3.6 Biological environment Resources

3.6.1 Terrestrial Ecology

3.6.1.1 Forest Resources

(1) Scope of Study

Construction and operation of the project may cause impacts to forest resources in the project area and in the area surrounding the U-Tapao International Airport area, especially near nature conservation areas. Therefore, basic information must be studied in order to consider environmental impacts and to determine measures to prevent and correct impacts on terrestrial ecology activities.

(2) Research Method

1) Secondary data

- Inspect documents and check the status of the area for conservation according to the law of project area and study area from the map specifying the National Reserved Forest, wildlife sanctuary, national park and other conservation areas located in the project area and study area, information geographic information system, Forest Department, and Department of National Parks, wildlife, and plants.
- Study and collect documents related to forest conditions, plants, both at the overview level of the province, project area and study area. Aerial photograph showing the nature of land use in the study area. Details of the activities of the project that will affect plants in the project area and study area to support the data collection plan.

2) Primary data

Basic area survey to study topography conditions, forest type/plant society, including the nature of land use in the current state of the project area, with consideration of data available from the map, topography conditions, satellite photos, or aerial photograph, as well as geographic information system such as Google Earth, by recording plant species that appear in the project study area

- **Survey area** conduct the survey of forest resources, in the outskirts of U-Tapao International Airport, and area around the airport.
- **Duration of survey**: survey of forests 2 times: survey no. 1 during 19-22 July 2019 and no. 2 between 15-18 November 2019
- **Index surveyed and analyzed** such as species of plant.

(3) Results of the Study

1) Secondary data

1.1) Rayong Forest Resources

Rayong has area of 3,665.29 square kilometers or 2,291,003.80 Rai is the province with the least forest resources in the east. Rayong in 2017 has forest area of 182,892.55 rai or 7.98% of the province area (**Figure 3.6-1**). There is a forest ecosystem in Khao Ang Rue Nai Wildlife Sanctuary, Khao Chamao-Khao Wong National Park, Khao Laem Ya-Mu Ko Samet National Park and preparation area The Natakhwan Non-Hunting Area consists of moist evergreen forests, hill evergreen forests, dry evergreen forests, limestone mountain forests, and beach forests which found spread from the flat floor to an altitude of about 800 meters, consisting of important plants such as *Diospyros malabarica* (Desr.) Kostel), *Adenanthera pavonina*, *Diospyros kaki* L.f.), *Baccaurea ramiflora* Lour.), *Caesalpinia cucullata* Roxb., *Irvingia malayana* Oliv. ex a. Benn., *Falconeria insignis* Royle., *Acalypha spiciflora*, *Canarium subulatum* Guillaumin, *Chukrasia tabularis* A.Juss., *Litsea Petiolata* L took.F. Hook.f., *Bauhinia saccocalyx* Pierre, *Croton oblongifolius* Roxb.), *Lagerstroemia calyculata Kurz.*, *Syzygium cumini* (L.) Skeels.,*Afzelia xylocarpa* (Kurz) Craib..*Peltophorum dasyrrhachis* (Miq.) Kurz), *Fernandoa adenophylla* (Wall. ex G.Don) Steenis, *Ficus carica* L., *Mangifera caloneura* Kurz., *Caryota urens*, *Phalaenopsis finleyi* Christenson.), etc. In the lower area, rattan and plants of the ginger family are found. The area at an altitude of more than 800 meters or more is covered by the evergreen forest which has important plant species such as *Garcinia hanburyi* Hook.f., *Castanopsis acuminatissima* Rehd., *Memecylon edule* Roxb.), *Symplocos racemosa* Roxb., *Calophyllum soualattri* Burm. f., *Lithocarpus ceriferus*, etc. The beach forest covers the sea coast, the species found such as *Thespesia populnea* (L.) Sol. ex Correa., *Streblus asper* Lour., *Xylocarpus rumphii* (Kostel.) Mabb., *Terminalia catappa*,*Casuarina equisetifolia* L., *Pandanus odoratissimus* L.f., *Ipomoea pes-caprae* (L.) R. Br.), etc.

1.2) Changes in forest resources of Rayong province

According to the forest statistics of the Forest Land Management Office, Forest Department, it was found that the area of Rayong has steadily declined since 2013 until present. In 2017, forest areas were found 182,892.55 rai, or 7.98 percent of the province area, which has decreased since 2016, which had forest areas of 188,196.38 rai, or 8.21 percent of the province area as detail shown in **Table 3.6-**1.

Table 3.6-1 Forest areas in Rayong compared to forest areas in the East and entire forest areas in the country.

Year	Rayong		Eastern Region		Whole countries	
	Rai	Percentage	Rai	Percentage	Rai	Percentage
2013	196,527.18	8.58	5,139,024.84	22.45	102,119,539.57	31.57
2014	176,427.14	7.70	5,076,313.56	22.18	102,285,400.62	31.62
2015	182,276.53	7.96	5,091,779.16	22.25	102,240,981.84	31.60
2016	188,196.38	8.21	5,107,774.29	22.32	102,174,805.09	31.58
2017	182,892.55	7.98	5,113,613.42	22.34	102,096,350.53	31.58
2018	185,410.63	8.09	5,126,835.05	22.40	102,488,302.19	31.68

Notes: Rayong area 2,291,003.80 rai

Source: Information Center Office of Planning and Information, Forest Department, 2019

