,640.98	12.13
1710	ชายฝั่งทะเลตะวันออก (ลุ่มน้ำสาขา 5)	530.48	3.92
17-is	ชายฝั่งทะเลตะวันออก (เกาะ)	401.62	2.97
รวมลุ่มน้ำชายฝั่งทะเลตะวันออก		**13,122.66**	**100.00**
รวมลุ่มน้ำชายฝั่งทะเลตะวันออก (รวมเกาะ)		**13,524.29**	

Source :National Water Resources Office, 2021 http://sonwr.onwr.go.th/wp-content/uploads/2021/07/22-basin-in-thailand.pdf Retrieved on 21 October 2021.

Figure 3.5-22 East Coast Basin Map

Table 3.5-20 Details of aquifers in the east coast

Sequence No.	Symbols	Description	Depth of groundwater layer (meters)	ability to use water (cu.m./hr.)	Area		Area percentage in the coastal basin
					(sq.km.)	(rai)	
1	Bs	Basalt aquifers	10-30	1-35	121.43	75,889	0.93
2	Cms	Sedimentary-metamorphic aquifers	-	-	2.32	1,453	0.02
3	Gr	Granite aquifer	10-30	1-10	2,026.20	1,266,377	15.47
4	Jmk	Central Korat aquifers, sedimentary rocks	30-60	2-10	125.77	78,606	0.96
5	Pc	Permian carbonate aquifers	20-40	1-40	170.16	106,352	1.30
6	PCms	Sedimentary-metamorphic aquifers	10-60	1-20	291.19	181,993	2.22
7	PEmm	Precambrian metamorphic aquifers	-	-	352.94	220,586	2.70
8	Pms	Sandy limestone and dark gray clay interspersed with quartzite	-	-	168.61	105,383	1.29
9	Qbs	Beach sand aquifers, sediment	-	-	240.42	150,260	1.84
10	Qcl	Foothill rock debris aquifers	-	-	3,541.23	2,213,270	27.04
11	Qfd	Sedimentary aquifers	15-50	5-30	1,014.20	633,878	7.74
12	Qyt	New sedimentary aquifers	-	-	571.42	357,137	4.36
13	SDmm	Metamorphic aquifers	-	-	14.57	9,109	0.11
14	SDms	Sedimentary-metamorphic aquifers	-	-	5.41	3,383	0.04
15	TRc	Carbonate rock of the Tynesic age aquifers	-	-	211.30	132,061	1.61
16	TRJlk	Lower Korat aquifers	30-60	2-10	39.67	24,794	0.30
17	TRms	Sedimentary-metamorphic aquifers	-	-	3,663.39	2,289,621	27.97
18	Vc	Volcanic rock aquifers	10-30	1-10	501.83	313,644	3.83
19	No data	No data	-	-	33.73	21,082	0.26
Total river basin area					13,095.80	8,184,878	100.00

Source: The Hydro and Agro Informatics Institute (Public Organization) February 2017 and the Environmental Office, Region 13 (Chonburi) in FY2017

(2) Rainfall

30-year rainfall statistics (1989-2018) of Sattahip Meteorological Station of the Meteorological Department which is located near the area of U-Tapao International Airport with the average monthly rainfall of 108.8 mm, and average 10 rainy days per month. The average rainfall during the rainy season from (May to October), ranged between 156.2-208.8 mm, with October being the wettest month with 19 rainy days, with average rainfall totaling 266.5 mm. December was the driest month with average 2 rainy days, with total average rainfall of 11.0 mm (Details are shown in Section 3.5.2 Air Quality in Table 3.5-9).

(3) Water conditions in reservoirs

The volumes of water in the reservoirs in the study area in 2020 indicated that the irrigation projects in Rayong Province consist of a medium- and large-sized reservoirs. Medium-sized reservoirs include Dok Krai Reservoir, Khlong Raok Reservoir and Khlong Yai Reservoirs with storage capacity of 79.411 19.650 and 45.465 million cubic meters, respectively, and water volumes of 76.479, 20.596 and 45.794 million cubic meters, respectively. At present, the water volumes in the reservoir are 77.176, 18.618 and 45.684 million cubic meters, respectively. Details as shown in TableTable 3.5-21.

Table 3.5-21 Information about reservoir condition in Rayong province

Reservoir	Water storage level capacity (million cubic meters)	Lowest water storage level volume (million cubic meters)	Volume of water in the reservoir				Volume of water flowing into the reservoir	Drainage volume	Usable water volume
			Year 2020	% of water storage level	current	% of water storage level			
Medium sized reservoirs									
Dok Krai Reservoir	79.411	3.000	76.479	96.308	77.176	97.186	1.366	0.405	74.176
Khlong Raok Reservoir	19.650	0.200	20.596	104.814	18.618	94.748	0.529	0.512	18.418
Khlong Yai Reservoir	45.465	3.000	45.794	100.724	45.684	100.482	0.597	0.00	42.684
Large reservoirs									
Nong Pla Lai Reservoir	163.75	-	175.93	107.44	178.00	108.70	0.40	0.12	164.50
Prasae Reservoir	295.00	-	222.16	75.31	285.81	96.88	2.21	0.00	265.81

Notes: Water storage level is abbreviated as RNK

Source: The Royal Irrigation Department, 2021, searched at https://app.rid.go.th/reservoir/rsvmiddle/dam_detail on 20 October 2021

(4) Surface water sources in the study area

Surface water sources in the study area are located in the eastern coastal marshlands, from the north to the south, flowing down to the Gulf of Thailand. In the vicinity of the project area, there are 2 main canals, namely Khlong Bang Phai and Khlong Phala, with the following details:

Khlong Bang Phai, a canal that marks the boundary of Rayong and Chonburi provinces. The canal has an average width of approximately 14–15 meters as shown in Figure 3.5-**23** Physical with the flow direction starting from the north of the project area, merging into Khlong Yai Ra in Sam Nak Thon Subdistrict, Ban Chang District, Rayong Province, before merging into Khlong Kod in Phlu Ta Luang Subdistrict, Sattahip District, Chonburi, before branching out and flow into the sea in the south of the project area. On water utilization, the water is not being used either for consumption or general cleaning.


Figure 3.5-23 Physicalcharacteristics of Khlong Bang Phai Area

Phala Canal, a small canal outside the U-Tapao International Airport area on the east side, has the average width of 10-11 meters as shown in Figure 3.5-**24** Physical, originating from the east side of the project before merging into Luek Canal in Phala Subdistrict, Ban Chang, Rayong Province, before branching out and flows into the sea to the south of the project area. On water utilization, the water is not being used either for consumption or general cleaning. In the future, after the development of the project, there was no plan to modify or make the canals for drainage of runoff from the project.


Figure 3.5-24 Physicalcharacteristics of Phala Canal

A network of waterways of surface water sources in the study area is shown in Figure 3.5-25

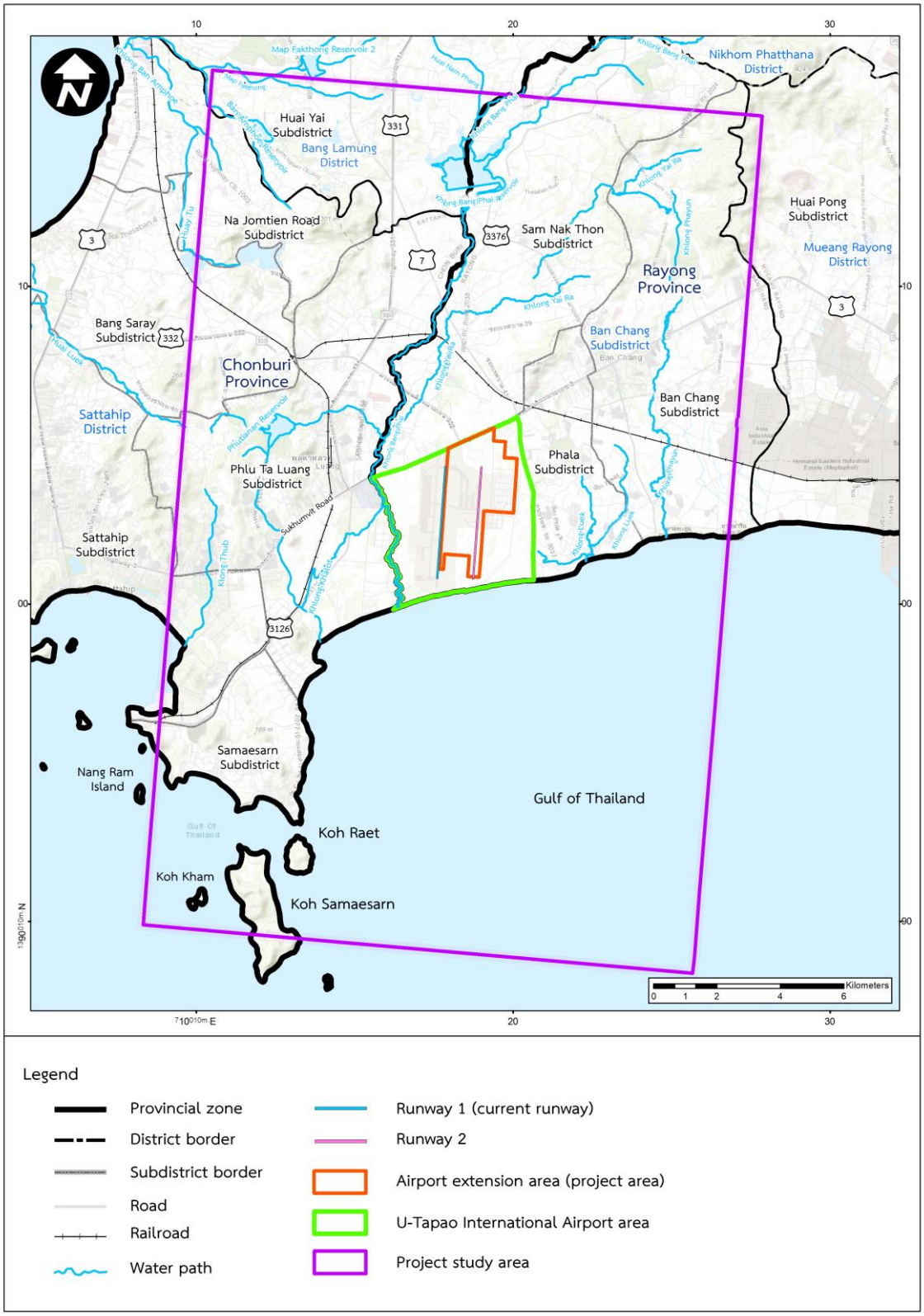


Figure 3.5□25 Surface water sources in the study area

3.5.8 Surface water quality

3.5.8.1 *Scope of Study*

Collect data on surface water quality measured in the study area. both from the relevant secondary data and sampling from water sources to be used as a basis for assessing potential impacts from the project.

3.5.8.2 *Study Methods*

(1) Secondary data

Collect relevant secondary data as follows:

- Data on surface water quality in the study area
- Data on surface water quality from the Environmental Office, Region 13 (Chonburi), 2021 from http://reo13.mnre.go.th/th/information/list/1830/page/1

(2) Primary data

Measure the quality of surface water in the project area as follows:

- Sample collection points, sample collection and quality analysis for surface water in water sources, totaling 4 points, i.e. 3 in Khlong Bang Phail and 1 in Khlong Phala. Details as shown in Table 3.5-22 and sample collection points as shown in Table 3.5-26
- Sampling was performed 2 times representing surface water during the rainy and dry seasons. The 1st time during the rainy season, 18 July 2019 and the 2nd time during the dry season, 31 October 2019.
- Method of sampling water sampling (figure 3.5-27) was performed according to the sample collection procedure, representative of the surface water quality at the sample collection points according to the National Environment Board Notification No. 8 (1994), issued in accordance with the National Environmental Promotion and Conservation Act 1992 Re: the establishment of quality standards for surface water sources, and in accordance with the principles referencing the sample collection and preservation methods in accordance with the Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017.
- Index and analysis method of surface water quality. The analysis index for surface water quality as determined in accordance with the Notification of National Environment Board No. 8 (1994) as shown inTable 3.5-23, with analysis performed by methods that meet the ISO/IEC17025 standards in accordance with APHA, AWWA and WEF: "Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017.
- Assess surface water quality index to determine whether it is suitable for utilization or not by comparing the quality standards for surface water in accordance with Notification No. 8 from the National Environment Board (1994) Re: Determination of Surface Water Quality Standards.

Table 3.5-22 Surface Water Quality and Surface Water Ecology Sample Collection Points

Collection point	Sample collection points and criteria for determination of collection points	Sample collection point coordinates	
		E	N
W1	Khlong Bang Phai, above the point of discharge: used as representative of water sources above the point of effluent discharge of the project, approximately 1,000 meters, above the point of discharge.	716229	1402379
W2	Khlong Bang Phai beyond the water discharge point: to be used as a representative of the water sources affected by the current project's effluent discharge, approximately 100 meters beyond the current project's effluent discharge point.	716242	1401210
W3	Khlong Bang Yai at point where water is discharged into the sea: To represent water quality before being discharged into the sea of the current project.	716315	1399935
W4	Khlong Phala: a water source near the project area, to the east.	720812	1401663

W1: Khlong Bang Phai, approximately 1,000 meters above the current project's effluent discharge point

W2: Khlong Bang Phai, approximately 100 meters beyond the current project's effluent discharge point.

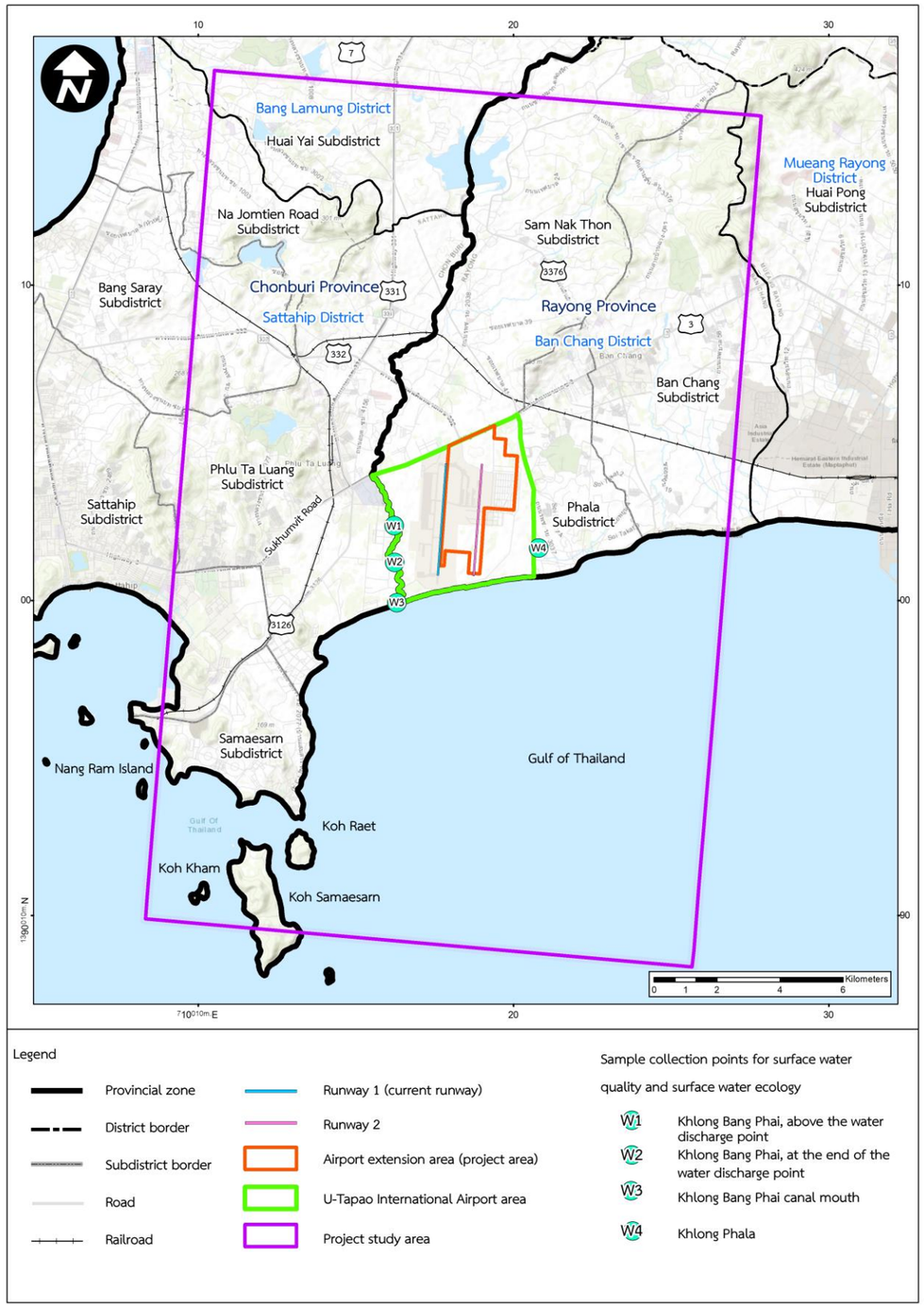


Table 3.5-26 Surface Water Quality and Surface Water Ecology Sample Collection Points

W3: Khlong Bang Phai, before discharging into the ocean

W4: Khlong Phala near the project area, to the east

Measure the width of the waterways.