- Eastern region area 60,048,349.14 rai
- Country area 323,528,699.65 rai

1.3) Conservation areas

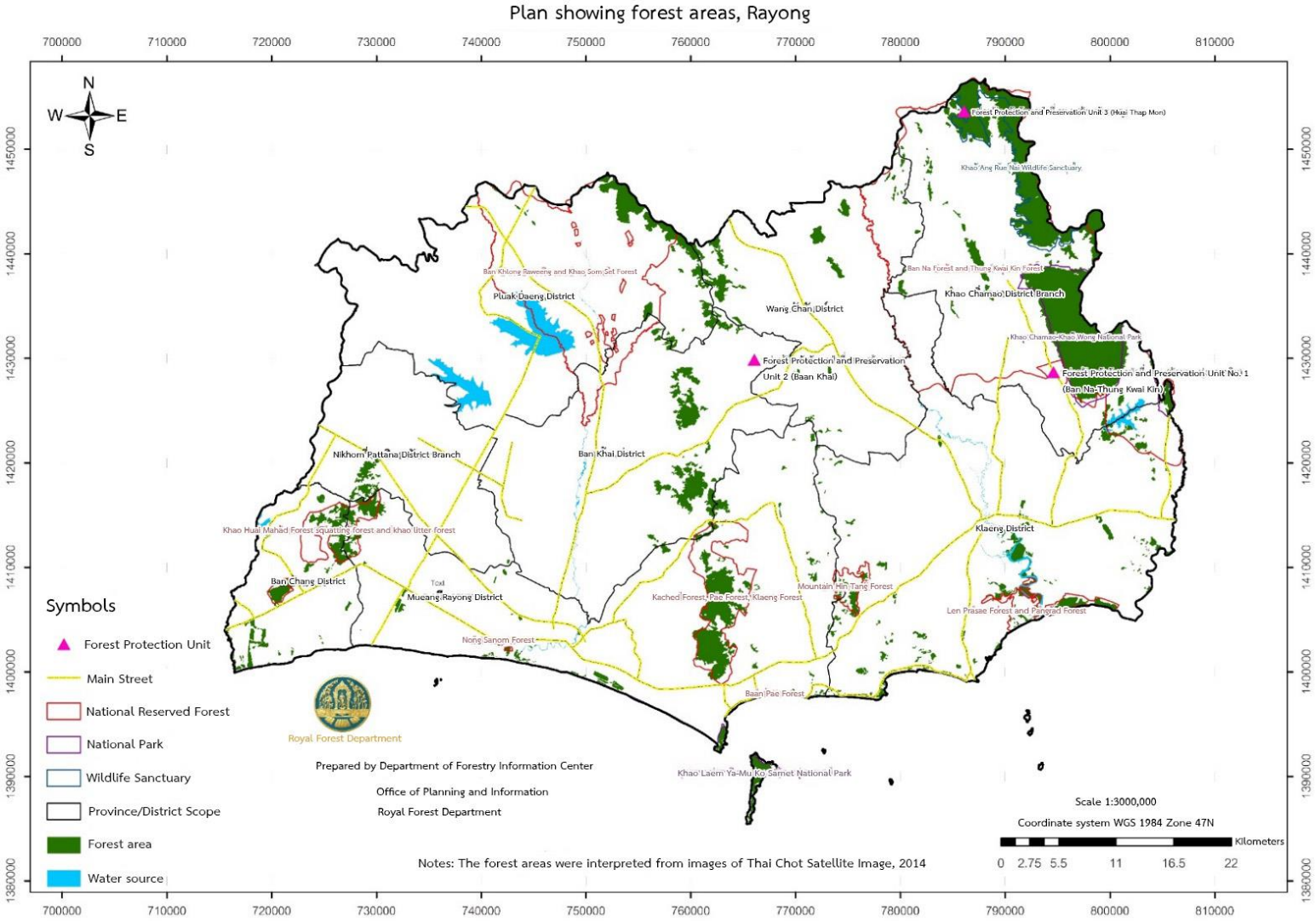
The collection of various types of conservation areas covering Rayong province are as follows:

1. The National Forest in Rayong Province contains 8 sites for the total of 513,743 rai. The list of the national forests of Rayong Province is shown in **Table 3.6-2**

2. Two national parks in Rayong Province, which have been announced by the Royal Decree Vol. 92, Section 267, dated 31 December 1975, are Khao Chamao-Khao Wong National Park with the area of 52,300 rai,, and Khao Laem Ya National Park - Koh Samet, with the area of 81,875 rai, announced in the Government Gazette, Volume 98, Section 162 dated 1 October 1981, with total area of 134,175 rai.

3. Wildlife Sanctuary, Rayong Province has 1 wildlife sanctuary, which is Khao Ang Rue Nai Wildlife Sanctuary published in the Government Gazette, Volume 94, Section 95, dated October 11, 1977, with a total area of 674,352 rai.

In areas nearby of construction projects, runway and driveway 2, U-Tapao International Airport within the study area, it was found a forested national area, Khao Huai Mahad National Reserved Forest, Nang Yong Forest and Khao Krok Forest, Ban Chang Subdistrict, Samnak Thon Subdistrict, Phala Subdistrict, Ban Chang District, and Huai Pong Subdistrict, Mueang District, Rayong Province.



Source: Department of Forestry Information Center Office of Planning and Information, Forest Department, 2014

Figure 3.6 1 Forest area conditions, Rayong

Table 3.6□2 National Forest in Rayong

Sequence No.	Name list	Area		Area according to ministerial regulation (rai)	ministerial regulation No.	Government Gazette
		Subdistrict	District			
1	Ka Chet Forest, Pae Forest and Klaeng Forest	Ka Chet, Ta Pong, Baan Lang Na Ta Kwan, Klaeng, Pae, Chak Bok	City: Ban Khai	28,937	36 (1964)	Volume 81, Section 124, 31 December 1964
2	Huai Ma Had Forest, Khao Nang Yong Forest and Khao Krok Forest	Huai Pong, Samnak Ka thon, Ban Chang , Phala	Mueang, Ban Chang	17,811	1,018 (1983)	Volume 100, Section 190, 6 December 1983
3	Khlong Raweng Forest - Khao Somsed	La Harn, Ta Sith, Pluak Daeng, Nong Bua	Ban Khai, Pluak Daeng	137,500	1,156 (1986)	Volume 103 Section 61, 16 April 1986
4	Baan Na Forest and Thung Kwai Kin Forest	Baan Na, Kra Sae Bon, Thung Kwai Kin	Klaeng	313,500	18 (1964)	Volume 81, Section 124, 31 December 1964
5	Baan Pae Forest	Pae, Klaeng	Mueang	625	39 (1959)	Volume 76, Section 71, 14 July 14 1959
6	Phu Kao Hin Tang Forest	Kachet, Chak Pong, Chak Don	Mueang Klaeng	5,700	831 (1979)	Volume 96, Section 44, 27 March 1979
7	Lane Prasae Forest and Pang Rad Forest	Nam Prasae Forest, Pang Rad, Nern Kho Thang Kwian	Klaeng	9,090	36 (1958)	Volume 75, Section 82, 21 October 2501
8	Nong Sanom Forest	Nern Phra	Mueang	580	143 (1962)	Volume 79, Section 109, 11 December 1962
Total				**513,743**		

Source: Information Center Office of Planning and Information, Forest Department, 2017

1.4) Forest Ecology in Khao Huai Mahad National Reserved Forest, Nang Yong Forest and Khao Krok Forest

According to the permission to study or research academic studies, the National Forest area, Khao Huai Mahad forest, the Khao Nung Yong forest, and the Khao Krok forest, as shown in**the Annex 3-6** and the results from the survey from January 27 to 31 2018 and April 19-24, 2018, the area of Khao Krok Ta Bak, which is a s mountain in the northeast of Utapao International Airport, surrounded by agricultural areas (cassava plantation , field crops and rubber)) and communities. The general condition was the area with Leucaena leucocephala de wit which was outstanding coverage and replaced the damaged forest area. There were other types of perennials mixed with some. It was a community area of dry evergreen forest mixed with giant acacia which appeared as a narrow line not less than 92 species of plants found as shown in **Table 3.6-3.**

Table 3.6 3 List of forests that surveyed the mountain of Grogtak Baghing in the National Reserve area, Khao Yuma Khao, Sai forest, Khao Rayong forest, and Khew forest

Sequence	Thai Name	Scientific Name	Family Name	Plant Characteristics	Restricted wood type
1	Ruellia Tuberosa	*Hygrophila erecta* Hochr.	Acanthaceae	H	-
2	Globe Amaranth	*Gomphrena celosioides* Mart	Amaranthaceae	H	-
3	Stachytarpheta jamaicensis	*Achyranthes aspera* L.	Amaranthaceae	H	-
4	Olives	*Spondias pinnata* Kurz	Anacardiaceae	T	-
5	White Cheesewood	*Alstonia scholaris* R. Br.	Apocynaceae	T	A
6	Wrightia arborea	*Wrightia arborea* (Dennst.) Mabb.	Anacardiaceae	ST	-
7	Crown Flower	*Calotropis gigantea*	Asclepiadaceae	ExS/ST	-
8	Karen Wood	*Markhamia stipulata* Seem. var. *stipulata*	Bignoniaceae	T	-
9	Papaya	*Carica papaya* L.	Caricaceae	ExST	-
10	Peach Cedar	*Trema orientalis* (L.) Blume.	Cannabaceae	ST	-
11	Cleome viscosa Linn	*Cleome viscosa* L.	Capparaceae	H	-
12	Coccinia grandis	*Coccinia grandis* Voigt	Cucurbitaceae	C	-
13	Bitter Gourd	*Momordica charantia* L.	Cucurbitaceae	C	-
14	Trichosanthes tricuspidata Lour	*Diplocyclos palmatus* (L.) C.Jeffrey	Cucurbitaceae	C	-
15	Operculina turpethum	*Aniseia martinicensis* (Jacq.) Choisy	Convolvulaceae	C	-

Table 3.6-3 List of forests that surveyed the mountain of Grogtak Baghing in the National Reserve area, Khao Yuma Khao, Sai forest, Khao Rayong forest, and Khew forest

Sequence	Thai Name	Scientific Name	Family Name	Plant Characteristics	Restricted wood type
16	Morning glory	*Ipomoea aquatica* Forssk.	Convolvulaceae	CrH	-
17	Bush willows	*Combretum quadrangulare* Kurz	Combretaceae	T	-
18	Philippine almond	*Terminalia calamansanai* (Blanco) Rolfe.	Combretaceae	T	-
19	Billygoat-weed	*Blumea aurita* (L.f.) DC.	Compositae	H	-
20	Siam Weed	*Chromolaena odoratum* (L.) R.M.King & H.Rob.	Compositae	ExH	-
21	Mikania cordata	*Mikania cordata* (Burm.f.) B.L.Rob.	Compositae	C	-
22	Vernonia cinereaLess	*Vernonia cinerea* (L.) Less.	Compositae	H	-
23	Bo Tree	*Diospyros ehretioides* Wall. Ex G. Don	Ebenaceae	T	-
24	Ebony	*Doispyros rhodocalyx* Kurz.	Ebenaceae	T	A
25	Ebony Tree	*Diospyros mollis* Griff.	Ebenaceae	T	-
26	Indian gooseberry	*Phyllanthus emblica* L.	Euphorbiaceae	ST	-
27	Croton persimilis Müll.Arg	*Croton persimilis* Mül.Arg.	Euphorbiaceae	T	-
28	Cassava	*Manihot esculenta* (L.) Crantz	Euphorbiaceae	ExS/ST	-
29	Garden spurge	*Euphorbia hirta* L.	Euphorbiaceae	H	-
30	Night Jasmine	*Phyllanthus reticulatus* Poir.	Euphorbiaceae	S	-
31	Chamber bitter	*Phyllanthus urinaria* L.	Euphorbiaceae	H	-
32	Acapulo	*Cassia alata* L.	Fabaceae	ExS	-
33	Pea bean	*Macroptilium lathyroides* (L.) Urb.	Fabaceae	C	-
34	West Indian Cherry	*Flacourtia rukam* Zoll. & Mor.	Flacourtiaceae	T	-
35	Ramontchi	*Flacourtia indica* (Burm.f.) Merr.	Flacourtiaceae	ST	-
36	Hydnocarpus ilicifolius King	*Hydnocarpus ilicifolia* King	Flacourtiaceae	T	-
37	Gnetum montanum Markgr	*Gnetum Montanum* Markgr.	Gnetaceae	C	-
38	Knotroot foxtail	*Setaria geniculata* Beauv.	Gramineae	G	-
39	Bamboo grass	*Thysanoleana maxima* Kuntze	Gramineae	G	-

Table 3.6-3 List of forests that surveyed the mountain of Grogtak Baghing in the National Reserve area, Khao Yuma Khao, Sai forest, Khao Rayong forest, and Khew forest