Measure the transparency of surface water with the Sechi Disc.

Collect grab sampling in the middle of the canal.

Collect water samples for Surface Sampling

Collect grab sampling of surface water specimen using in the middle of the canal.

Surface water samples in various types of suitable containers, according to the water quality index, sent to the laboratory.

figure 3.5-27 Sampling of surface water quality in the study field

Table 3.5-23 Index and analytical method of surface water quality according to international standards and minimum measurement capacity used to report results of ISO/IEC 17025 testing laboratory

Index of surface water quality tested	Standard analysis methods established by law and internationally.[1/]	Minimum measurement value (Detection limit) mg/l
1) pH	Electrometric Method at site (SM : 4500-H^+ B)	-
2) Temperature	Thermometer at site (SM : 2550 B)	-
3) Conductivity	Electrical Conductivity Method at site (SM : 2510 B)	0.1
4) Transparency	Secchi Disc Method	-
5) Turbidity	Nephelometric Method (SM : 2130 B)	0.1
6) Salinity	Electrical Conductivity Method at site (SM : 2520 B)	0.1
7) Dissolved oxygen (DO)	Azide Modification Method at site (SM : 4500-O C)	0.5
8) BOD	Azide Modification Method (SM : 4500-O C and 5210 B)	1.0
9) Suspended solid (SS)	Suspended Solids Dried at 103-105 °C (SM : 2540 D)	5.0
10) Total dissolved solids (TDS)	Total Dissolved Solids Dried at 180 °C (SM : 2540 C)	25
11) Fat, oil and grease	Liquid-Liquid, Partition-Gravimetric Method (SM : 5520 B)	3
12) Nitrate (NO^-_3-N) in Nitriane units	Cadmium Reduction Method (SM : 4500-NO_3^- E)	0.02
13) Phosphate-phosphorus (PO^-_4-P)	Ascorbic Acid Method (SM : 4500-P E)	0.01
14) Arsenic (As)	Hydride Generation AAS Method (SM : 3314 C)	0.0003
15) Manganese (Mn)	Nitric Acid Digestion and Direct Air Acetylene Flame Method ;SM : 3030 E and 3111 B	0.005
16) Mercury (Hg)	Cold Vapor AAS Method (SM : 3112 B)	0.0002
17) Zinc (Zn)	Nitric Acid Digestion and Direct Air Acetylene Flame Method; SM : 3030 E and 3111 B	0.005
18) Cadmium (Cd)	Nitric Acid Digestion and Direct Air Acetylene Flame Method; SM : 3030 E and 3111 B	0.003
19) Copper (Cu)	Nitric Acid Digestion and Direct Air Acetylene Flame Method; SM : 3030 E and 3111 B	0.003
20) Nickel (Ni)	Nitric Acid Digestion and Direct Air Acetylene Flame Method); SM : 3030 E and 3111 B	0.005
21) Chromium hexavalent (Cr^{6+})	Extraction and Air-Acetylene Flame Method (SM : 3111 C)	0.001
22) Lead (Pb)	Nitric Acid Digestion and Direct Air Acetylene Flame Method); SM : 3030 E and 3111 B	0.010
23) Chromium (Cr)	Nitric Acid Digestion and Direct Air Acetylene Flame Method); SM: 3030 E and 3111 B	0.010
24) Total coliform bacteria	Multiple-Tube Fermentation Technique (SM : 9921 E)	18 (MPN/100 ml)
25) Fecal coliform bacteria	Multiple-Tube Fermentation Technique (SM : 9921 B)	18 (MPN/100 ml)

Notes: [1/]Standard Methods for the Examination of Water and Wastewater, APHA, AWWA , WEF 23rd Edition, 2017.

3.5.8.3 *Study Results*

(1) Secondary data

Results of water quality measurements of rivers in nearby areas of the project, from Environmental Office Region 13 (Chonburi), which is responsible for monitoring water quality at 6 stations of the Rayong River and 5 stations of the Prasae River. Water samples were collected and water quality analysis conducted in both physical, chemical properties and bacterial content. In FY2021 (October 2020 - September 2021), the results of the water measurements were shown in Figure 3.5-28 Surface. The results are summarized as follows:

1) Rayong River

Khlong Yai is a tributary of Rayong River, consisting of several tributaries running through the Ban Khai District and Mueang District of Rayong and into the Gulf of Thailand. The lower Rayong River from the mouth of the river at Rong in Ban Pak Khlong Subdistrict, Mueang Rayong District, Rayong Province at Km marker 0 to Rayong River, Chanthaburi-Rayong bridge in Cherng Noen Subdistrict, Mueang Rayong District, Rayong Province at Km marker 19.

The results of the water quality monitoring for the Rayong River, from the Tessaban 8 bridge, Ban Pak Khlong Subdistrict, Mueang District to the bridge at Wat Lahanrai Sangkharam in Nong Lalok Subdistrict, Ban Khai District, Rayong, from 6 stations, it was found that the water quality mostly in degraded criteria. The parameters indicating water quality issue indicators included dissolved oxygen (DO) and ammonia-nitrogen (NH3-N) content exceeding the acceptable surface water quality standards although the content of heavy metals did not exceed the acceptable quality standards for surface water sources.

The quality of water is within the acceptable water quality standards in water resources type 4 according to the National Environment Board Notification No. 8 (1994) issued under the provisions of the National Environmental Quality Promotion and Conservation Act, 1992 Re: Establishment of Quality Standard of Surface Water Resources, namely water resources receiving effluent discharge from certain activities and which may be utilized for consumption and general cleaning through regulation disinfection and through special water quality treatment and for industrial use.

2) Prasae River

Prasae River is a main river in the river basin, located on the east side of Rayong province. The river is about 26 kilometers long, and flows into the sea at Klaeng District.

Results of monitoring of the water quality of the Prasae River from the mouth of the Prasae River, at Ban Paknam Prasae to the Ban Wang Khao Chik Bridge in Prasae Bon Subdistrict, Klaeng District, Rayong Province, based on results from 5 stations, indicated that water quality was mostly within acceptable standard. Parameters indicating problems with water quality are dissolved oxygen (DO), Total Coliform Bacteria (TCB), bacterial contamination caused by Fecal Coliform Bacteria and Ammonia-Nitrogen (NH3-N). For heavy metal content, it was found that it did not exceed the quality standard for surface water sources.

The quality of water is within the acceptable water quality standards in water resources type 3 according to the National Environment Board Notification No. 8 (1994) issued under the provisions of the National Environmental Quality Promotion and Conservation Act, 1992 Re: Establishment of Quality Standard of Surface Water Resources, namely water resources receiving effluent discharge from certain activities and which may be utilized for consumption and general cleaning through regulation disinfection and through special water quality treatment and for agricultural use.

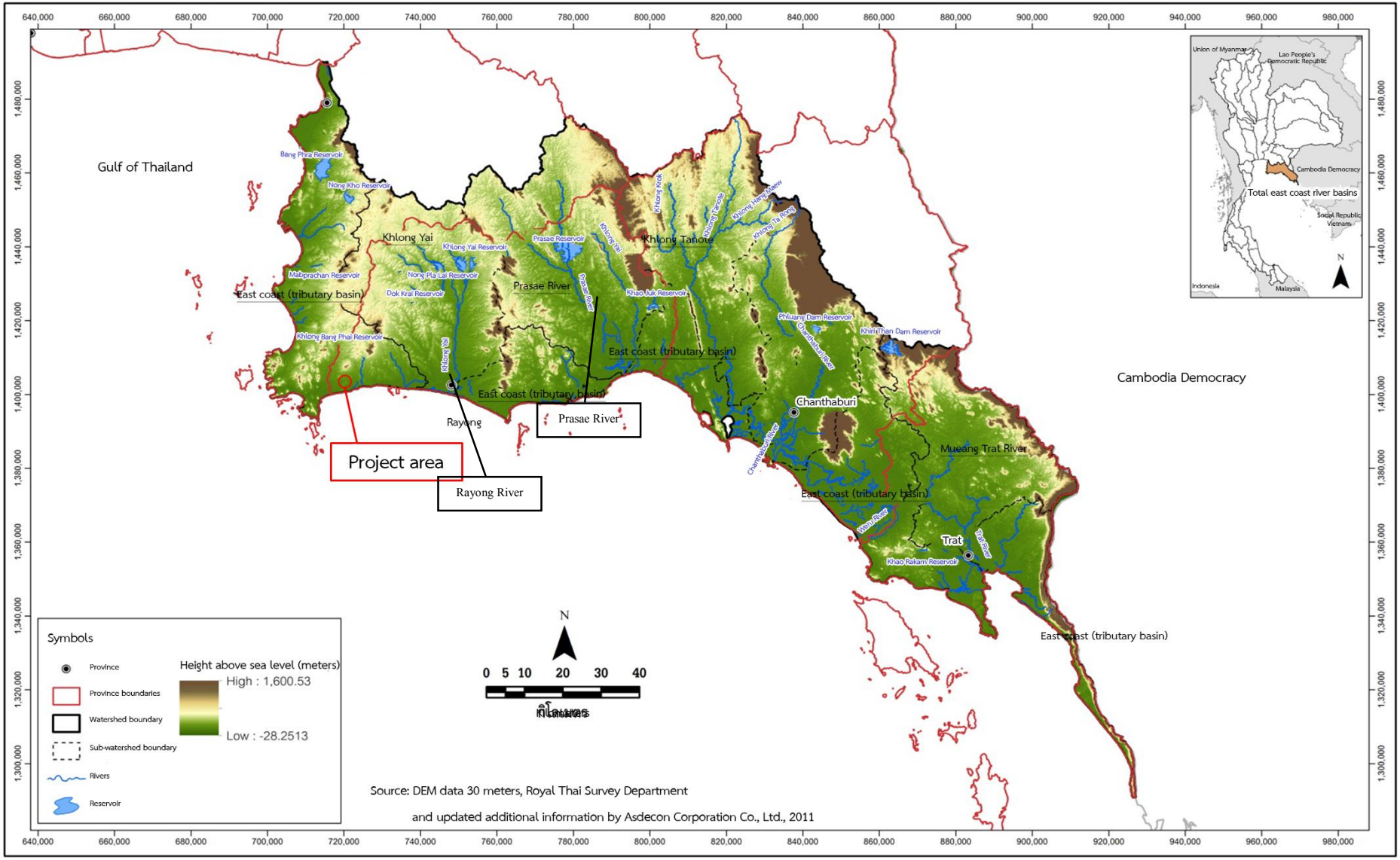


Figure 3.5-28 Surface water sources close to study areas of the project

(2) Primary data

From inspection of the natural water sources at the study area, it was found that there was only one natural surface water source in the area of the study, namely Khlong Bang Phai, which flows through the west of U-Tapao International Airport, and is expected to be affected by the development of this project in the future and used as a waterway to receive discharge from the project's current wastewater treatment system. Another natural surface water source is Khlong Phala, which is near the project area to the east as shown in Figure 3.5**-29**.

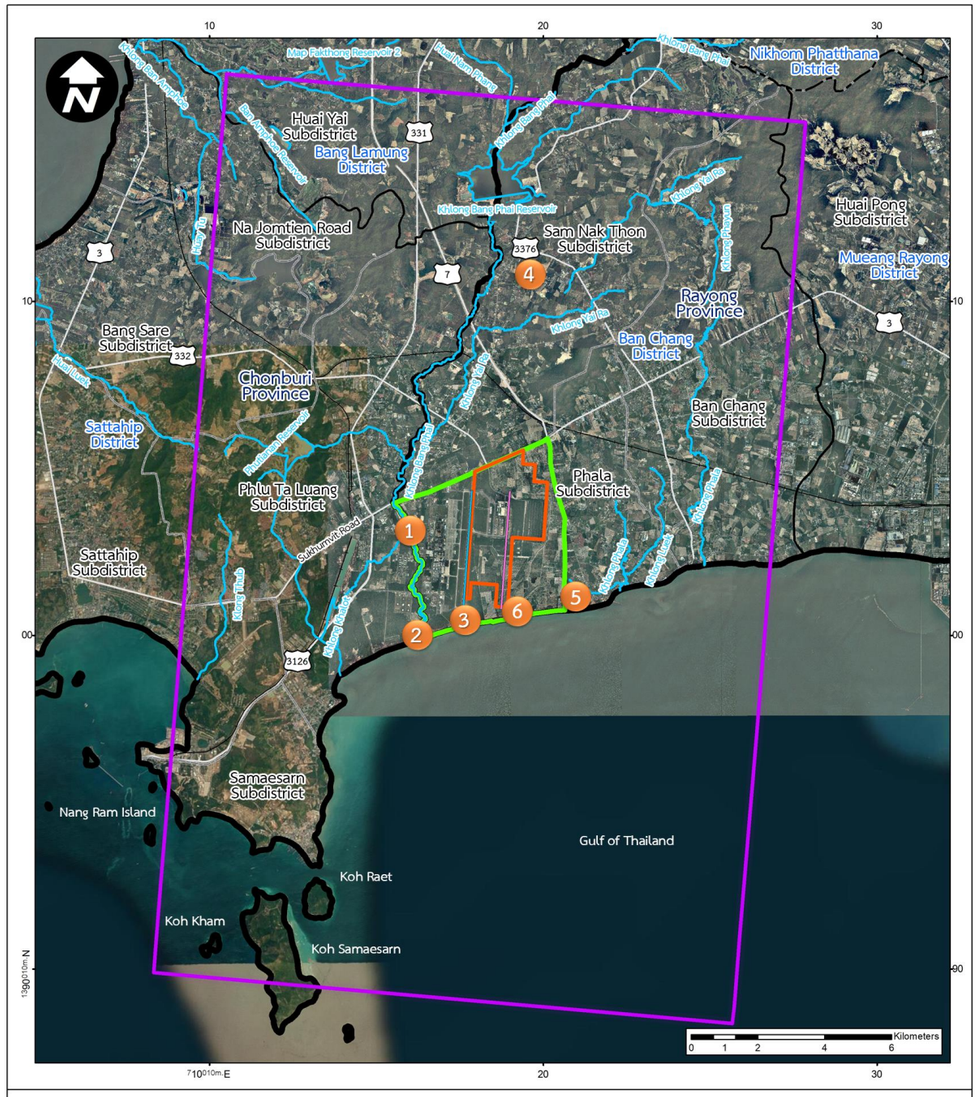
The characteristics of surface water sources surrounding the project area are as follows:

- On the north and west side of the project, there is Khlong Bang Phai reservoir Sam Nak Thon Sub-district, Ban Chang, Rayong, which releases water into Khlong Bang Phai that flows through the west of U-Tapao International Airport and flows into the sea.
- On the east side of the project, Khlong Phala is adjacent to the U-Tapao International Airport area that flows into the ocean in Phala Subdistrict, Ban Chang District, Rayong Province.
- On the south side of the project, there is no surface water source as the area borders the sea.