Sequence	Thai Name	Scientific Name	Family Name	Plant Characteristics	Restricted wood type
40	Goose grass	*Digitaria ciliaris* (Retz.) Koel	Gramineae	G	-
41	Red sprangletop	*Leptochloa chinensis* Nees	Gramineae	G	-
42	Lalang	*Imperata cylindrica* (L.) P.Beauv.	Gramineae	G	-
43	Goose grass	*Brachiaria distachya* Stapf	Gramineae	G	-
44	Desho grass	*Penisetum polystachyon* (L.) Schult.	Gramineae	G	-
45	Vetiver grass	*Vetiveria zizanioides* (L.) Nash ex Small	Gramineae	G	-
46	Indochinese milla	*Vitex canescens* Kurz.	Labiatae	T	-
47	Sindora siamensis Teijsm	*Sindora siamensis* Teijsm. ex Miq.	Leguminosae-Caesalpinioideae	T	-
48	Iron nudges	*Senna siamea* (Lam.) Irwin & Barneby		T	-
49	Golden shower	*Cassia fistula* Linn.		T	A
50	Flam-boyant	*Delonix regia* Raf.		T	-
51	Tamarind	*Tamarinddus indica* L. *ExT*		ExT	-
52	Orchid tree	*Bauhinia glauca* (Wall.ex Benth.) Benth.		C	-
53	White popinac/Lead tree	*Leucaena leucocephala* de Wit	Leguminosae-Mimosoidea	S/ST	-
54	Khrai Yoi	*Parkia sumatrana* Miq.		T	-
55	Phellinus linteus	*Acacia harmandiana* (Pierre) Gagnep.		ST	-
56	Manila tamarind	*Pithecellobium dulce* (Roxb.) Benth.		ExT	-
557	Earleaf arcacia	*Acacia auriculiformis* A.Cunn. ex Benth.		ExT	-
58	White siris	*Albizia procera* (Roxb.) Benth.		T	A
59	Rain tree	*Albizia lebback* (L.) Benth		T	-
60	Benth	*Albizia odoratissima* (L.f.) Benth.		T	A
61	Sensitive plant	*Mimosa pudica* L.		H	-

Table 3.6-3 List of forests that surveyed the mountain of Grogtak Baghing in the National Reserve area, Khao Yuma Khao, Sai forest, Khao Rayong forest, and Khew forest

Sequence	Thai Name	Scientific Name	Family Name	Plant Characteristics	Restricted wood type
62	Burmese Padauk	*Pterocorpus macrocarpus* Kurz.	Eguminosae-Papilionoideae	T	A
63	Butterfly pea	*Clitoria macrophylla* Wall.		C	-
64	Thai bungor	*Lagerstroemia tomentosa* C.Presl	Lythraceae	T	-
65	Mango parasites	*Dendrophthoe pentandra* (L.) Miq	Loranthaceae	PaS	-
66	Siamese neem tree	*Azadirachta indica* Juss. var. *siamensis* Valeton	Meliaceae	T	A
67	Memecylon ovatum	*Memecylon ovatum* Sm.	Melastamotaceae	S/ST	-
68	Toothbrush tree	*Streblus asper* Lour.	Moraceae	T	-
69	Streblus ilicifolius	*Streblus ilicifolius* (Vidal) Corner	Moraceae	S/ST	-
70	Monkey jack	*Artocarus lacucha* Roxb.	Moraceae	T	-
71	Banyan	*Ficus annulata* Bl.	Moraceae	T	-
72	Bothi tree	*Ficus religiosa* Linn.	Moraceae	ExT	-
73	Species of a tree	*Ficus superba* (Miq.) Miq. var. *superba*	Moraceae	T	-
74	Black plum	*Syzygium cumini* Druce	Myrtaceae	T	-
75	Eucalyptus	*Eucalyptus global bill*.	Myrtaceae	T	-
76	Casearia grewiifolia	*Horsfieldia macrocoma* Warb.	Myristicaceae	T	-
77	Scarlet fruit passionflower	*Passiflora foetida* Linn.	Passifloraceae	HC	-
78	Jujube	*Zizyphus mauritiana* Lamk.	Rhamnaceae	ST	-
79	Jackal jujube	*Ziphus oenopolia* (L.) Mill.	Rhamnaceae	S	-
80	Freshwater mangrove tree	*Carallia brachiata* (Lour.) Merr.	Rhizophoreceae	T	-
81	Fragrant Ixora	*Pavetta indica* L.	Rubiaceae	S	-
82	Faver vine	*Paederia linearis* Hook. f.	Rubiaceae	HC	-
83	Acronychia pedunculata	*Acronychia pedunculata* (L.) Miq.	Rutaceae	ST	-
84	Lupine	*Cardiospermum halicacabum* Linn.	Sapindaceae	HC	-
85	Lepisanthes rubiginosa Leenh	*Lepisanthes rubiginosa* (Roxb.) Leenh.	Sapindaceae	ST	-

Table 3.6-3 List of forests that surveyed the mountain of Grogtak Baghing in the National Reserve area, Khao Yuma Khao, Sai forest, Khao Rayong forest, and Khew forest

Sequence	Thai Name	Scientific Name	Family Name	Plant Characteristics	Restricted wood type
86	Hogweed	*Adenosma hirsutum* Kurz	Scrophulariaceae	H	-
87	Po khi kai	*Helicteres angustifolia* L.	Sterculiaceae	S	-
88	Tetrameles tedifora	*Tetrameles tedifora* R.Br.	Tetramelaceae	T	-
89	Grewia eriocarpa Juss	*Grewia eriocarpa* Juss.	Tiliaceae	T	-
90	Galanga	*Alpinia galanga* (L.) Wild.	Zingiberaceae	ExH	-
91	Cloth of gold	*Lantana camara* L.	Verbenaceae	ExC	-
92	Virginia creeper	*Cissus carnosa* Roxb.	Vitaceae	C	-

Notes : AgH : Aquatic Herb, herbaceous plant that lives in water Ex : Exotic from overseas.
B : Bamboo ExT : Exotic Tree, foreign perennials
C : Climber, Vine, Ivy S/ST : Shrub/Shrubby Tree, light and small shrubs
G : Grass including various sedge ST : The small tree stump, small perennials
H : Herb, herbaceous plant HC : Herbaceous Climber, herbaceous vine
P : Palm, Betel Nut, or Palm PaHC Palm: Parasitic Herbal Climber, Biennial vine parasitic
S : Shrub, bramble Pas : Parasitic Shrub, bush parasitic
T : Tree, herbaceous plant US : Undershrub, small shrubs
CP : Climbing Palm, Betel nut or palm that has climbing habits
CrH : Creeping Herb, a herbaceous plant that winds down to soil, rock or tree trunks.
Restricted wood type: Type A Restricted wood, ordinary restricted wood under the Royal Decree regarding of restricted wood, 1987, as defined by the Forest Act of 1941

2) Primary data

According to the field survey of forest resources in the project area, details are as follows:

2.1) Ecological condition in the project area

According to the inspection of documents and information from related government agencies, it was found that in the construction area of the runway and driveway 2, U-Tapao International Airport, there is no overlapping area with conservation areas or national forest reserves. From the land use data, it was found that presently, there is no forest preserved area in the area. Most of the area is a vacant lot with growing trees. In the area still remains a large tree with a diameter of 40 centimeters that is the original tree in the area, including *Parinari anamensis*, *Mangifera caloneura* Kurz., *Pterospermum diversifolium* Blume, *Azadirachta indica* A. Juss.)i. The southern part of the seafront area is spread along the beach, namely *Hibiscus tiliaeus* L.,*Hibiscus tiliaceus* L.). In addition to agricultural areas in the northern part of the area, this is an area that used to be built before, but now it has become a wasteland with dense vegetation. Plant species found are*Trama orientalis* (L). Blume, *Peltophorum dasyrrhachis* (Miq.) Kurz), *Leucaena leucocephala*

(Lam.) de Wit), *Streblus asper* Lour, *Acacia auriculaeformis* A.Cunn. ex Benth. Details are shown in **Table 3.6-**4 and **Figure 3.6-2**

Table 3.6-4 List of wooden plants surveyed in the study project area

Thai Name	Scientific Name	Family Name	Characteristics Wood varieties	Category Restricted wood	Project area				Study area of the project			
					Large wood	Fruits	Seedling	Other	Large wood	Fruits	Seedling	Other
Hydnocarpus ilicifolius King	*Hydnocarpus ilicifolia* King	Achariaceae	ST	A					x	x	x	
Wild mango	*Mangifera caloneura* Kurz	Anacardiaceae	T	A	x				x	x	x	
Broken bone tree	*Oroxylum indicum* (L.) Kurz	Bignoniaceae	ST	-					x			
Garuga pinnata	*Garuga pinnata* Roxb.	Burseraceae	T	A					x	x		
Maerua siamensis	*Maerua siamensis* (Kurz) Pax	Capparaceae	T	-	x				x			
Australian pine	*Casuarina equisetifolia* J.R. & G. Forst.	Casuarinaceae	T	-					x	x		
Ma Pok	*Parinari anamensis* Hance	Chrysobalanaceae	T	A	x							
Bush willows	*Combretum quadrangulare* Kurz	Combretaceae	T	-	x				x			
Iron wood	*Hopea odorata* Roxb.	Dipterocarpaceae	T	A					x			
Burmese sal	*Shorea siamensis* Miq.	Dipterocarpaceae	T	A					x			
Monkey-faced tree	*Mallotus philippensis* (Lam.) Müll. Arg.	Euphorbiaceae	S/T	-					x			
Croton roxburghii	*Croton roxburghii* N.P. Balaker.	Euphorbiaceae	S/ST	-					x			
Earleaf arcacia	*Acacia auriculaeformis* A.Cunn. ex Benth.	Fabaceae	ExT	-	x				x	x		
Giant Acacia	*Leucaena leucophala* (Lam.) de Wit.	Fabaceae	S/ST	-	x	x	x		x			
Iron wood	*Xylia xylocarpa* (Roxb.) W. Theob. var.*kerrii* (Craib & Hutch.) I. C. Nielsen	Fabaceae	T	A					x			
Burmese padauk	*Pterocarpus macrocarpus* Kurz	Fabaceae	T	A								x
Siamese rosewood	*Dalbergia cochinchinensis* Pierre	Fabaceae	T	A					x	x	x	
Red sandol wood tree	*Adenanthera pavonina* L.	Fabaceae	T	A	x				x			

Table 3.6-4 List of wooden plants surveyed in the study project area

Thai Name	Scientific Name	Family Name	Characteristics Wood varieties	Category Restricted wood	Project area				Study area of the project			
					Large wood	Fruits	Seedling	Other	Large wood	Fruits	Seedling	Other
Afzelia	*Afzelia xylocarpa* (Kurz) Craib	Fabaceae	T	A					x	x	x	
Copper pod	*Peltorum dasyrrhachis* (Miq.) Kurz	Fabaceae	T	A					x			
Sa Vong	*Vitex limonifolia* Wall. ex Walp.	Lamiaceae	T	A					x			
Teak	*Tectona grandis* L. f.	Lamiaceae	T	A								
Queen's flower	*Lagerstroemia floribunda* Jack	Lythraceae	T	A								
Thai bungor	*Lagerstroemia tomentosa* C.Presl	Lythraceae	T	A					x			
Coast cotton tree	*Hibiscus tiliaceus* L.	Malvaceae	S/ST	-	x							
Microcos tomentosa	*Microcos tomentosa* Sm.	Malvaceae	T	-		x			x			
Portia tree	*Hibiscus tiliaceus* L.	Malvaceae	S/ST	-	x				x			
Lam Pang	*Pterospermum diversifolium* Blume	Malvaceae	T	A	x				x			
Almond-wood	*Chukrasia tabularis* A. Juss.	Meliaceae	T	A					x			
Siamese neem tree	*Azadirachta indica* A. Juss.	Meliaceae	T	A	x							
Toothbrush tree	*Streblus asper* Lour.	Moraceae	T	-	x				x	x		
Monkey jack	*Artocarpus lacucha* Roxb.ex Buch.-Ham.	Moraceae	T	A					x			
Black plum	*Syzygium cumini* (L.) Skeels	Myrtaceae	T	-								
Bamboosa	*Thyrsostachys siamensis* Gamble	Poaceae	B	-								
Bridal couch tree	*Hymenodictyon orixense* (Roxb.) Mabb.	Rubiaceae	T	-					x			
Type of bush	*Zolingeria dongnaiensis* Pierre	Sapindaceae	T	-					x			
Spanish cherry	*Mimusops elengi* L.	Sapotaceae	T	A					x			
Java olive tree	*Sterculia foetida* L.	Sterculiaceae	T	-					x	x	x	

Table 3.6-4 List of wooden plants surveyed in the study project area

Thai Name	Scientific Name	Family Name	Characteristics Wood varieties	Category Restricted wood	Project area				Study area of the project			
					Large wood	Fruits	Seedling	Other	Large wood	Fruits	Seedling	Other
Peach cedar	*Trema orientalis* (L.) Blume	Ulmaceae	ST	-		x			x			
Total			**39**	**21**	**12**	**3**	**1**	**-**	**31**	**9**	**5**	**1**

Note : x is the species found in the survey.