Khlong Bang Phai, on the west side of the project

Khlong Bang Phai, connection point to the sea

The conditions of the area in the south of Runway and Taxiway 1



Legend

- Provincial zone
- District border
- Subdistrict border
- Road
- Railroad
- Water path
- Runway 1 (current runway)
- Runway 2
- Airport extension area (project area)
- U-Tapao International Airport area
- Project study area

Figure 3.5-29 Surface water sources in the study area

Khlong Bang Phai Reservoir

Khlong Phala

The conditions of the area in the south of Runway and Taxiway 2

Results of surface water quality measurements in the study area based on 2 measurements, i.e., the 1st time during the rainy season, on 18 July 2019, in the area of Khlong Bang Phai totaling 3 points, i.e. W1: Khlong Bang Phai, above the point of effluent discharge, W2: Khlong Bang Phai, beyond the effluent discharge point, and W3: Khlong Bang Phai, at the point the water flows into the sea. Two measurements were performed during dry season on 31 October 2019, totaling 4 points: W4: Khlong Phala (added point as suggested in comments of residents, in the 1st hearing, including joint consultation on impacts from activities of the project) which may be impacted by the development of the project. Measurement results as shown in Table 3.5-24 andTable 3.5-25 (details shown in Annex 3-4) can be summarized as follows:

Results of surface water quality measurements during the rainy season on 18 July 2019.

1) W1: Khlong Bang Phai, above water discharge point

The results of the water quality measurement at Khlong Bang Phai above the discharge point During the dry season, it was found that the Acid and alkali 7.3 Water temperature 30 degrees Celsius Electrical conductivity 320 micromohs per centimeter, transparency 0.3 m, turbidity 15 NTU, salinity 0.1 parts per thousand, Dissolved oxygen 5.1 milligrams per liter, BOD 2.1 milligrams per liter, suspended solids 18.5 mg/l, Total dissolved solids 184 mg/L, nitrates in nitrogen unit 0.17 milligrams per liter, Phosphate-Phosphorus 0.06 mg/L, while oil and grease were not detected.

On heavy metals and bacterial analysis, it was found that arsenic 0.005 milligrams per liter, manganese 0.778 milligrams per liter, total mercury 0.0002 milligrams per liter, zinc, cadmium, copper, nickel, chromium hexavalent, lead, and chromium were not detected. For total coliform bacteria, the value was greater than 16,000 MPN per 100 milliliter and fecal coliform bacteria over 16,000 MPN per 100 milliliter.

When analysis results were compared with type 4 surface water quality standards (water sources receiving effluent discharge from certain types of activities and can be utilized for consumption and general cleaning through regular sterilization and special water quality improvement processes, and for industrial use, it was found that water quality of Khlong Bang Phai above the effluent discharge point was within the acceptable standards based on all indices.

2) W2: Khlong Bang Phai, beyond effluent discharge point

The results of the water quality measurement at Khlong Bang Phai beyond the discharge point during the dry season, it was found that the pH value was 7.5, water temperature 33 degrees Celsius, Electrical conductivity 340 micromohs per centimeter, transparency 0.2 m, turbidity 6.8 NTU, salinity 0.1 parts per thousand, Dissolved oxygen 4.4 milligrams per liter, BOD 1.1 milligrams per liter, suspended solids 9.2 mg/l, Total dissolved solids 193 mg/L, nitrates in nitrogen unit 0.03 milligrams per liter, Phosphate-Phosphorus 0.07 mg/L, while oil and grease were not detected.

On heavy metals and bacterial analysis, it was found that arsenic 0.0087 milligrams per liter, manganese 0.294 milligrams per liter, total mercury, zinc, cadmium, copper, nickel, chromium hexavalent, lead, and chromium were not detected. For total coliform bacteria the value was 490 MPN per 100 ml and fecal coliform bacteria 130 MPN per 100 ml.

When analysis results were compared with type 4 surface water quality standards (water sources receiving effluent discharge from certain types of activities and can be utilized for consumption and general cleaning through regular sterilization and special water quality improvement processes, and for industrial use, it was found that water quality of Khlong Bang Phai beyond the effluent discharge point was within the acceptable standards based on all indices.

3) W3: Khlong Bang Phai, sea discharge point

The results of the water quality measurement at Khlong Bang Phai at the point where it discharges into the sea during the dry season, it was found that the pH value was 8.1, water temperature 33 degrees Celsius, Electrical conductivity 35,255 micromohs per centimeter, transparency 0.6 m, turbidity 14 NTU, salinity 18.8 parts per thousand, Dissolved oxygen 4.9 milligrams per liter, BOD 4.2 milligrams per liter, suspended solids 19.2 mg/l, Total dissolved solids 23,480 mg/L, Phosphate-Phosphorus 0.07 mg/L, while nitrates in nitrogen unit, oil and grease were not detected.

On heavy metals and bacterial analysis, it was found that arsenic 0.0043 milligrams per liter, manganese 0.093 milligrams per liter, total mercury 0.0003 milligrams per liter, zinc over or equivalent to 0.005 and less than 0.025 milligrams per liter, lead over or equivalent to 0.010 and less than 0.100 milligrams per liter, while cadmium, copper, nickel, chromium hexavalent were not detected. For total coliform bacteria less than 1.8 MPN per 100 milliliters, fecal coliform bacteria less than 1.8 MPN per 100 milliliters.

When analysis results were compared with type 4 surface water quality standards (water sources receiving effluent discharge from certain types of activities and can be utilized for consumption and general cleaning through regular sterilization and special water quality improvement processes, and for industrial use, it was found that water quality of Khlong Bang Phai at the point it discharges into the sea was within the acceptable standards based on indices, except BOD which exceeded the acceptable standard (not exceeding 4.0 ml per liter).

Table 3.5-24 Analysis of surface water quality during the rainy season on 18 July 2019.

Index	Unit	Khlong Bang Phai			Standard values for surface water quality type 4[1/]
		W1: Above the effluent discharge point	W2: Beyond the effluent discharge point	W3: At the point of discharge into the sea	
1) pH	-	7.3	7.5	8.1	5.0-9.0
2) Temperature	degrees Celsius	30	33	33	Not higher than 3 °C of the natural temperature
3) Conductivity	micromohs per centimeter	320	340	35,255	-
4) Transparency	meters	0.3	0.2	0.6	-
5) Turbidity	NTU	15	6.8	14	-
6) Salinity	parts per thousand	0.1	0.1	18.8	-
7) Dissolved oxygen (DO)	milligrams per liter	5.1	4.4	4.9	Not less than 2.0
8) BOD	milligrams per liter	2.1	1.1	4.2	Not more than 4.0
9) Suspended solid (SS)	milligrams per liter	18.5	9.2	19.2	-
10) Total dissolved solids (TDS)	milligrams per liter	184	193	23,480	-
11) Fat, oil and grease	milligrams per liter	Not detected	Not detected	Not detected	-
12) Nitrate (NO_3) in Nitriane units	milligrams per liter	0.17	0.03	Not detected	Not more than 5.0
13) Phosphate-Phosphorus	milligrams per liter	0.06	0.07	0.05	-
14) Arsenic (As)	milligrams per liter	0.0050	0.0087	0.0043	Not more than 0.01
15) Manganese (Mn)	milligrams per liter	0.778	0.294	0.093	Not more than 1.0
16) Total mercury (Total Hg)	milligrams per liter	0.0002	Not detected	0.0003	Not more than 0.002
17) Zinc (Zn)	milligrams per liter	Not detected	Not detected	<LOQ	Not more than 1.0
18) Cadmium (Cd)	milligrams per liter	Not detected	Not detected	Not detected	Not more than 0.05
19) Copper (Cu)	milligrams per liter	Not detected	Not detected	Not detected	Not more than 0.1
20) Nickel (Ni)	milligrams per liter	Not detected	Not detected	Not detected	Not more than 0.1
21) Chromium hexavalent (Cr^{6+})	milligrams per liter	Not detected	Not detected	Not detected	Not more than 0.05

Table 3.5-24 Analysis of surface water quality during the rainy season on 18 July 2019.

Index	Unit	Khlong Bang Phai			Standard values for surface water quality type 4[1/]
		W1: Above the effluent discharge point	W2: Beyond the effluent discharge point	W3: At the point of discharge into the sea	
22) Lead (Pb)	milligrams per liter	Not detected	Not detected	<LOQ	Not more than 0.05
23) Chromium (Cr)	milligrams per liter	Not detected	Not detected	Not detected	-
24) Total coliform bacteria	MPN per 100 ml	>160,000	490	<1.8	-
25) Fecal coliform bacteria	MPN per 100 ml	>160,000	130	<1.8	-

Note : (-) means no standard is defined
< LOQ defined as < level of quantitation (lead ≥0.010 and < 0.100 milligrams per liter, zinc ≥ 0.005 and <0.025 milligrams per liter, copper ≥ 0.003 and < 0.100 milligrams per liter)
[1/] The quality of water is within the acceptable water quality standards in water resources type 4 according to the National Environment Board Notification No. 8 (1994) issued under the provisions of the National Environmental Quality Promotion and Conservation Act, 1992 Re: Establishment of Quality Standard of Surface Water Sources (published in the Government Gazette on 24 February 1994)

Source: United Analyst and Engineering Consultants Co., Ltd. (Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

Surface water quality test results during dry season on 31 October 2019.

1) W1 : Khlong Bang Phai, above effluent discharge point

The results of the water quality measurement at Khlong Bang Phai above the discharge point during the dry season, it was found that pH value was 7.2 Water temperature 29 degrees Celsius, Electrical conductivity 261 micromohs per centimeter, transparency 0.2 m, turbidity 90 NTU, salinity 0.1 parts per thousand, Dissolved oxygen 5.5 milligrams per liter, BOD 1.6 milligrams per liter, suspended solids 35.7 mg/l, Total dissolved solids 261 mg/L, nitrates in nitrogen unit 0.64 milligrams per liter, Phosphate-Phosphorus 0.08 mg/L, while oil and grease were not detected.

On heavy metals and bacterial analysis, it was found that arsenic 0.0073 milligrams per liter, manganese 0.374 milligrams per liter, copper over 0.003 and less than 0.100 milligrams per liter, lead over or equivalent to 0.010 and less than 0.100 milligrams per liter, while total mercury, zinc cadmium, nickel, chromium hexavalent were not detected. For total coliform bacteria 7,900 MPN per 100 milliliters, fecal coliform bacteria 92,000 MPN per 100 milliliters.

When analysis results were compared with type 4 surface water quality standards (water sources receiving effluent discharge from certain types of activities and can be utilized for consumption and general cleaning through regular sterilization and special water quality improvement processes, and for industrial use, it was found that water quality of Khlong Bang Phai above the effluent discharge point was within the acceptable standards based on all indices.

2) W2: Khlong Bang Phai, beyond effluent discharge point

The results of the water quality measurement at Khlong Bang Phai beyond the discharge point during the dry season, it was found that the pH value was 7.9, water temperature 28 degrees Celsius, Electrical conductivity 253 micromohs per centimeter, transparency 0.2 m, turbidity 110 NTU, salinity 0.1 parts per thousand, Dissolved oxygen 4.9 milligrams per liter, BOD 1.9 milligrams per liter, suspended solids 101 mg/l, Total dissolved solids 253 mg/L, nitrates in nitrogen unit 0.33 milligrams per liter, Phosphate-Phosphorus 0.08 mg/L, while oil and grease were not detected.

On heavy metals and bacterial analysis, it was found that arsenic 0.0080 milligrams per liter, manganese 0.281 milligrams per liter, zinc over or equivalent to 0.005 and less than 0.025 milligrams per liter, and copper over 0.003 and less than 0.100 milligrams per liter, while total mercury, cadmium, nickel, chromium hexavalent, lead and chromium were not detected. For total coliform bacteria 6,300 MPN per 100 milliliters, fecal coliform bacteria 14,000 MPN per 100 milliliters.

When analysis results were compared with type 4 surface water quality standards (water sources receiving effluent discharge from certain types of activities and can be utilized for consumption and general cleaning through regular sterilization and special water quality improvement processes, and for industrial use, it was found that water quality of Khlong Bang Phai beyond the effluent discharge point was within the acceptable standards based on all indices.

3) W3: Khlong Bang Phai, sea discharge point

The results of the water quality measurement at Khlong Bang Phai at point of discharge into the sea during the dry season, it was found that the pH value was 7.4, water temperature 29 degrees Celsius, Electrical conductivity 9,265 micromohs per centimeter, transparency 0.5 m, turbidity 20 NTU, salinity 4.3 parts per thousand, Dissolved oxygen 4.6 milligrams per liter, suspended solids 43.0 mg/l, Total dissolved solids 5,823 mg/L, nitrates in nitrogen unit 0.34 milligrams per liter, Phosphate-Phosphorus 0.04 mg/L, while BOD, oil and grease were not detected.

On heavy metals and bacterial analysis, it was found arsenic 0.0036 milligrams per liter, manganese 0.132 milligrams per liter, copper over 0.003 and less than 0.100 milligrams per liter, total mercury, zinc, cadmium, nickel, chromium hexavalent, lead, and chromium were not detected. For total coliform bacteria 1,100 MPN per 100 milliliter and fecal coliform bacteria 49 MPN per 100 milliliter.

When analysis results were compared with type 4 surface water quality standards (water sources receiving effluent discharge from certain types of activities and can be utilized for consumption and general cleaning through regular sterilization and special water quality improvement processes, and for industrial use, it was found that water quality of Khlong Bang Phai at the point of discharge into the sea was within the acceptable standards based on all indices.

4) W4: Khlong Phala

The results of the water quality measurement at Khlong Phala in the dry season, it was found that the pH value was 5.8, water temperature 29 degrees Celsius, Electrical conductivity 570 micromohs per centimeter, transparency 0.3 m, turbidity 23 NTU, salinity 0.3 parts per thousand, Dissolved oxygen 4.4 milligrams per liter, suspended solids 11.0 mg/l, Total dissolved solids 420 mg/L, Phosphate-Phosphorus 0.03 mg/L, while BOD, oil, grease and nitrate-nitrogen were not detected.

On heavy metals and bacterial analysis, it was found arsenic 0.0030 milligrams per liter, manganese 1.84 milligrams per liter, zinc over or equivalent to 0.005 and less than 0.025 milligrams per liter, total mercury, cadmium, copper, nickel,

chromium hexavalent, lead, and chromium were not detected. For total coliform bacteria 350 MPN per 100 milliliter and fecal coliform bacteria 7.8 MPN per 100 milliliter.

When analysis results were compared with type 4 surface water quality standards (water sources receiving effluent discharge from certain types of activities and can be utilized for consumption and general cleaning through regular sterilization and special water quality improvement processes, and for industrial use, it was found that water quality of Khlong Phala was with in the acceptable standards based on all indices.

Table 3.5-25 Analysis of surface water quality during the rainy season on 31 July 2019.