Wood varieties: B : Bamboo, Bamboo S : Shrub, Bramble S/ST: Shrub/Shrubby Tree, small semi-evergreen shrub : Shrub/Tree: semi-evergreen shrub ST: Shrubby Tree small semi-evergreen shrub ST/T : Shrubby Tree/Tree, semi-small perennial T : Tree, Perennial

Restricted wood type: **Type A Restricted wood, ordinary restricted wood under the Royal Decree regarding of restricted wood, 1987, as defined by the Forest Act of 1941**

Figure 3.6 2 Ecological condition in project area

2.2) Ecological condition in the study area of the project

In the study area of the project, some areas on the north side of the project are in the Khao Huai Mahad National Forest Reserve, Khao Nang Yong Forest and Khao Krok Forest. According to the land use data and Thailand's forest species database for 2017-2018, it was found that there are still some preserved forest areas in the area, especially in the area that is in the territory of Khiri Phawanaram Temple which still retains the original plants in the area, including, namely *Pterocarpus macrocarpus* Kurz, *Tectona grandis* L. f., *Hopea odorata* Roxb., *Afzelia xylocarpa* (Kurz) Craib, *Dalbergia cochinchinensis* Pierre, *Artocarpus lacucha* Roxb.ex Buch.-Ham, *Lagerstroemia floribunda* Jack), *Mangifera caloneura* Kurz, *Xylia xylocarpa* (Roxb.) W. Theob. var. *kerrii* (Craib & Hutch.) I. C. Nielsen,*Oroxylum indicum* (L.) Kurz,*Shorea siamensis* Miq., *Garuga pinnata* Roxb., *Hymenodictyon orixense* (Roxb.) Mabb., *Chukrasia tabularis* A. Juss. This shows that in the past this forest reserve was a dry evergreen forest. But from the survey in the field, it was found that the forest area outside the temple was a natural regeneration forest. The plants that were surveyed were the predominant plants in the area is *Leucaena leucocephala* (Lam.) de Wit. The rest are the plants found in regenerating forest such as *Croton roxburghii* N.P. Balaker., *Peltophorum dasyrrhachis* (Miq.) Kurz, *Acacia auriculaeformis* A.Cunn. ex Benth.,*Streblus asper* Lour.,*Microcos tomentosa* Sm.), etc, as shown in **Figure 3.6-3**

Natural regeneration forest on the top of Khao Krok Tabaek in the area of Khiri Bhavanaram Temple

Natural regeneration forest on the top of Khao Krok Tabaek in the area of Khiri Bhavanaram Temple

Original plants in the area of Khiri Phawanaram Temple

Natural regeneration forest on the top of Khao Krok Tabaek in the area of Khiri Bhavanaram Temple

Figure 3.6-3 Forest conditions and plants in the areas of Khiri Bhavanaram Temple

The green areas found in naval area and airport areas are all planted forest areas, with plants including *Acacia auriculaeformis* A.Cunn. ex Benth.) and *Pterocarpus macrocarpus* Kurz. In addition to the plants that are planted, there are also plants that grow naturally as well such as*Lagerstroemia tomentosa* C.Presl), *Lagerstroemia floribunda* Jack, *Microcos tomentosa* Sm.,*Trema orientalis* (L.) Blume, *Streblus asper* Lour., etc. The green area around the beach, sea pines are planted *Casuarina equisetilifolia* J.R. & G. Forst sporadically. Inaddition, the green areas of Khao Phlu Ta Luang were also found, which was previously an old mine, and was restored by finding mostly planted wood, such as *Acacia auriculaeformis* A.Cunn. ex Benth, etc., details are shown in **Table 3.6-**4 Survey Route and Condition of the area surrounding the project area as shown in **Figure 3.6-5**

Figure 3.6-4 Forest area conditions in the study area

Figure 3.6□5 Guidelines for exploring forest resources and wildlife in the project area

3.6.1.1 Wildlife resources

(1) Scope of Study

Conducted 4 studies of wildlife resources in accordance with the Environmental Impact Assessment Guidelines, the Transport Project Categories, 2006 and according to the Wildlife Preservation and Protection Act,1992 such as Aves, Mammals, Reptiles and Amphibians by study of the type, abundance, food sources and the current status of wildlife in the project area and surrounding area of U-Tapao International Airport.

(2) Research Method

1) Secondary data

- Collect secondary data on wildlife resources, by emphasizing on only aves, from the related study report, which are
  - Statistical data from report of a bird crash into a plane according to the International Civil Aviation Organization (ICAO) form
  - Summary of survey results for bird hazard assessment at U-Tapao Rayong-Pattaya International Airport, 2018

2) Primary data

Survey all 4 wildlife groups in project area and nearby by exploring 2 seasons: rainy season, between 15-17 July 2019 and 19-22 July 2019 and dry season (migration season), between 15-18 November 2019 and 18-20 December 2019.

- **Survey Method**

  Collecting data from inquiries of local communities surrounding the project area in order to know the information of wildlife species that have ever been seen by processing from the characteristics of wildlife such as color, carcass, food source, habitat and interesting behavior. The results of the interviews provided information on wildlife species that were not directly searched for because some wildlife is less abundant and hiding or moving at all times or finding food at night. A direct search with a limited time period didn't find anything. The inquiry covered hunting and wildlife species that are consumed or used in the daily life of the local community which is used as supplementary information for planning further field surveys which there are 2 survey methods as follows,

  - Direct Count Survey uses trekking in the study area along the survey line to cover the study area and observe animal types using double-eye cameras. When animals are exposed, then record types and frequency of encounters with each type of wildlife to assess the relative abundance level.
  - Indirect Count Survey explores traces of wildlife left over, such as footprints, cavities, nests, droppings, hairs, stains, etc. In animals with

specific vocals, such as birds or some amphibian animals, relying on listening its sounds in classification.

- **The survey equipment** uses a two-eye 8x32 camera, a 20-60-X telescope, and a camera with a maximum expansion of 600 millimeters for wildlife recording and general conditions of the survey area.
- **Survey area**, explore wildlife resources outside of U-Tapao International Airport aviation area and area surrounding airport.
- **Classification** Classify and validate of each type of wildlife, and the taxonomic rank in the wildlife roster table for each group is documented as follows.
  - Mammals use John (2003), Lekagul and McNeely (1977), Corbet and Hill (1992), Wilson and Reeder (1993), Frances (2001), Frances (2008) and IUCN (2019).
  - Aves use Jaruchint, et al. (2018), Robson (2002) and IUCN (2019).
  - Reptiles use Taylor (1963, 1965, 1970), Cox (1991), Cox et al. (1998), and Pough et al. (2001) and IUCN (2019)
  - Amphibians use Tanya (2003), Frost (2000), Pough et al. (2001) and Frost et al. (2006) and IUCN (2019)

- **Abundance**, Wild animal abundance assessment by using the frequency of encounters with each species of wild animals was calculated as the relative abundance according to Pettingill's method (1970) as follows,

$$\text{Relative abundance} = \frac{\text{Number of animals encounters} \times 100}{\text{Number of surveys}}$$

  The derived values were evaluated as 3-level of abundance, i.e., high abundance, moderate abundance, and low abundance, using the criteria of (1) high abundance, i.e., the species found in surveys are very frequent and the relative abundance was 67-100 percent; (2) moderate abundance, i.e species found in relatively few surveys and has a relative abundance of 34-66%; and (3) less abundant, i.e. species found in rare surveys and have a relative abundance of 1-33% and including the species obtained from the questionnaire.
- **Status,** assessing wildlife status by classify as legal status, conservation status, and seasonal status (Aves), with the following details:
  - Legal Status: According to the Wildlife Preservation and Protection Act, 2019, the status of wildlife is divided into 3 categories, namely, Reserved Animals, meaning rare wildlife or endangered wildlife is necessary. It must be preserved and preserved in the strict accordance with this Act and Protected Animal means that wildlife that is important to the ecosystem or the population of that species has a tendency to decrease, which may affect the ecosystem as

provided for in this Act. For species that are not listed on both lists, they are classified as wild animals that are not protected by law (Non-Protected Animal).

- Conservation status is classified as wildlife status, which is determined by the Thailand Red Data list of the Office of Natural Resources and Environmental Policy and Planning (ONEP) 2017, which considers the wildlife of Thailand under threat conditions (Threatened) in Thailand and the use of the International Union for Conservation of Nature and Natural Resources (IUCN), which considers wildlife under the conditions of global threat and is the standard accepted by the International and Thailand as follows:
  - Extinct (EX)
  - Extinct in the Wild (EW)
  - Critically Endangered (CR)
  - Endangered (EN)
  - Vulunerable (VU)
  - Near threatened (NT)
  - Least Concern (LC)
  - Data Deficiency (DD)
- Aves Seasonal status improved according to Lekagul & Round 1991 rating, divided into 5 categories, i.e.
  - Residents (R) is a type found all year round, or nesting, laying eggs in Rayong or nearby areas.
  - Winter Visitor (W) is a type that does not create nests and lay eggs in Thailand or has been relocated for a period of time.
  - Passage Migrant (P) is a bird that passes into the area or takes a short break of 1-3 days and then travels further.
  - A bird that has relocated into the area to create nests, laying eggs only in the rainy season (Breeding Visitor : B)
  - Imported birds from overseas or birds escape from cage(Introduced : I)

(3) Results of the Study

1) Secondary data

1.1) The wildlife conditions in area of Khao Huai Mahad National Forest Reserve, Khao Nang Yong forest and Khao Krok Forest

According to the survey during 27-31 January 2018 and 19-24 April 2018, no less than 120 wildlife were found in the study area from 23 orders, 64 families , 98 genus, divided into 11

mammal species, 85 aves species, 17 reptile species, and 7 amphibian species, as shown in **Table 3.6-**5 and **Figure 3.6-**6 as follows:

Table 3.6-5 Various species of wildlife surveyed in the study area

Category	Order	Family	Genus	(Species)
Mammals	6	7	10	11
Aves	15	45	66	85
Reptiles	1	8	15	17
Amphibians	1	4	7	7
Total	**23**	**64**	**98**	**120**

Source: Based on field surveys by Navy Counselors, 27-31 January 2018 and 19-24 April, 2018

- **Mammals** 11 species, 6 orders, 7 families and 10 genus were found, such as *Pipistrellus javanicus*, *Macaca fascicularis*, *Sus scrofa*, *Cllosciurus caniceps*, *Menetes berdmorei*, *Rattus rattus*, *Tupaia belangeri*, *Herpestes javanicus*, etc. In addition, by inquiring people in nearby area, *Macaca fascicularis*were found which had habitat in forest area on the west side of project area.
- **Aves** are the largest number and most diverse groups, with 85 species being discovered from 15 orders, 45 families, 66 genus. Most commonly found in agricultural area, communities, rubber plantation, waste areas, and forest areas, etc. It is divided into 71 species of Residents, such as *Acridotheres tristis*, *Coracias benghalensi*), *Rhipidura javanica*, *Pycnonotus blanfordi*, *Corvus macrorhynchos*,*Gallus gallus*,*Streptopelia chinensis*,*Geopelia striata*,*Tyto alba*), (*Vanellus indicus*, *Megalaima lineata*, etc. And there are 11 species of Winter Visitor such as *Anastomus oscitans*, *Charadrius alexandrius*, *Ardeola bacchus*, *Bubulcus ibis* and *Tringa hypoleucos*, etc.

- Reptiles are found from the survey as 17 species, 1 order from 8 families and 15 genus, which are reptiles in Squamata order such as *Calotes versicolor Ptyas korros*, *Naja kaouthia*, *Xenochrophis flavipunctatus*, *Mabuya multifasciata*, *Python reticulatus*, *Varanus salvator*, *Varanus nebulosus*, *Cosymbotus platyurus*, *Gekko gecko* and *Leiolepis belliana*.
- Amphibian are found from survey as 7 species from 1 order, 4 families, 7 genus. Wild animals in this group are animals that live in various water sources, along canals, marshlands, and areas that are still moist. Most of them are animals in the frog family (Ranidae) such as *Hoplobatrachus rugulosa*, *Kaloula pulchra*, *Polypedates leucomystax*, *Rana erythraea* and *Duttaphrynus melanostictus*, etc.

1.2) Hazard from aves assessment at U-Tapao International Airport

According to the summary report, the results of the bird hazard assessment at U-Tapao Rayong- Pattaya International Airport from 21-22 February 2018, the period from 6am to 9pm, the study of aves species and the physical characteristics of the airport that result in drawing the birds close to the runway, which may cause them to crash birds while take-off and landing at the airport.