Index	Unit	Khlong Bang Phai			Khlong Phala	Standard values for surface water quality type 4[1/]
		W1: Above the effluent discharge point	W2: Beyond the effluent discharge point	W3: At the point of discharge into the sea	W4: Khlong Phala	
1) pH	-	7.2	7.9	7.4	5.8	5.0-9.0
2) Temperature	degrees Celsius	29	28	29	29	Not higher than 3 °C of the natural temperature
3) Conductivity	micromohs per centimeter	261	253	9,265	570	-
4) Transparency	meters	0.2	0.2	0.5	0.3	-
5) Turbidity	NTU	90	110	20	23	-
6) Salinity	parts per thousand	0.1	0.1	4.3	0.3	-
7) Dissolved oxygen (DO)	milligrams per liter	5.5	4.9	4.6	4.4	Not less than 2.0
8) BOD	milligrams per liter	1.6	1.9	Not detected	Not detected	Not more than 4.0
9) Suspended solid (SS)	milligrams per liter	35.7	101	43.0	11.0	-
10) Total dissolved solids (TDS)	milligrams per liter	261	253	5,823	420	-
11) Fat, oil and grease	milligrams per liter	Not detected	Not detected	Not detected	Not detected	-
12) Nitrate (NO_3) in Nitriane units	milligrams per liter	0.64	0.33	0.34	Not detected	Not more than 5.0
13) Phosphate-Phosphorus	milligrams per liter	0.08	0.08	0.04	0.03	-
14) Arsenic (As)	milligrams per liter	0.0073	0.0080	0.0036	0.0030	Not more than 0.01
15) Manganese (Mn)	milligrams per liter	0.374	0.281	0.132	1.84	Not more than 1.0
16) Total mercury (Total Hg)	milligrams per liter	Not detected	Not detected	Not detected	Not detected	Not more than 0.002
17) Zinc (Zn)	milligrams per liter	Not detected	<LOQ	Not detected	<LOQ	Not more than 1.0
18) Cadmium (Cd)	milligrams per liter	Not detected	Not detected	Not detected	Not detected	Not more than 0.05
19) Copper (Cu)	milligrams per liter	<LOQ	<LOQ	<LOQ	Not detected	Not more than 0.1
20) Nickel (Ni)	milligrams per liter	Not detected	Not detected	Not detected	Not detected	Not more than 0.1
21) Chromium hexavalent (Cr^{6+})	milligrams per liter	Not detected	Not detected	Not detected	Not detected	Not more than 0.05

Table 3.5-25 Analysis of surface water quality during the rainy season on 31 July 2019.

Index	Unit	Khlong Bang Phai			Khlong Phala	Standard values for surface water quality type 4[1/]
		W1: Above the effluent discharge point	W2: Beyond the effluent discharge point	W3: At the point of discharge into the sea	W4: Khlong Phala	
22) Lead (Pb)	milligrams per liter	<LOQ	Not detected	Not detected	Not detected	Not more than 0.05
23) Chromium (Cr)	milligrams per liter	Not detected	Not detected	Not detected	Not detected	-
24) Total coliform bacteria	MPN per 100 ml	7,900	6,300	1,100	350	-
25) Fecal coliform bacteria	MPN per 100 ml	92,000	14,000	49	7.8	-

Note: (-) means no standard is defined

< LOQ defined as < level of quantitation (lead ≥0.010 and < 0.100 milligrams per liter, zinc ≥ 0.005 and <0.025 milligrams per liter, copper ≥ 0.003 and < 0.100 milligrams per liter)

[1/ Ground water] quality standards, category 4, water sources that receive effluent discharge from certain types of activities, and industry according to the Notification of the National Environment Board No. 8 (1994)

issued under the provision of the Environmental Quality Promotion and Conservation Act 1992 Re: Establishment of Quality Standards of Surface Water (published in the Government Gazette on 24 February 1994)

Source: United Analyst and Engineering Consultants Co., Ltd. (Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

3.5.9 Groundwater quality

3.5.9.1 *Scope of Study*

Collect groundwater quality data that were measured in the study area. as well as information from relevant secondary sources to be used as a basis for assessing the potential impacts of the project

3.5.9.2 *Study Methods*

Collect groundwater quality data in the project area and nearby as follows:

- Groundwater well data in Rayong and Chonburi provinces, Department of Groundwater Resources
- Groundwater quality data for Rayong and Chonburi provinces, 2018-2020, Department of Groundwater Resources

3.5.9.3 *Study Results*

Groundwater sources in Rayong and Chonburi provinces can be summarized as follows:

(1) Groundwater sources

Rayong Province has groundwater sources characterized by aquifers in rock fragments, beach sand sediment, waterborne sediment in plains, rock fragments at the foothills and hard rock (semi-metamorphic aquifer, metamorphic aquifer, granite aquifer, and nais rock aquifer). The quality of groundwater in hard rock and rock fragment formations at the waterborne sediment plains mostly has chemical and physical properties within the acceptable standard for consumption of groundwater for consumption. While brackish water and salt water sources are mostly found in coastal areas from Mueang District to Klaeng District. Salt water is found at greater depth under the beach sand layer at the mouth of river where mangrove forests are, which yield brackish to salt water.

In Chonburi, the characteristics of aquifers include unconsolidated aquifers and semi-consolidated aquifers in the clay layer of the soil. In some places, the thin layers of sand and gravel is protrude into clay layer, with aquifer with water layer that is 10-200 meters deep. But due to the water being retained win the clay, the amount of freshwater that can be utilized is low, with yield of groundwater as high as 10 cubic meters per hour. Water is mostly brackish. The amount of underground water is spread over wide areas, offering high volumes of good quality freshwater.

For groundwater sources in Rayong and Chonburi provinces, the artesian wells can be divided into 2 types of artesian wells, namely for consumption-general use and for agricultural wells. Rayong province has a total of 816 general consumption wells and 76 agricultural wells, with an average water yield volume of 5.67 cubic meters per hour and 5.09 cubic meters per hour, respectively. Chonburi province has a total of 617 artesian wells. Of this 617 wells are for general consumption and 69 wells for agriculture, with average yield volume of 4.98 cubic meters and 6.88 cubic meters per hour, respectively. Details as shown in Table 3.5-26

Table 3.5-26 Groundwater sources in Rayong and Chonburi provinces

Utilization type	Number of wells	Average depth (meters)	Average water volume (cubic meters/hour)	Average normal water level (meters)	Average water level (meters)
Rayong Province					
Wells for general consumption	816	75.47	5.67	5.63	21.17
Agricultural wells	76	83.71	5.09	4.99	39.21
Chon Buri Province					
Wells for general consumption	617	69.09	4.98	6.36	25.60
Agricultural wells	69	80.70	6.88	6.63	23.81

Source: Department of Groundwater Resources. *Groundwater well information.* Searched on 10 February 2021
Information can be accessed from http://app.dgr.go.th/newpasutara/xml/tshow.php?ddlGeo=12&ddlProvince=&btn1=.

For groundwater sources in the study area, the summary is as follows:

- Rayong Province, Phala Subdistrict, Sam Nak Thon Subdistrict, Ban Chang Subdistrict, has 3, 22 and 11 groundwater wells for general consumption, respectively and has 2 agricultural wells in San Nak Thon Subdistrict. In Huai Pong Subdistrict, Mueang District of Rayong Province, there are 8 general consumption wells with average yield volume of 2.94-6.17 cubic meters per hour.
- Rayong Province, Huai Yai Subdistrict, Bang Lamung District, there are 11 general consumption wells while in Na Jomtien Subdistrict, Bangsare Subdistrict, Phlu Ta Luang Subdistrict, Sattahip Subdistrict of Sattahip District, there are 9, 6, 38 and 58 wells, respectively, with average yield ranging from 2.69-13.54 cubic meters per hour.

Details are shown in Table 3.5**-27**

Table 3.5-27 Groundwater sources in the study area

Study area		Utilization type	Number (wells)	Average depth (meters)	Average water volume (cubic meters/hour)	Average normal water level (meters)	Average water level (meters)
Rayong							
Ban Chang District	Phala Subdistrict	Wells for general consumption	3	43.83	6.17	3.55	30.11
	Sam Nak Thon Subdistrict	Wells for general consumption	22	59.84	3.68	4.49	24.98
		Agricultural wells	2	107.00	4.00	10.00	40.00
	Ban Chang Subdistrict	Wells for general consumption	11	43.91	4.03	4.90	12.17
Mueang Rayong District	Huai Pong Subdistrict	Wells for general consumption	8	57.44	2.94	3.74	28.47
Chonburi Province							
Bang Lamung District	Huai Yai Subdistrict	Wells for general consumption	11	80.59	2.69	6.78	21.99
Sattahip District	Na Jomtien Subdistrict	Wells for general consumption	9	61.94	5.84	6.38	30.86
	Bang Sare Subdistrict	Wells for general consumption	6	84.67	4.10	5.46	25.88
	Phlu Ta Luang Subdistrict	Wells for general consumption	38	79.20	10.21	4.91	29.80

Table 3.5-27 Groundwater sources in the study area

Study area		Utilization type	Number (wells)	Average depth (meters)	Average water volume (cubic meters/hour)	Average normal water level (meters)	Average water level (meters)
	Sattahip Subdistrict	Wells for general consumption	58	77.36	13.54	10.53	17.50
	Samaesarn Subdistrict	-	-	-	-	-	-

Note: (-) means No data available.

Source: Department of Groundwater Resources. *Groundwater well information.* Accessed on February 12, 2019 http://app.dgr.go.th/newpasutara/xml/search.php

(2) Groundwater quality

According to the Department of Groundwater Resources 2018-2020, it was found that groundwater quality from the groundwater wells (observation wells) in Ban Chang District (4 wells) and Rayong District (24 wells). Groundwater quality in Rayong Province mostly have chemical properties that exceed the allowable standards in iron, manganese, sulphate, chloride, fluoride contents and total mass soluble. As for physical and toxic properties, they do not exceed the allowable standard. Among observation wells, the ones with water quality far exceeding the allowable standard were found at Wat Petra Sukharom School, Wat Khot Hin and Public Health center at Ban Takuan.

As for the quality of groundwater from artesian wells (observation wells) in Bang Lamung District (11 wells) and Sattahip district (11 wells), Chonburi Province. Most of them have chemical contents, such as iron, manganese, sulph ate, chloride, fluoride and total soluble mass, exceeding allowable standards. The physical properties and toxicity do not exceed the allowa ble standards. Among observation wells, those with water quality far exceeding the allowable standards were found at Wat Na Jomtien and RTN golf course in Phlu Ta Luang (A38B11) as shown in Table 3.5-28

When comparing groundwater quality to standard values, groundwater can be used for general consumption - but water quality should be improved through further treatment in order to improve water quality before use by reducing or elimin ating undesirable contents, such as iron, manganese, sulfate, chloride, fluoride, and total dissolved mass content. This can be done in many ways, such as boiling, filtering, chemical treatment, aeration, and reverse osmotic method (Department of Ground Water Resour ces, 2018).

Table 3.5-28 Groundwater quality from observation ponds in the project study area 2018-2020

Sequence No.	Observation wells	Year	Physical characteristics		Chemical characteristics										Toxic characteristics					
			pH	EC (µS/cm)	Fe (mg/l)	Mn (mg/l)	Cu (mg/l)	Zn (mg/l)	SO_4 (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	$CaCO_3$ (mg/l)	TDS (mg/l)	As (mg/l)	CN (mg/l)	Pb (mg/l)	Hg (mg/l)	Cd (mg/l)	Se (mg/l)
Rayong																				
Ban Chang District																				
1	Nong Namyen Subdistrict Health Promotion Hospital	2018	6.4	241.0	3.5	0.5	0.0	0.1	4.0	12.0	0.3	2.3	19.0	157.0	0.0275	-	<0.0007	<0.0002	<0.0004	<0.0018
		2019	6.6	254.0	3.0	0.4	0.0	0.0	3.0	12.0	0.4	<0.9	13.0	165.0	0.0317	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	6.7	151.0	0.1	0.2	0.0	0.0	4.0	13.0	0.4	11.0	12.0	98.0	0.0098	-	0.0013	<0.0002	<0.0004	<0.0018
2	Air Defense Artillery Battalion	2018	6.1	150.0	0.4	0.0	0.0	0.2	14.0	19.0	0.3	11.0	4.3	98.0	<0.0028	-	0.0009	<0.0002	<0.0004	<0.0018
		2019	6.5	154.0	0.0	0.0	0.0	0.0	11.0	20.0	0.4	9.0	5.6	100.0	-	-	-	-	-	-
		2020.	6.6	160.0	0.0	0.0	0.0	0.0	11.0	18.0	0.3	11.0	4.5	104.0	<0.0028	-	0.0051	<0.0002	<0.0004	<0.0018
3	Ban Chang District Office	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2019	8.0	641.0	0.0	0.0	0.0	0.0	72.0	41.0	0.4	36.0	53.0	417.0	0.0072	-	<0.0007	<0.0002	<0.0004	0.0031
		2020.	8.4	652.0	0.0	0.0	0.0	0.0	61.0	43.0	0.4	36.0	50.0	424.0	0.0074	-	<0.0007	<0.0002	<0.0004	0.0043
4	Wat Chonlateetharam	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2019	7.2	3,110.0	0.5	0.3	0.0	0.0	12.0	940.0	1.1	1.0	420.0	2,020.0	-	-	-	-	-	-
		2020.	7.5	3,120.0	0.1	0.1	0.0	0.0	13.0	940.0	0.9	1.7	410.0	2,030.0	-	-	-	-	-	-
Mueang Rayong District																				
1	No. 15, opposite the Rayong landfill	2018	7.7	38,900.0	0.4	0.1	0.1	0.0	330.0	15,000.0	0.2	10.0	550.0	25,300.0	-	-	-	-	-	-
		2019	8	37,500.0	0.1	0.0	0.1	0.0	470.0	3,000.0	0.2	13.0	70.0	24,400.0	-	-	-	-	-	-
		2020.	7.8	39,000.0	0.3	0.1	0.0	0.0	490.0	15,000.0	0.3	15.0	380.0	25,400.0	-	-	-	-	-	-
2	No. 15 Thessaban Bumrung Road (Map Ta Phut Municipal Landfill)	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2019	6.7	1,580.0	2.0	0.3	0.0	0.1	42.0	320.0	0.3	11.0	48.0	1,030.0	0.0044	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	6.4	2,220.0	9.7	0.4	0.0	0.1	50.0	530.0	0.3	88.0	22.0	1,440.0	-	-	-	-	-	-
3	Landfill Rayong waste	2018	7.3	3,190.0	0.7	0.4	-	-	-	-	-	-	-	2,070.0	0.0000	-	0.1000	-	-	-
		2019	7.6	2,800.0	0.1	0.3	-	-	-	-	0.1		-	1,820.0	0.0000	-	0.1000	-	-	-
		2020.	7.2	3,840.0	0.1	0.2	0.0	0.0	-	-	0.1		-	2,500.0	-	-	-	-	-	-
4	Ban Takraothong School	2018	7.3	203.0	0.4	0.0	0.0	0.1	4.0	9.6	0.4	<0.9000	18.0	132.0	0.0122	-	0.0025	<0.0002	<0.0004	<0.0018
		2019	7.8	208.0	0.1	0.0	0.0	0.0	2.0	9.6	0.4	<0.9000	18.0	135.0		-				
		2020.	7.4	187.0	0.2	0.0	0.0	0.1	<1.0	7.6	0.3	1.1	18.0	122.0	0.0138	-	0.0009	<0.0002	<0.0004	<0.0018
5	Ban Nong Chok School	2018	7.8	2,280.0	0.5	0.3	0.0	0.0	50.0	610.0	4.4	<0.9000	45.0	1,480.0	-	-	-	-	-	-
		2019	7.8	2,130.0	0	0.1	0.0	0.0	56.0	540.0	4.9	<0.9000	50.0	1,380.0	-	-	-	-	-	-
		2020.	8.2	2,000.0	0.1	0.0	0.0	0.1	34.0	490.0	5.2	0.9	39.0	1,300.0	-	-	-	-	-	-
6	Wat Petra Sukharom School	2018	7.5	29,700.0	0.0	0.1	0.0	0.0	1,800.0	8,600.0	0.2	1.0	1,100.0	19,300.0	-	-	-	-	-	-
		2019	7.2	29,800.0	0.0	0.7	0.0	0.0	2,700.0	11,000.0	0.3	<0.9	1,400.0	19,400.0	-	-	-	-	-	-
		2020.	7.3	29,500.0	0.0	0.1	0.0	0.0	2,400.0	10,000.0	0.3	1.3	1,200.0	19,200.0	-	-	-	-	-	-
7	Map Ta Phut Hospital	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2019	7.2	310.0	0.4	0.2	0.0	0.0	16.0	34.0	0.5	1.1	15.0	202.0	0.0237	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	7.2	418.0	3.8	1.6	0.0	0.1	33.0	53.0	0.3	3.5	21.0	272.0	0.0039	-	<0.0007	<0.0002	<0.0004	<0.0018
8	And the entrance to the Map Ta Phut Industrial Estate (Bhumirak Garden)	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2019	6.8	673.0	13	2.6	0.0	0.0	10.0	86.0	0.4	7.2	59.0	437.0	0.0124	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	7.2	674.0	8.3	2.8	0.0	0.1	2.0	86.0	0.5	18.0	52.0	438.0	0.0751	-	0.0007	<0.0002	<0.0004	<0.0018
9	Wat Khao Phrabhat	2018	7.0	124.0	0.1	0.0	0.0	0.1	13.0	9.2	0.1	7.2	11.0	81.0	<0.0028	-	0.0217	<0.0002	<0.0004	<0.0018
		2019	7.4	123.0	0.2	0.0	0.0	0.0	4.0	13.0	0.1	3.2	9.1	80.0		-				

Table 3.5-28 Groundwater quality from observation ponds in the project study area 2018-2020

Sequence No.	Observation wells	Year	Physical characteristics		Chemical characteristics										Toxic characteristics					
			pH	EC (µS/cm)	Fe (mg/l)	Mn (mg/l)	Cu (mg/l)	Zn (mg/l)	SO_4 (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	$CaCO_3$ (mg/l)	TDS (mg/l)	As (mg/l)	CN (mg/l)	Pb (mg/l)	Hg (mg/l)	Cd (mg/l)	Se (mg/l)
		2020.	7.1	119.0	0.2	0.0	0.0	0.0	13.0	11.0	0.1	6.3	9.1	77.0	<0.0028	-	0.0062	<0.0002	<0.0004	<0.0018
10	Wat Khot Hin	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2019	7.7	3,110.0	0.1	0.0	0.0	0.0	510.0	690.0	6.4	<0.9	98.0	2,020.0	-	-	-	-	-	-
		2020.	7.7	3,080.0	2.0	0.1	0.0	0.0	410.0	700.0	6.2	<0.9	79.0	2,000.0	-	-	-	-	-	-
11	Wat Nairai	2018	7.8	449.0	0.2	0.0	0.0	0.0	72.0	11.0	0.7	<0.9	75.0	292.0	0.0069	-	0.003	<0.0002	<0.0004	<0.0018
		2019	8.2	443.0	0.0	0.0	0.0	0.0	5.0	11.0	0.8	<0.9	63.0	288.0	-	-				
		2020.	8.0	445.0	0.0	0.0	0.0	0.0	14.0	11.0	0.9	<0.9	65.0	289.0	0.0079	-	<0.0007	<0.0002	< 0.0004	<0.0018
12	Wat Chak Luk Ya	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
		2019	6.7	118.0	0.0	0.0	0.0	0.0	<1.0	10.0	0.2	2.1	9.3	77.0	<0.0028	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	7.2	125.0	0.1	0.1	0.0	0.0	<1.0	10.0	0.2	3.2	9.9	81.0	<0.0028	-	<0.0007	<0.0002	<0.0004	<0.0018
13	Wat Soi Khiri	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2019	7.8	535.0	0.3	0.2	0.0	0.0	<1.0	28.0	3.1	3.2	23.0	348.0	0.0530	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	8.2	500.0	0.2	0.1	0.0	0.1	<1.0	21.0	2.5	1.9	40.0	325.0	0.0267	-	<0.0007	<0.0002	<0.0004	<0.0018
14	Wat Taphong Nok	2018	7.8	443.0	12.0	0.4	0.0	0.0	<1.0	68.0	5.0	<0.9	9.4	288.0	0.0075	-	0.0033	<0.0002	<0.0004	0.0018
		2019	7.9	430.0	6.0	0.2	0.0	0.0	2.0	69.0	5.3	<0.9	8.3	280.0		-				
		2020.	7.8	438.0	12.0	0.2	0.0	0.0	4.0	66.0	5.4	1.0	7.8	285.0	0.0080	-	<0.0007	<0.0002	<0.0004	<0.0018
15	Wat Nam Khok Kao	2018	7.3	2,010.0	0.0	0.0	0.0	0.0	67.0	560.0	0.3	1.4	53.0	1,310.0		-				
		2019	7.3	2,080.0	0.1	0.0	0.0	0.0	89.0	570.0	0.3	<0.9	53.0	1,350.0		-				
		2020.	7.6	2,150.0	0.1	0.0	0.0	0.0	83.0	580.0	0.3	1.2	54.0	1,400.0		-				
16	Wat Ban Chawuek	2018	5.9	123.0	0.1	0.0	0.0	0.0	4.0	17.0	0.0	17.0	1.8	80.0	<0.0028	-	0.0059	<0.0002	<0.0004	<0.0018
		2019	6.6	147.0	0.0	0.1	0.0	0.1	2.0	22.0	0.1	31.0	4.3	96.0		-				
		2020.	6.3	157.0	0.1	0.1	0.0	0.1	<1.0	18.0	0.1	34.0	6.2	102.0	<0.0028	-	0.0021	<0.0002	<0.0004	<0.0018
17	Wat Ban Don	2018	7.6	1,720.0	5.6	0.5	0.0	0.0	160.0	230.0	0.4	2.5	61.0	1,120.0	<0.0028	-	0.0017	<0.0002	<0.0004	<0.0018
		2019	7.3	1,460.0	3.1	0.2	0.0	0.0	210.0	180.0	0.4	<0.9	60.0	949.0		-				
		2020.	7.9	1,390.0	1.9	0.2	0.0	0.0	110.0	160.0	0.3	2.0	54.0	904.0	<0.0028	-	<0.0007	<0.0002	<0.0004	<0.0018
18	Wat Phluak Ket	2018	8.1	574.0	0.4	0.0	0.0	0.0	4.0	33.0	0.1	4.2	37.0	373.0	<0.0028	-	0.0022	<0.0002	<0.0004	<0.0018
		2019	8.5	563.0	0.0	0.0	0.0	0.0	6.0	32.0	0.1	3.3	35.0	366.0		-				
		2020.	8.4	575.0	0.1	0.0	0.0	0.0	<1.0	34.0	0.1	3.1	34.0	374.0	<0.0028	-	<0.0007	<0.0002	<0.0004	<0.0018
19	Wat Mab Chalood	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2020.	7.6	271.0	13.0	1.3	0.0	0.0	<1.0	26.0	0.9	14.0	24.0	176.0	0.0817	-	<0.0007	<0.0002	<0.0004	<0.0018

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Table 3.5-29 Groundwater quality from observation ponds in the project study area 2018-2020

Sequence No.	Observation wells	Year	Physical characteristics		Chemical characteristics										Toxic characteristics					
			pH	EC (µS/cm)	Fe (mg/l)	Mn (mg/l)	Cu (mg/l)	Zn (mg/l)	SO_4 (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	$CaCO_3$ (mg/l)	TDS (mg/l)	As (mg/l)	CN (mg/l)	Pb (mg/l)	Hg (mg/l)	Cd (mg/l)	Se (mg/l)
20	Wat Huai Pong	2018														-				
		2019	7.4	251.0	0.1	0.0	0.0	0.0	<1.0	24.0	1.3	<0.9	11.0	163.0	0.0105	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	7.1	328	0.6	0.5	0.0	0.0	<1.0	24.0	2.0	<0.9	29.0	213	0.0190	-	0.001	<0.0002	<0.0004	0.0027
21	Ban Ta Kuan Public Health Service Center	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2019	3.4	3,100.0	12.0	3.9	0.0	0.1	290.0	820.0	0.1	<0.9	89.0	2,020.0		-				
		2020.	3.1	3,060.0	4.5	4.1	0.0	0.2	240.0	820.0	0.1	25.0	79.0	1,990.0		-				
22	Wat Chang Chon Sirirat Bamrung Child Development Center	2018	7.1	170.0	0.3	0.2	0.0	0.0	8.0	11.0	0.1	4.1	26.0	110.0	<0.0028	-	0.0036	<0.0002	0	<0.0018
		2019	7	196.0	0.0	0.2	0.0	0.0	17.0	14.0	0.1	3.2	24.0	127.0		-				
		2020.	6.9	181.0	0.4	0.5	0.0	0.0	5.0	11.0	0.1	3.5	22.0	118.0	<0.0028	-	<0.0007	<0.0002	<0.0004	<0.0018
23	Map Ta Phut Temple	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2019	7.8	649.0	0.1	0.0	0.0	0.0	19.0	57.0	2.1	2.2	61.0	422.0	<0.0028	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	Wat Nern Phuttra	2018	7.8	4,300.0	0.2	0.2	0.0	0.0	120.0	1,300.0	0.6	2.9	170.0	2,800.0	-	-	-	-	-	-
		2019	8.1	4,520.0	0.0	0.0	0.0	0.0	290.0	1,300.0	0.6	3.7	150.0	2,940.0	-	-	-	-	-	-
		2020.	8.1	4,560.0	0.0	0.0	0.0	0.0	140.0	1,400.0	0.3	5.1	150.0	2,960.0	-	-	-	-	-	-
Chonburi Province																				
Bang Lamung District																				
1	Pattaya Municipality	2018	7.6	459.0	1.4	1.0	0.0	0.0	< 1.0	20.0	1.4	30.0	69.0	298.0	0.0153	-	0.001	<0.0002	<0.0004	<0.0018
		2019	8.0	430.0	0.3	0.1	0.0	0.0	< 1.0	10.0	1.5	11.0	63.0	280.0	0.0082	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	7.5	4,010.0	0.2	0.1	0.0	0.0	240.0	1,100.0	1.4	11.0	200.0	2,610.0	-	-	-	-	-	-
2	Pattaya landfill site	2018	7.0	179.0	0.4	0.0	0.0	0.0	<1.0	16.0	0.5	2.4	8.6	116.0	0.0096	-	0.0008	<0.0002	< 0.0004	<0.0018
		2019	6.5	173.0	0.3	0.0	0.0	0.0	<1.0	14.0	0.5	2.0	7.5	112.0	0.0087	-	< 0.0007	<0.0002	< 0.0004	<0.0018
		2020.	7.6	630.0	0.3	0.4	0.0	0.0	15.0	25.0	0.5	1.6	64.0	410.0	<0.0028	-	<0.0007	<0.0002	<0.0004	<0.0018
3	Ban Phu Sai 881 (Waste Landfill Khao Mai Kaew Subdistrict (Ban Thung Sa Kaeo))	2018	7.6	252.0	0.5	0.1	0.0	0.0	<1.0	18.0	1.0	3.9	27.0	164.0	0.0063	-	0.001	<0.0002	<0.0004	<0.0018
		2019	7.8	229.0	0.8	0.1	0.0	0.0	<1.0	12.0	1.0	1.9	21.0	149.0	0.0069	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	7.3	601.0	0.6	0.6	0.0	0.0	<1.0	20.0	0.2	9.6	100.0	391.0	<0.0028	-	0.0007	<0.0002	<0.0004	<0.0018
4	Ban Huai Khai Nao	2018	7.5	254.0	5.5	0.5	0.0	0.0	1.0	7.6	1.5	2.2	25.0	165.0	0.0052	-	0.0021	<0.0002	<0.0004	<0.0018
		2019	7.8	229.0	0.8	0.1	0.0	0.0	<1.0	12.0	1.0	1.9	21.0	149.0	0.0069	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	7.4	434.0	3.3	0.4	0.0	0.0	3.0	15.0	0.2	1.0	71.0	282.0	0.0085	-	<0.0007	<0.0002	<0.0004	< 0.0018
5	Ban Huai Khai Nao (Waste landfill site Khao Mai Kaew Subdistrict (Ban Thung Sa Kaeo))	2018	7.8	330.0	0.4	0.2	0.0	0.0	<1.0	34.0	1.1	17.0	31.0	214.0	0.0378	-	0.0008	<0.0002	<0.0004	<0.0018
		2019	7.8	370.0	0.3	0.4	0.0	0.0	<1.0	34.0	1.6	14.0	28.0	240.0	0.0454	-	<0.0007	<0.0002	<0.0004	<0.0018
		2020.	6.6	280.0	0.3	0.2	0.0	0.0	<1.0	30.0	0.1	< 0.9	4.0	182.0	< 0.0028	-	0.0016	<0.0002	<0.0004	<0.0018
6	Khao Mai Kaew Temple	2018	8.0	571.0	0.1	0.8	0.0	0.0	8.0	20.0	1.7	<0.9	84.0	371.0	0.0269	-	0.0016	<0.0002	<0.0004	<0.0018
		2019	7.6	566.0	0.3	3.2	0.0	0.0	12.0	21.0	1.7	1.4	78.0	368.0	0.0151	-	0.0008	< 0.0002	<0.0004	<0.0018
		2020.	7.5	369.0	22	0.1	0.0	0.0	<1.0	10.0	0.4	1.2	48.0	240.0	0.0117	-	<0.0007	<0.0002	<0.0004	<0.0018
7	Wat Yan Nasangwararam	2018	6.3	199.0	3.0	0.1	0.0	0.0	26.0	20.0	0.1	<0.9	16.0	129.0	0.0066	-	0.0019	< 0.0002	<0.0004	<0.0018
		2019	7.6	566.0	0.3	3.2	0.0	0.0	12.0	21.0	1.7	1.4	78.0	368.0	0.0151	-	0.0008	<0.0002	<0.0004	<0.0018
		2020.	7.6	442.0	0.6	0.2	0.0	0.0	2.0	8.8	0.2	<0.9	67.0	287.0	<0.0028	-	< 0.0007	< 0.0002	<0.0004	<0.0018
8	Takhianthong Temple	2018	6.2	630.0	0.2	0.5	0.0	0.0	3.0	130.0	0.2	43.0	14.0	410.0	<0.0028	-	0.0028	<0.0002	<0.0004	0.0024
		2019	5.6	768.0	2.4	0.3	0.0	0.0	<1.0	180.0	0.2	79.0	22.0	499.0	-	-	-	-	-	-

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Table 3.5-29 Groundwater quality from observation ponds in the project study area 2018-2020

Sequence No.	Observation wells	Year	Physical characteristics		Chemical characteristics										Toxic characteristics					
			pH	EC (µS/cm)	Fe (mg/l)	Mn (mg/l)	Cu (mg/l)	Zn (mg/l)	SO_4 (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	$CaCO_3$ (mg/l)	TDS (mg/l)	As (mg/l)	CN (mg/l)	Pb (mg/l)	Hg (mg/l)	Cd (mg/l)	Se (mg/l)
		2020.	7.1	277.0	6.6	0.4	0.0	0.0	<1.0	13.0	1.0	1.0	19.0	180.0	0.0357	-	<0.0007	<0.0002	<0.0004	<0.0018
9	Wat Sawang Arom	2018	6.5	340.0	0.0	0.1	0.0	0.0	7.0	48.0	0.2	54.0	14.0	221.0	<0.0028	-	0.0011	<0.0002	<0.0004	<0.0018
		2019	6.2	331.0	0.5	0.3	0.0	0.0	13.0	44.0	0.2	57.0	17.0	215.0	-	-	-	-	-	-
		2020.	7.4	620.0	1.3	0.7	0.0	0.0	1.0	12.0	1.7	5.0	63.0	403.0	0.017	-	<0.0007	<0.0002	<0.0004	<0.0018
10	Ban Phu Sai Community Learning Center	2018	7.1	305.0	0.2	0.0	0.0	0.1	1.0	11.0	0.2	11.0	48.0	198.0	<0.0028	-	0.0015	<0.0002	<0.0004	<0.0018
		2019	6.8	309.0	0.0	0.0	0.0	0.0	<1.0	8.0	0.1	7.8	53.0	201.0	<0.0028	-	0.0009	<0.0002	<0.0004	<0.0018
		2020.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Mabprachan Reservoir	2018	8.0	438.0	0.0	0.0	0.0	0.0	7.0	38.0	2.9	6.9	35.0	285.0	<0.0028	-	0.0007	<0.0002	<0.0004	<0.0018
		2019	7.7	436.0	15	0.8	0.0	0.0	<1.0	7.2	0.2	1.1	83.0	283.0	0.0031	-	0.0045	<0.0002	<0.0004	<0.0018
		2020.	7.7	436.0	15	0.8	0.0	0.0	<1.0	7.2	0.2	1.1	83.0	283.0	0.0031	-	0.0045	<0.0002	<0.0004	<0.0018
Sattahip District																-				
1	Bang Sare Subdistrict Municipality	2018	7.2	484.0	64.0	5.3	0.0	0.1	<1.0	37.0	0.4	15.0	42.0	315.0	0.0859	-	0.0052	<0.0002	<0.0004	<0.0018
		2019	6.5	449.0	27.0	4.8	0.0	0.0	<1.0	36.0	0.4	5.1	33.0	292.0		-				
		2020.	7.1	452.0	2.1	0.7	0.0	0.0	1.0	14.0	1.4	4.4	55.0	294.0	0.0143	-	<0.0007	<0.0002	<0.0004	<0.0018
2	Phlu Ta Luang School	2018	7.2	311.0	5.4	0.6	0.0	0.0	9.0	8.4	0.2	<0.9	47.0	202.0	<0.0028	-	0.002	<0.0002	<0.0004	<0.0018
		2019	6.6	276.0	39.0	1.6	0.0	0.1	10.0	8.4	0.2	<0.9	38.0	179.0		-				
		2020.	7.5	228.0	0.2	0.0	0.0	0.0	<1.0	11.0	1.0	2.2	23.0	148.0	0.0092	-	<0.0007	<0.0002	<0.0004	<0.0018
3	Wat Tao Than	2018	7.7	1,130.0	0.2	0.0	0.0	0.0	19.0	200.0	0.1	1.0	69.0	734.0	0.0039	-	0.0019	<0.0002	<0.0004	0.0039
		2019	7.4	1,130.0	0.1	0.0	0.0	0.0	27.0	220.0	1.6	<0.9	64.0	734.0		-				
		2020.	6.6	424.0	0.9	0.9	0.0	0.0	<1.0	64.0	1.6	<0.9	31.0	276.0	0.003	-	<0.0007	<0.0002	<0.0004	<0.0018
4	Wat Mai Yu Sangad	2018	7.1	234.0	0.3	0.0	0.0	0.0	31.0	11.0	3.1	3.4	16.0	152.0	<0.0028	-	<0.0007	<0.0002	<0.0004	<0.0018
		2019	6.5	232.0	0.1	0.0	0.0	0.0	20.0	8.8	3.3	2.1	12.0	151.0		-				
		2020.	7.7	469.0	1.3	0.2	0.0	2.1	<1.0	57.0	0.1	<0.9	36.0	305.0	<0.0028	-	<0.0007	<0.0002	<0.0004	<0.0018
5	Wat Tung Prong	2018	7.5	246.0	0.4	0.0	0.0	0.1	15.0	15.0	0.2	10.0	20.0	160.0	<0.0028	-	0.0018	<0.0002	<0.0004	<0.0018
		2019	6.6	280.0	0	0.0	0.0	0.0	20.0	21.0	0.2	9.0	21.0	182.0	-	-	-	-	-	-
		2020.	7.4	487.0	0.2	0.3	0.0	0.0	2.0	33.0	2.9	2.4	41.0	317.0	0.0261	-	0.0007	<0.0002	<0.0004	<0.0018
6	Wat Na Jomtien	2018	7.7	5,590.0	1.2	0.0	0.0	0.0	380.0	1,600.0	0.8	1.4	290.0	3,630.0	-	-	-	-	-	-
		2019	7.6	5,380.0	0.2	0.2	0.0	0.0	320.0	1,600.0	1.0	<0.9	250.0	3,500.0	-	-	-	-	-	
		2020.	6.4	251.0	0.0	0.1	0.0	0.1	13.0	22.0	0.7	3.5	22.0	163.0	<0.0028	-	<0.0007	<0.0002	<0.0004	<0.0018
7	Wat Samakkhi Banphot	2018	7.8	1140.0	0.2	2.0	0.0	0.0	34.0	180.0	4.6	<0.9	67.0	741.0	0.0182	-	0.0023	<0.0002	<0.0004	0.0034
		2019	7.5	896.0	0.1	1.0	0.0	0.0	45.0	99.0	3.1	41.0	68.0	582.0		-				
		2020.	7.4	559.0	0.2	1.5	0.0	0.0	9.0	20.0	1.6	<0.9	80.0	363.0	0.019	-	<0.0007	<0.0002	<0.0004	<0.0018
8	Sattahip Technical College	2018	7.9	980.0	0.0	0.0	0.0	0.0	36.0	190.0	0.8	22.0	68.0	637.0	0.0036	-	0.0027	<0.0002	<0.0004	0.0043
		2019	6.7	1180.0	0.7	1.6	0.0	0.0	23.0	240.0	1.7	<0.9	78.0	767.0	-	-	-	-	-	-
		2020.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Phu Ta Luang Royal Navy Golf Course A38B11	2018	8.4	889.0	0.0	0.0	0.0	0.0	39.0	130.0	0.5	9.0	60.0	578.0	0.0049	-	0.0031	<0.0002	<0.0004	0.0018
		2019	8.2	926.0	0.2	0.0	0.0	0.0	44.0	130.0	0.5	16.0	64.0	602.0	-	-	-	-	-	-
		2020.	7.1	3,670.0	1.4	1.7	0.0	0.1	3.0	1,000.0	0.5	4.2	74.0	2,390.0	-	-	-	-	-	-
10	Phu Ta Luang Royal Navy Golf Course A40B05	2018	7.6	280.0	0.1	0.0	0.0	2.2	1.0	30.0	0.1	8.2	36.0	182	<0.0028	-	0.0017	<0.0002	<0.0004	<0.0018
		2019	7.4	284.0	0.3	0.0	0.0	1.9	<1.0	30.0	0.1	4.2	31.0	185	-	-	-	-	-	-

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Table 3.5-29 Groundwater quality from observation ponds in the project study area 2018-2020

Sequence No.	Observation wells	Year	Physical characteristics		Chemical characteristics										Toxic characteristics					
			pH	EC (µS/cm)	Fe (mg/l)	Mn (mg/l)	Cu (mg/l)	Zn (mg/l)	SO_4 (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	$CaCO_3$ (mg/l)	TDS (mg/l)	As (mg/l)	CN (mg/l)	Pb (mg/l)	Hg (mg/l)	Cd (mg/l)	Se (mg/l)
		2020.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Sattahip Indexing Section	2018	7.8	1,800.0	0.0	0.0	0.0	0.0	230.0	330.0	2.8	<0.9	140.0	1,170.0	0.0045	-	0.0015	<0.0002	<0.0004	0.0055
		2019	7.0	1,660.0	0.0	0.5	0.0	0.0	250.0	300.0	3.5	<0.9	130.0	1,080.0	-	-	-	-	-	-
		2020.	8.0	2,140.0	0.3	0.2	0.0	0.1	22.0	360.0	0.9	1.4	63.0	1,390.0	-	-	-	-	-	-
Appropriate criteria*			7.0-8.5	n/a	0.5	0.3	1.0	5.0	200.0	250.0	0.7	45.0	300.0	600.0	Must not contain	Must not contain	Must not contain	Must not contain	Must not contain	Must not contain
Maximum allowance*			6.5-9.2	n/a	1.0	0.5	1.5	15.0	250.0	600.0	1.0	45.0	500.0	1,200.0	0.05	0.10	0.05	0.001	0.01	0.001

Note : underlined means that the standard value is exceeded
(-) means no measurement results
(n/a) means no standard value

Source: * Notification of the Ministry of Natural Resources and Environment Re: Prescribing Criteria and Technical Measures for Protection of Public Health and Prevention of Environmental Toxicity, 2008, published in the Government Gazette, Volume 125, Special Section 85 D, dated 21 May 2009.
Department of Groundwater Resources, 2021. Information on the quality of artesian wells. Retrieved on 11 February 2021, accessed from http://tgms.dgr.go.th/#/home

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3.5.10 Marine water quality

3.5.10.1 *Scope of Study*

Collecting data on marine water quality measured in the study area as well as information from secondary sources of information that are related to be used as a basis for assessing the potential impact of the project.

3.5.10.2 *Study Methods*

(1) Secondary data

Collecting marine water quality data from the Thailand Pollution Situation Report, Pollution Control Department (http://www.pcd.go.th/public/Publications/print_report.cfm)

(2) Primary data

Measure the marine water quality in the project area, detailed as follows:

- Sampling points Set up 6 seawater sampling points, as shown in Table 3.5-30 and Figure 3.5-30
- Sampling period The samples were collected twice, the first time during the rainy season on 19 July 2019 and the second time during the dry season on 1 November 2019.
- Sample collection method Collection of seawater samples (Figure 3.5-31) has been done in accordance with the methods accepted by the Office of Natural Resources and Environmental Policy and Planning (ONEP), and according to the Notification of the National Environment Board Re: Determination of Marine Water Quality Standards (Announced on 13 October 2017).
- Indices and method of analysis Analysis of samples in the laboratory (Table 3.5-31). Samples sent to the analytical laboratory will be entered into the analysis standards control system within the analytical laboratory. After the water samples are recorded in the Log Book system, the sample will be kept in the refrigeration chamber for further analysis. The analytical methods comply with APHA, AWWA and WEF: "Standard Methods for the Examination of Water and Wastewater", 23rd Edition, 2017.

The results of the marine water quality analysis are compared with the current condition of marine water quality that have been compiled, and marine water quality standards, according to the announcement of the National Environment Board Subject: Determination of marine water quality standards (2017).

Table 3.5-30 Marine water quality and seawater ecology measurement points for the project

Point at	Sample collection point location	Monitoring point coordinates		Rationale:
		E	N	
SW1	South of Runway 1 300 meters from the shore	717615	1399956	Points expected to be impacted by project operations
SW2	South of Runway 2 300 meters from the shore	719398	1400277	Points expected to be impacted by project operations
SW3	Southeast of Runway 2 300 meters from the shore	721348	1400499	Points expected to be impacted by project operations
SW4	Southwest of Runway 1 500 meters from the shore	716258	1399334	Points that might not be directly impacted by the project
SW5	South of Runway 2 500 meters from the shore	718751	1399959	Points that might not be directly impacted by the project
SW6	Southeast of Runway 2 500 meters from the shore	721114	1400286	Points that might not be directly impacted by the project

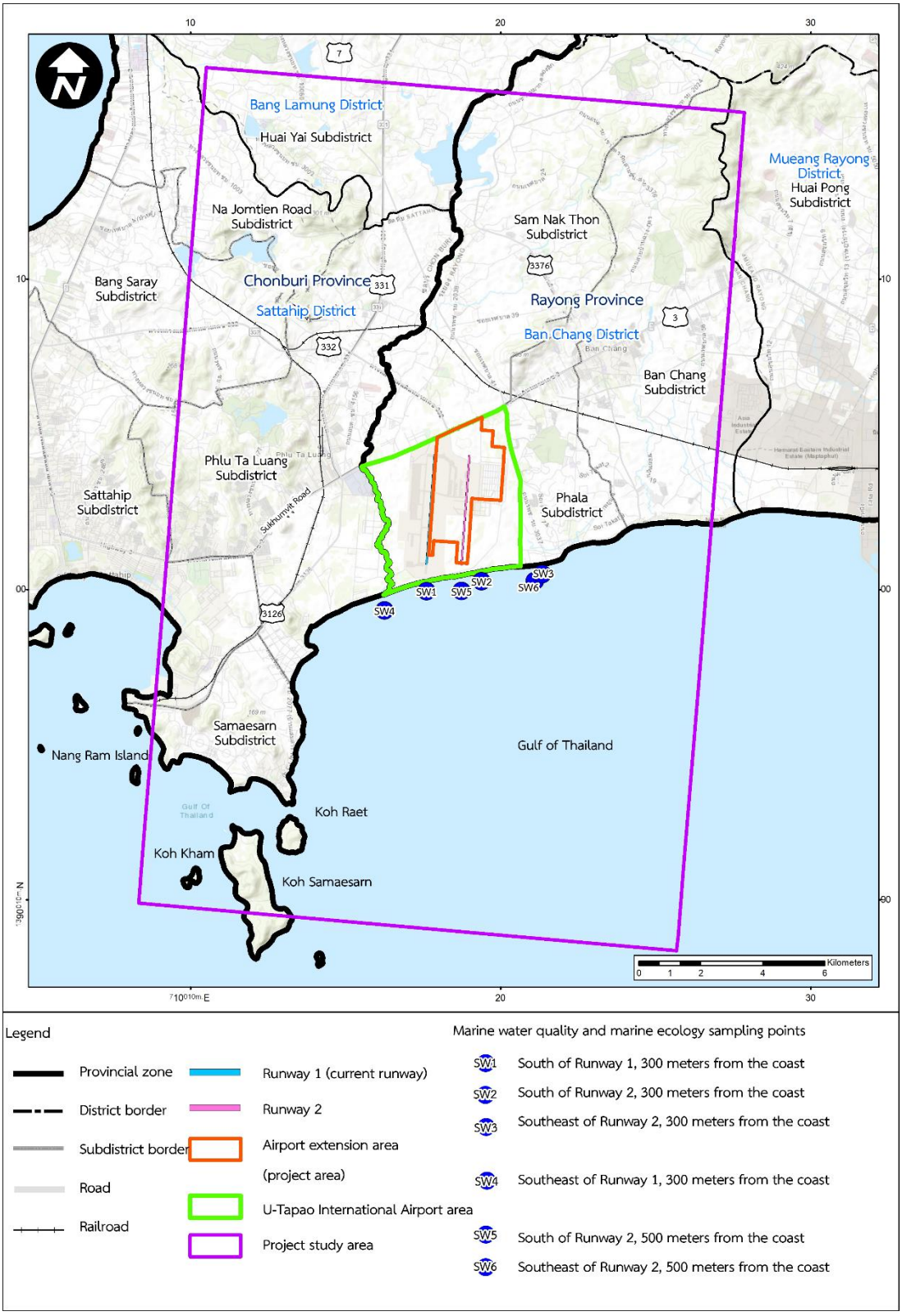
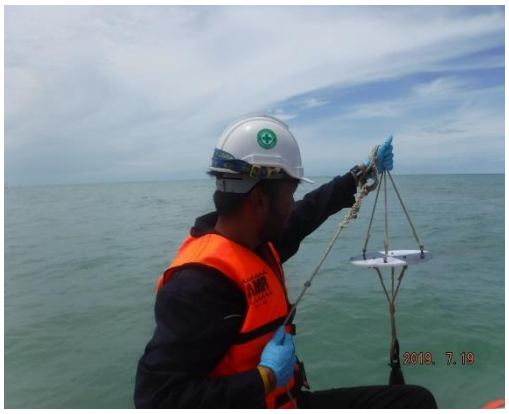


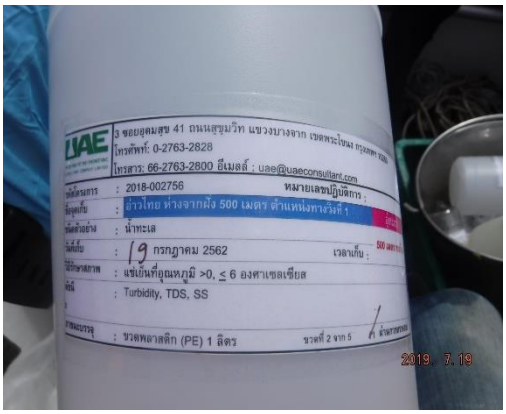
Figure 3.5-30 Marine water quality and seawater ecology sampling points for the project



Seawater Transparency Measurement with Secchi Disc

Sampling of marine water with a Teflon Sampler

Depth measurement with Depth Gauge



Marine water sample containers for general water quality analysis such as Turbidity, TDS and SS, etc.

Store samples in sample containers

Collect seawater samples in HDPE containers

Figure 3.5-31 Collection of marine water quality samples in the study area

Table 3.5-31 Indices and methods of marine water quality analysis

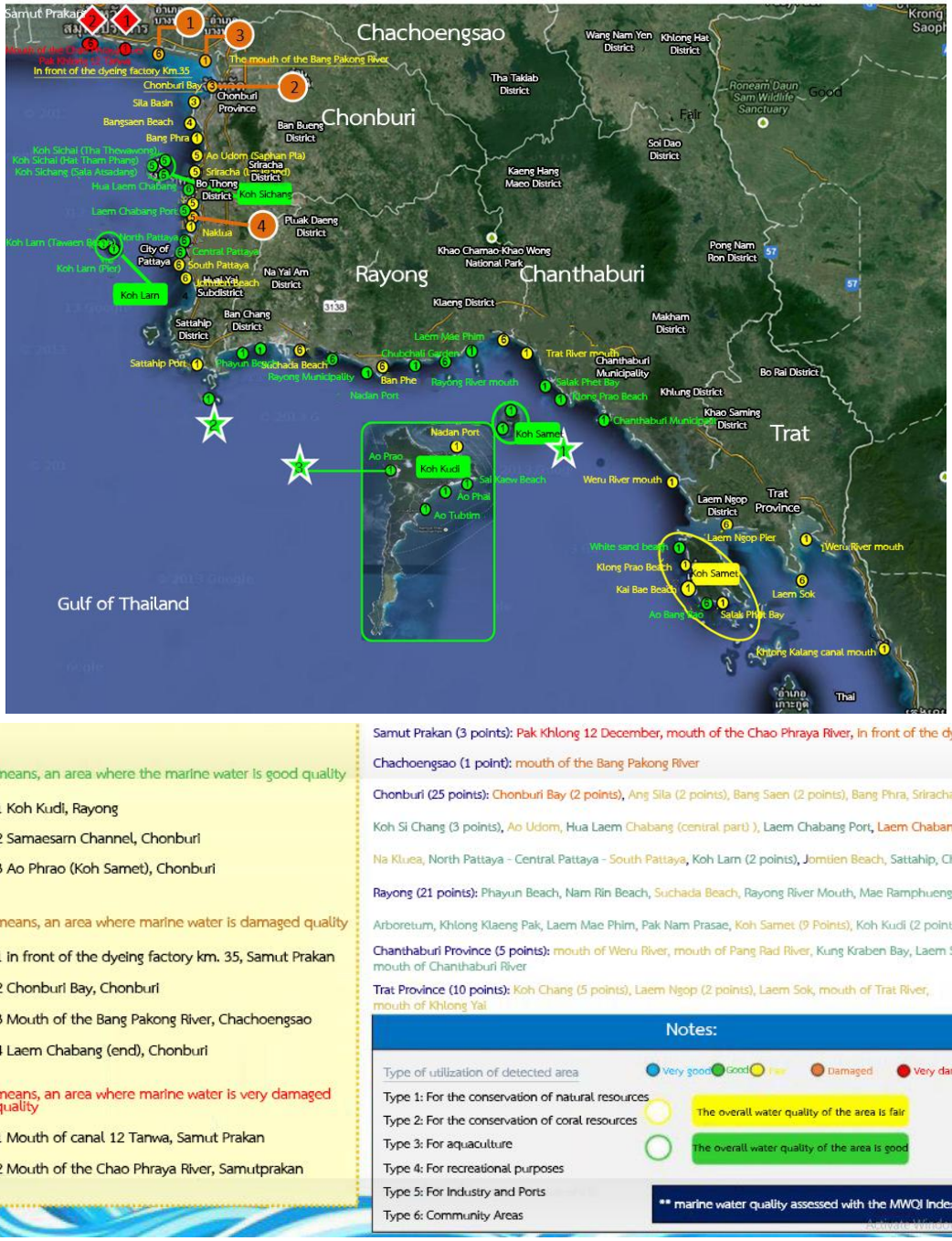
Index	Analysis method[1/]	Minimum of the measurement device
1) pH	Electrometric Method at site (SM : 4500-H^+ B)	-
2) Water temperature	Thermometer at site (SM : 2550 B)	-
3) conductivity	Electrical Conductivity Method at site (SM : 2510 B)	-
4) Transparency	Secchi Disc	-
5) Turbidity	Nephelometric Method (SM : 2130 B)	0.1
6) Salinity	Electrical Conductivity Method at site (SM : 2520 B)	0
7) Dissolved oxygen (DO)	Aside Modification Method at site (SM : 4500-O C)	-
8) BOD	Aside Modification Method (SM: 4500-O C and 5210 B)	0.5
9) Suspended solid (SS)	Suspended Solids Dried at 103-105 °C (SM : 2540 D)	1.0
10) Total dissolved solids (TDS)	Total Dissolved Solids Dried at 180 °C (SM : 2540 C)	25
11) Fat, Oil and Grease (Fat, Oil and Grease)	Liquid-Liquid, Partition-Gravimetric Method (SM : 5520 B)	3
12) Nitrate-Nitride	Cadmium Reduction Method (SM : 4500-NO_3^- E)	0.20
13) Phosphate-phosphorus	Ascorbic Acid Method (SM : 4500-P E)	0.10
14) Arsenic (As)	Hybrid Generation AAS Method (SM : 3314 C)	0.300
15) Manganese (Mn)	In-House Method UAE.TP.SW.01 (Nitric Acid Digestion and Direct Air Acetylene Flame Method); SM : 3030 E and 3111 B	0.100
16) Total mercury (Total Hg)	Cold Vapor AAS Method (SM : 3112 B)	0.020
17) Zinc (Zn)	In-House Method UAE.TP.SW.01 (Nitric Acid Digestion and Direct Air Acetylene Flame Method); SM : 3030 E and 3111 B	0.100
18) Cadmium (Cd)	In-House Method UAE.TP.SW.01 (Nitric Acid Digestion and Direct Air Acetylene Flame Method); SM : 3030 E and 3111 B	0.100
19) Copper (Cu)	In-House Method UAE.TP.SW.01 (Nitric Acid Digestion and Direct Air Acetylene Flame Method); SM : 3030 E and 3111 B	0.100
20) Nickel (Ni)	In-House Method UAE.TP.SW.01 (Nitric Acid Digestion and Direct Air Acetylene Flame Method); SM : 3030 E and 3111 B	0.100
21) Chromium hexavalent (Cr^{6+})	Extraction and Air-Acetylen Flame Method (SM : 3111 C)	0.100
22) Lead (Pb)	In-House Method UAE.TP.SW.01 (Nitric Acid Digestion and Direct Air Acetylene Flame Method); SM : 3030 E and 3111 B	0.100
23) Chromium (Cr)	In-House Method UAE.TP.SW.01 (Nitric Acid Digestion and Direct Air Acetylene Flame Method); SM : 3030 E and 3111 B	0.100
24) Total coliform bacteria	Multiple-Tube Fermentation Technique (SM : 9921 E)	1.8
25) Fecal coliform bacteria	Multiple-Tube Fermentation Technique (SM : 9921 B)	1

Notes: [1/]Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF 23rd Edition, 2017.

3.5.10.3 Study Results

(1) Secondary data

According to the Thai Pollution Situation Report, Pollution Control Department, 2018, marine water quality in the eastern region of 6 provinces (Samut Prakan, Chachoengsao, Chon Buri, Rayong, Chanthaburi and Trat), most of them (49%) were in good condition, 40% were fair, 8% were deteriorated, and 3% were very deteriorated, from the total collection points, respectively (Figure 3.5-32). Although most of the marine water quality is in good condition, in the past 4 years it was found that marine water quality has had a tendency to deteriorate since 2015. The areas with marine water quality continuously deteriorating, including the Chonburi Bay area, Chonburi province, which is the bay area with many shellfish farms, such as mussels, oysters, etc. The coast is densely urbanized (Mueang Chonburi area) at the end of Laem Chabang Port, Chonburi province, which is the opening area of the Bang Lamung Canal which handles wastewater from communities in Laem Chabang area flowing into to the sea and the coastal area of Samut Prakan Province.



Source : Thailand's Pollution Situation Report 2018, Pollution Control Department

Figure 3.5-32 Map showing the marine water quality of coastal waters in the eastern area during 2018

(2) Primary data

Results of the marine water quality measurement No. 1

Conducted measurements of marine water quality in the study area of the project at 6 points during the rainy season on 19 July 2019. The results of the analysis are shown in Table 3.5-32 (Details shown in Appendix 3-5). The results of the analysis can be summarized as follows:

1) SW1 : South of Runway 1, 300 meters from the coast

The results of the measurement of marine water quality at SW1 during the rainy season showed the pH 8.2, conductivity 50,720 µmhos/cm, transparency 1.5 m, turbidity 8.9 NTU, salinity 29.7 parts per thousand, dissolved oxygen 5.7 mg/l, BOD 0.7 mg/l, suspended solids 23.4 mg/l, total dissolved solids 36,360 mg/l. and nitrate-nitrogen 8.08 micrograms per liter. Oil, fats and phosphate-phosphorus were not detected.

The results of heavy metals and bacteria, found arsenic 0.985 micrograms per liter, zinc 3.08 micrograms per liter, copper 0.630 micrograms per liter, nickel 0.170 micrograms per liter, lead 0.760 micrograms per liter. The manganese, total mercury, cadmium, chromium hexavalent, lead and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the rainy season, the marine water quality in this area was within the standard specified in every index.

2) SW2 : South of Runway 2, 300 meters from the coast

The results of the measurement of marine water quality at SW2 during the rainy season showed the pH 8.3, conductivity 51,035 µmhos/cm, transparency 1.0 m, turbidity 18 NTU, salinity 29.8 parts per thousand, dissolved oxygen 5.8 mg/l, BOD 0.9 mg/l, suspended solids 34.7 mg/l, total dissolved solids 32,560 mg/l, nitrate-nitrogen 9.24 micrograms per liter and phosphate-phosphorus 0.30 micrograms per liter. Oil and fats were not detected.

The results of heavy metals and bacteria, found arsenic 0.805 micrograms per liter, manganese 0.301 micrograms per liter, zinc 2.16 micrograms per liter, copper 0.810 micrograms per liter, nickel 3.51 micrograms per liter, lead 0.810 micrograms per liter. The total mercury, cadmium, chromium hexavalent and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the rainy season, the marine water quality in this area was within the standard specified in every index.

3) SW3 : Southeast of Runway 2, 300 meters from the coast

The results of the measurement of marine water quality at SW3 during the rainy season showed the pH 8.3, conductivity 50,758 µmhos/cm, transparency 1.5 m, turbidity 6.3 NTU, salinity 29.7 parts per thousand, dissolved oxygen 5.7 mg/l, BOD 1.2 mg/l, suspended solids 13.6 mg/l, total dissolved solids 34,760 mg/l, nitrate-nitrogen 12.1 micrograms per liter and phosphate-phosphorus 0.60 micrograms per liter. Oil and fats were not detected.

The results of heavy metals and bacteria, found arsenic 0.643 micrograms per liter, zinc 1.55 micrograms per liter, copper 0.540 micrograms per liter, nickel 0.170 micrograms per liter, lead 0.150 micrograms per liter. The manganese, total mercury, cadmium, chromium hexavalent and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the rainy season, the marine water quality in this area was within the standard specified in every index.

4) SW4 : Southeast of Runway 1, 500 meters from the coast

The results of the measurement of marine water quality at SW4 during the rainy season showed the pH 8.2, conductivity 50,857 µmhos/cm, transparency 1.8 m, turbidity 3.7 NTU, salinity 29.8 parts per thousand, dissolved oxygen 5.7 mg/l, BOD 0.7 mg/l, suspended solids 7.9 mg/l, total dissolved solids 32,320 mg/l, nitrate-nitrogen 9.57 micrograms per liter and phosphate-phosphorus 1.19 micrograms per liter. Oil and fats were not detected.

The results of heavy metals and bacteria, found zinc 1.26 micrograms per liter, copper 0.540 micrograms per liter. The arsenic, manganese, total mercury, cadmium, nickel, chromium hexavalent, lead and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the rainy season, the marine water quality in this area was within the standard specified in every index.

5) SW5 : South of Runway 2, 500 meters from the coast

The results of the measurement of marine water quality at SW5 during the rainy season showed the pH 8.3, conductivity 50,277 µmhos/cm, transparency 1.8 m, turbidity 3.7 NTU, salinity 29.7 parts per thousand, dissolved oxygen 5.9 mg/l, BOD 0.5 mg/l, suspended solids 7.0 mg/l, total dissolved solids 35,860 mg/l. and nitrate-nitrogen 9.16 micrograms per liter. Oil, fats and phosphate-phosphorus were not detected.

The results of heavy metals and bacteria, found arsenic 0.556 micrograms per liter, manganese 0.760 micrograms per liter, zinc 7.54 micrograms per liter, copper 1.78 micrograms per liter, nickel 0.410 micrograms per liter, lead 0.790 micrograms per liter and chromium 1.63 micrograms per liter. The total mercury, cadmium, and chromium hexavalent were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the rainy season, the marine water quality in this area was within the standard specified in every index.

6) SW6 : Southeast of Runway 2, 500 meters from the coast

The results of the measurement of marine water quality at SW6 during the rainy season showed the pH 8.2, conductivity 50,241 µmhos/cm, transparency 2.0 m, turbidity 3.7 NTU, salinity 29.6 parts per thousand, dissolved oxygen 5.8 mg/l, BOD 0.8 mg/l, suspended solids 9.8 mg/l, total dissolved solids 35,200 mg/l, nitrate-nitrogen 18.8 micrograms per liter. Oil, fats and phosphate-phosphorus were not detected.

The results of heavy metals and bacteria, found zinc 1.16 micrograms per liter, copper 0.740 micrograms per liter and nickel 0.545. The arsenic, manganese, total mercury, cadmium, chromium hexavalent, lead and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the rainy season, the marine water quality in this area was within the standard specified in every index.

Table 3.5-32 Analysis of marine water quality during the rainy season on 19 July 2019[1/]

Index (Parameter)	Unit	Marine water quality								
		SW1	SW2	SW3	SW4	SW5	SW6	Marine water quality standards		
								Category 3	Category 4	Category 5
1) pH	-	8.2	8.3	8.3	8.2	8.3	8.2	7.0-8.5	7.0-8.5	7.0-8.5
2) Water temperature	degrees Celsius	30	30	30	30	30	30	The increase is not more than 1 °C of the natural value	with an increase of not more than 2°C from the natural temperature	with an increase of not more than 2°C from the natural temperature
3) Conductivity	micromohs per centimeter	50,720	51,035	50,758	50,857	50,277	50,241	-	-	-
4) Transparency	meters	1.5	1.0	1.5	1.8	1.8	2.0	The natural reduction is no more than 10% of the lowest transparency	The natural reduction is no more than 10% of the lowest transparency	The natural reduction is no more than 10% of the lowest transparency
5) Turbidity	NTU	8.9	18	6.3	3.7	3.7	3.7	-	-	-
6) Salinity	parts per thousand	29.7	29.8	29.7	29.8	29.7	29.6	The change is not more than 10% of the minimum salinity	The change is not more than 10% of the minimum salinity	The change is not more than 10% of the minimum salinity
7) Dissolved oxygen (DO)	milligrams per liter	5.7	5.8	5.7	5.7	5.9	5.8	Not less than 4	Not less than 4	Not less than 4
8) BOD	milligrams per liter	0.7	0.9	1.2	0.7	0.5	0.8	-	-	-
9) Suspended solid (SS)	milligrams per liter	23.4	34.7	13.6	7.9	7.0	9.8	-	-	-
10) Total dissolved solids (TDS)	milligrams per liter	36,360	32,560	34,760	32,320	35,860	35,200	-	-	-
11) Fat, Oil and Grease (Fat, Oil and Grease)	milligrams per liter	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	-	-	-
12) Nitrate-Nitrogen	micrograms per liter	8.08	9.24	12.1	9.57	9.16	18.8	Not more than 60	Not more than 60	Not more than 60
13) Phosphate-phosphorus (Phosphate-Phosphorus)	micrograms per liter	Not detected	0.30	0.60	1.19	Not detected	Not detected	Not more than 45	Not more than 45	Not more than 45

Table 3.5-32 Analysis of marine water quality during the rainy season on 19 July 2019[1/]

Index (Parameter)	Unit	Marine water quality								
		SW1	SW2	SW3	SW4	SW5	SW6	Marine water quality standards		
								Category 3	Category 4	Category 5
14) Arsenic (As)	micrograms per liter	0.985	0.805	0.643	Not detected	0.556	Not detected	Not more than 10	Not more than 10	Not more than 10
15) Manganese (Mn)	micrograms per liter	Not detected	0.310	Not detected	Not detected	0.760	Not detected	Not more than 100	Not more than 100	Not more than 100
16) Total mercury (Total Hg)	micrograms per liter	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not exceeding 0.1	Not exceeding 0.1	Not exceeding 0.1
17) Zinc (Zn)	micrograms per liter	3.08	2.16	1.55	1.26	7.54	1.16	Not more than 50	Not more than 50	Not more than 50
18) Cadmium (Cd)	micrograms per liter	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not more than 5	Not more than 5	Not more than 5
19) Copper (Cu)	micrograms per liter	0.630	0.810	0.540	0.540	1.78	0.740	Not more than 8	Not more than 8	Not more than 8
20) Nickel (Ni)	micrograms per liter	0.170	3.51	0.170	Not detected	0.410	0.545	-	-	-
21) Chromium hexavalent (Cr^{6+})	micrograms per liter	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not more than 50	Not more than 50	Not more than 50
22) Lead (Pb)	micrograms per liter	0.760	0.810	0.150	Not detected	0.790	Not detected	Not more than 8.5	Not more than 8.5	Not more than 8.5
23) Total Chromium (Total Cr)	micrograms per liter	Not detected	Not detected	Not detected	Not detected	1.63	Not detected	Not more than 100	Not more than 100	Not more than 100
24) Total coliform bacteria (Total coliform Bacteria)	MPN per 100 ml	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	Not more than 100 MPN per 100 ml	Not more than 100 MPN per 100 ml	Not more than 100 MPN per 100 ml
25) Fecal coliform bacteria (Fecal Coliform Bacteria)	CFU per 100 ml	<1	<1	<1	<1	<1	<1	Not more than 70 CFU per 100 milliliters	Not more than 100 CFU per 100 milliliters	Not more than 100 CFU per 100 milliliters

Note : (-) means no standard

[1/] Standards according to the Announcement of the National Environment Board Re: Determination of Marine Water Quality Standards (Announced on 13 October 2017)

Type 3 means marine water quality for aquaculture, including marine water that has been designated as an aquaculture area according to the fisheries law

Table 3.5-32 Analysis of marine water quality during the rainy season on 19 July 2019[1/]

Index (Parameter)	Unit	Marine water quality								
		SW1	SW2	SW3	SW4	SW5	SW6	Marine water quality standards		
								Category 3	Category 4	Category 5

Type 4 means marine water quality for recreational purposes, including marine water that has been designated as a swimming zone or for recreational use by the local administrative organizations

Type 5 means marine water quality for industry and ports, including marine water resources adjacent to industrial estates, according to the law on Industrial Estate Authority of Thailand; industrial zones, according to the law on factories; port areas, according to the law on navigation in Thai waters, ports or berth, as the case may be, with the boundary from the lowest tide line out to a distance of 1,000 meters along a horizontal line with the water surface.

Source : United Analyst and Engineering Consultants Co., Ltd. (Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

Results of the marine water quality measurement No. 2

The results of 6 points marine water quality measurements in the project study area, measured during dry season on 1 November 2019. The results of the analysis are shown in Table 3.5-33 and the results of the analysis are summarized as follows:

1) SW1 : South of Runway 1, 300 meters from the coast

The results of the measurement of marine water quality at SW1 during the dry season showed the pH 8.0, conductivity 48,750 µmhos/cm, transparency 2.5 m, turbidity 1.6 NTU, salinity 28.9 parts per thousand, dissolved oxygen 5.9 mg/l, BOD 1.3 mg/l, suspended solids 5.7 mg/l, total dissolved solids 31,640 mg/l, nitrate-nitrogen 2.06 micrograms per liter. Oil, fats and phosphate-phosphorus were not detected.

The results of heavy metals and bacteria, found arsenic 8.06 micrograms per liter, manganese 0.150 micrograms per liter, zinc 5.16 micrograms per liter, copper 0.340 micrograms per liter, nickel 0.410 micrograms per liter, and lead 0.850 micrograms per liter. The total mercury, cadmium, chromium hexavalent and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the dry season, the marine water quality in this area was within the standard specified in every index.

2) SW2 : South of Runway 2, 300 meters from the coast

The results of the measurement of marine water quality at SW2 during the dry season showed the pH 8.0, conductivity 49,250 µmhos/cm, transparency 2.5 m, turbidity 1.6 NTU, salinity 29.1 parts per thousand, dissolved oxygen 5.8 mg/l, BOD 1.3 mg/l, suspended solids 18.4 mg/l, total dissolved solids 29,740 mg/l and phosphate-phosphorus 36.1 micrograms per liter. Oil, fats and nitrate-nitrogen were not detected.

The results of heavy metals and bacteria, found zinc 6.85 micrograms per liter, copper 1.35 micrograms per liter, nickel 0.370 micrograms per liter and lead 1.81 micrograms per liter. The arsenic, manganese, total mercury, cadmium, chromium hexavalent and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the dry season, the marine water quality in this area was within the standard specified in every index.

3) SW3 : Southeast of Runway 2, 300 meters from the coast

The results of the measurement of marine water quality at SW3 during the dry season showed the pH 8.0, conductivity 49,500 µmhos/cm, transparency 3.0 m, turbidity 1.1 NTU, salinity 29.3 parts per thousand, dissolved oxygen 5.9 mg/l, BOD 1.6 mg/l, suspended solids 7.2 mg/l, total dissolved solids 32,940 mg/l and phosphate-phosphorus 11.6 micrograms per liter. Oil, fats and nitrate-nitrogen were not detected.

The results of heavy metals and bacteria, found manganese 1.11 micrograms per liter, zinc 6.29 micrograms per liter, copper 0.420 micrograms per liter, nickel 0.280 micrograms per liter and lead 0.820 micrograms per liter. The arsenic, total mercury, cadmium, chromium hexavalent and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the dry season, the marine water quality in this area was within the standard specified in every index.

4) SW4 : Southeast of Runway 1, 500 meters from the coast

The results of the measurement of marine water quality at SW4 during the dry season showed the pH 8.0, conductivity 48,800 µmhos/cm, transparency 3.0 m, turbidity 1.6 NTU, salinity 29.0 parts per thousand, dissolved oxygen 5.9 mg/l, BOD 1.2 mg/l, suspended solids 10.1 mg/l, total dissolved solids 31,580 mg/l, nitrate-nitrogen 0.73 micrograms per liter and phosphate-phosphorus 5.97 micrograms per liter. Oil and fats were not detected.

The results of heavy metals and bacteria, found zinc 4.31 micrograms per liter, copper 0.380 micrograms per liter, nickel 0.290 micrograms per liter, lead 0.910 micrograms per liter. The arsenic, manganese, total mercury, cadmium, chromium hexavalent and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of sea water quality standards 2017, it was found that during the dry season, the marine water quality in this area was within the standard specified in every index.

5) SW5 : South of Runway 2, 500 meters from the coast

The results of the measurement of marine water quality at SW5 during the dry season showed the pH 8.0, conductivity 49,000 µmhos/cm, transparency 3.0 m, turbidity 1.1 NTU, salinity 29.1 parts per thousand, dissolved oxygen 5.9 mg/l, BOD 1.2 mg/l, suspended solids 12.1 mg/l, total dissolved solids 32,460 mg/l, nitrate-nitrogen 1.27 micrograms per liter and phosphate-phosphorus 6.87 micrograms per liter. Oil and fats were not detected.

The results of heavy metals and bacteria, found manganese 0.820 micrograms per liter, zinc 4.00 micrograms per liter, copper 1.04 micrograms per liter, nickel 0.520 micrograms per liter and lead 0.790 micrograms per liter. The arsenic, total mercury, cadmium, chromium hexavalent and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the dry season, the marine water quality in this area was within the standard specified in every index.

6) SW6 : Southeast of Runway 2, 500 meters from the coast

The results of the measurement of marine water quality at SW6 during the dry season showed the pH 8.0, conductivity 49,400 µmhos/cm, transparency 3.0 m, turbidity 1.1 NTU, salinity 29.2 parts per thousand, dissolved oxygen 5.9 mg/l, BOD 1.4 mg/l, suspended solids 5.9 mg/l, total dissolved solids 34,460 mg/l and phosphate-phosphorus 4.78 micrograms per liter. Oil, fats and nitrate-nitrogen were not detected.

The results of heavy metals and bacteria, found zinc 4.68 micrograms per liter, copper 0.400 micrograms per liter, nickel 0.520 micrograms per liter and lead 0.625 micrograms per liter. The arsenic, manganese, total mercury, cadmium, chromium hexavalent and chromium were not found. Total coliform bacteria had less than 1.8 MPN per 100 ml and fecal coliform bacteria had less than 1 CFU per 100 ml.

When comparing the results of the analysis with marine water quality standards type 3, 4 and 5 according to the announcement of the National Environment Board on the determination of marine water quality standards 2017, it was found that during the dry season, the marine water quality in this area was within the standard specified in every index.

Table 3.5-33 Analysis of marine water quality during the dry season on 1 November 2019.

Index (Parameter)	Unit	Marine water quality								
		SW1	SW2	SW3	SW4	SW5	SW6	Marine water quality standards[1/]		
								Category 3	Category 4	Category 5
1) pH	-	8.0	8.0	8.0	8.0	8.0	8.0	7.0-8.5	7.0-8.5	7.0-8.5
2) Water temperature	degrees Celsius	29	30	30	29	30	30	The increase is not more than 1 °C of the natural value	The increase is not more than 2 °C of the natural value	The increase is not more than 2 °C of the natural value
3) Conductivity	micromohs per centimeter	48,750	49,250	49,500	48,800	49,000	49,400	-	-	-
4) Transparency	meters	2.5	2.5	3.0	3.0	3.0	3.0	The natural reduction is no more than 10% of the lowest transparency	The natural reduction is no more than 10% of the lowest transparency	The natural reduction is no more than 10% of the lowest transparency
5) Turbidity	NTU	1.6	1.6	1.1	1.6	1.1	1.1	-	-	-
6) Salinity	parts per thousand	28.9	29.1	29.3	29.0	29.1	29.2	The change is not more than 10% of the minimum salinity	The change is not more than 10% of the minimum salinity	The change is not more than 10% of the minimum salinity
7) Dissolved oxygen (DO)	milligrams per liter	5.9	5.8	5.9	5.9	5.9	5.9	Not less than 4	Not less than 4	Not less than 4
8) BOD	milligrams per liter	1.3	1.3	1.6	1.2	1.2	1.4	-	-	-
9) Suspended solid (SS)	milligrams per liter	5.7	18.4	7.2	10.1	12.1	5.9	-	-	-
10) Total dissolved solids (TDS)	milligrams per liter	31,640	29,740	32,940	31,580	32,460	34,460	-	-	-
11) Fat, oil and grease	milligrams per liter	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	-	-	-
12) Nitrate-Nitrogen	micrograms per liter	2.06	Not detected	Not detected	0.73	1.27	Not detected	Not more than 60	Not more than 60	Not more than 60
13) Phosphate-Phosphorus	micrograms per liter	Not detected	36.1	11.6	5.97	6.87	4.78	Not more than 45	Not more than 45	Not more than 45
14) Arsenic (As)	micrograms per liter	8.06	Not detected	Not detected	Not detected	Not detected	Not detected	Not more than 10	Not more than 10	Not more than 10

Table 3.5-33 Analysis of marine water quality during the dry season on 1 November 2019.

Index (Parameter)	Unit	Marine water quality								
		SW1	SW2	SW3	SW4	SW5	SW6	Marine water quality standards[1/]		
								Category 3	Category 4	Category 5
15) Manganese (Mn)	micrograms per liter	0.150	Not detected	1.11	Not detected	0.820	Not detected	Not more than 100	Not more than 100	Not more than 100
16) Total mercury (Total Hg)	micrograms per liter	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not exceeding 0.1	Not exceeding 0.1	Not exceeding 0.1
17) Zinc (Zn)	micrograms per liter	5.16	6.85	6.29	4.31	4.00	4.68	Not more than 50	Not more than 50	Not more than 50
18) Cadmium (Cd)	micrograms per liter	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not more than 5	Not more than 5	Not more than 5
19) Copper (Cu)	micrograms per liter	0.340	1.35	0.420	0.380	1.04	0.400	Not more than 8	Not more than 8	Not more than 8
20) Nickel (Ni)	micrograms per liter	0.410	0.370	0.280	0.290	0.520	0.295	-	-	-
21) Chromium hexavalent (Cr^{6+})	micrograms per liter	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not more than 50	Not more than 50	Not more than 50
22) Lead (Pb)	micrograms per liter	0.850	1.81	0.820	0.910	0.790	0.625	Not more than 8.5	Not more than 8.5	Not more than 8.5
23) Total Chromium (Total Cr)	micrograms per liter	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not more than 100	Not more than 100	Not more than 100
24) Total coliform bacteria	MPN per 100 ml	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	Not more than 100 MPN per 100 ml	Not more than 100 MPN per 100 ml	Not more than 100 MPN per 100 ml
25) Fecal coliform bacteria	CFU per 100 ml	<1	<1	<1	<1	<1	<1	Not more than 70 CFU per 100 milliliters	Not more than 100 CFU per 100 milliliters	Not more than 100 CFU per 100 milliliters

Note : (-) means no standard is defined

[1/] Standards according to the Announcement of the National Environment Board Re: Determination of Marine Water Quality Standards (Announced on 13 October 2017)

Type 3 means marine water quality for aquaculture, including marine water that has been designated as an aquaculture area according to the fisheries law

Type 4 means marine water quality for recreational purposes, including marine water that has been designated as a swimming zone or for recreational use by the local administrative organizations

Type 5 means marine water quality for industry and ports, including marine water resources adjacent to industrial estates, according to the law on Industrial Estate Authority of Thailand; industrial zones, according to the law on factories; port areas, according to the law on navigation in Thai waters, ports or berth, as the case may be, with the boundary from the lowest tide line out to a distance of 1,000 meters along a horizontal line with the water surface.

Table 3.5-33 Analysis of marine water quality during the dry season on 1 November 2019.

Index (Parameter)	Unit	Marine water quality								
		SW1	SW2	SW3	SW4	SW5	SW6	Marine water quality standards[1/]		
								Category 3	Category 4	Category 5

Source : United Analyst and Engineering Consultants Co., Ltd. (Private Analytical Laboratory, Registration No. W-145, ISO/IEC 17025)

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