- **Aves species**

Runway, Taxiway, Apron, and outside aviation area survey found 43 aves species, such as *Anastomus oscitans, Columba livia*, *Egretta garzetta*, *Microcarbo niger*, *Vanellus indicus*, *Streptopelia tranquebarica*, *Geopelia striata*, *Cypsiurus balasiensis*, *Coracias benghalensis*, *Pycnonotus conradi*, *Acridotheres tristis*, *Acridotheres grandis*, *Passer montanus*, *Passer flaveolus*, *Anthus rufulus*,etc. Details are shown in **Table 3.6-**6**.**

Installation of wildlife cameras

Sus scrofa

Tamiops rodolphi

Mentates berdmorei

Gallus gallus

Saxicola caprata

Centropus sinensis

Accipiter badius

Figure 3.6 6 Species of wildlife from surveys conducted during 27–31 January 2018 and 19-24 April 2018

Elanus caeruleus

Ergretta sacra

Ashy wood swallow (*Artamus fuscus*)

Dicrurus leucophaeus

Anthus rufulus

Ptyas korros

Chrysoplea ornata

Calotes vericor

Figure 3.6-6Species of wildlife from surveys conducted during 27–31 January 2018 and 19-24 April 2018

Table 3.6 6 Report on results of aves survey at U-tapao International Airport, 2018

Sequence	Common Name	Scientific Name	Weight (grams)	Behavior	Airport abundance	Food
1	Asian Openbill	*Anastomus oscitans*	1,800	Walk slowly on the water to the area to feed by finding cherry scallop in shallow water sources.	Moderate	Cherry scallops, small aquatic animals
2	Chinese Pond-Heron	*Ardeola bacchus*	400	Stand still by the water, waiting to catch a small aquatic life, or walk to find insects along the lawn to eat.	Moderate	Small aquatic animals, insects, worms
3	Intermediate Egret	*Ardea intermedia*	1,000	Stand still with your neck stretched out, looking for fish and small aquatic creatures. and then rushed out of his mouth to grab it quickly.	Slightly	Small aquatic animals
4	Little Egret	*Egretta garzetta*	600	Tricky mixed with other egrets, eat fish and small aquatic animals by walking on the ground to make the prey startled to catch and eat.	Moderate	Small aquatic animals, worms, insects
5	Little Cormorant	*Microcarbo niger*	800	Perched on branches along the water's edge, keeping an eye out for fish and small marine life. When found preys, it dived down to catch them.	Slightly	Fish and small aquatic animals
6	Black-shouldered Kite	*Elanus caeruleus*	500	Flying, searching for food along groves, fields and area near water sources.	High	Small birds, frogs, cuddly, reptiles
7	Shikra	*Accipiter badius*	270	Usually found flying along trees to change the mount waiting for the bait, like to catch large insects and reptiles.	Slightly	Small reptiles, large insects
8	White-breasted Waterhen	*Amaurornis phoenicurus*	250	Walking in the thickets of overgrown aquatic plants Likes to come out in the open water in the morning and evening.	Slightly	Insects, small aquatic animals

Table 3.6 6 Report on results of aves survey at U-tapao International Airport, 2018

Sequence	Common Name	Scientific Name	Weight (grams)	Behavior	Airport abundance	Food
9	Red-wattled Lapwing	*Vanellus indicus*	150	Usually walks as open, alternating with stop insects and small animals, along the lawn.	Moderate	Insects and small aquatic animals
10	Kentish Plover	*Charadrius alexandrinus*	60	Found as a small group, prefers running on the ground to eat food.	High	Insects and small aquatic animals
11	Rock Pigeon	*Columba livia*	400	Live on the buildings, human buildings, smother along each other in herds and eat seeds.	High	Seeds
12	Red Turtle Dove	*Streptopelia tranquebarica*	90	Live on the trees and find seeds on the ground.	Moderate	Seeds
13	Spotted Dove	*Spilopelia chinensis*	120	Live on the trees and find seeds on the ground.	Moderate	Seeds
14	Zebra Dove	*Geopelia striata*	80	Live on trees and seek for the seeds of plants on the ground in small swarms.	Slightly	Seeds
15	Pink-necked Green bird Pink-necked Pigeon	*Treron vernans*	150	Flying fluently between trees in the forest.	Slightly	Fruits
16	Greater Coucal	*Centropus sinensis*	390	Often hides in the overgrown trees, walk on the ground and fly a short distance.	Slightly	Small animals, worms, carcasses
17	Common Koel	*Eudynamys scolopaceus*	500	Tricky alone or in pairs on the densely leafed tree and swooped down a large tree.	Slightly	Fruits
18	Burn Owl	*Tyto javanica*	900	During the day time, mount for rests on trees or buildings that have shade and goes out to eat at night.	Moderate	Rodents and small animals
19	Asian Palm Swift (Asian Palm-Swift)	*Cypsiurus balasiensis*	12	Flying to eat insects in the air.	High	Insects in the air

Table 3.6 6 Report on results of aves survey at U-tapao International Airport, 2018

Sequence	Common Name	Scientific Name	Weight (grams)	Behavior	Airport abundance	Food
20	Swiftlet (Common Swift)	*Apus nipalensis*	15	Flying as a herd in an open space to catch insects in the air.	High	Insects in the air
21	Indian roller Indian roller	*Coracias Benghalensis*	200	Usually live in an open field, mount on the wooden perch to catches the bait on the ground or chases in the air.	Moderate	Small reptiles
22	Ashy wood swallow (Ashy Woods-wallow)	*Artamus fuscus*	80	Usually found flying in the middle of the sky and crowded together along the top of the trees.	High	Insects in the air
23	*Merops orientalis* Green Bee-eater	*Merops orientalis*	70	Live in dry area, like to stick on open plants to look for baits and fly to eat insects.	Slightly	Insects
24	Coppersmith barbet Coppersmith Barbet	*Psilopogon haemacephalus*	55	Found alone or on a couple, on a treetop and squeaking continuously.	Slightly	Fruits
25	Brown shrike (Brown Shrike)	*Lanius cristatus*	70	Like to look for prey in open spaces or lunges at trees by hovering from the mount to eat prey.	Moderate	Small animals
26	Black drongo (Black Drongo)	*Dicrurus macrocercus*	75	Found in open spaces, clinging to tree branches, hovering from the perch, catching prey in the air.	Moderate	Insects in the air
27	Ashy Drongo (Ashy Drongo)	*Dicrurus leucophaeus*	75	Usually found on open branches looking for insects , once found, will fly to catch their victims in the air	Slightly	Insects in the air
28	Pied Fantail Pied Fantail	*Rhipidura javanica*	20	Usually found alone or in couple, jumping and eating along trees.	Slightly	Insects
29	Large-billed Crow	*Corvus macrorhynchos*	700	Live in human habitats	Slightly	Plants or meat
30	*Pycnonotus goiavier*	*Pycnonotus goiavier*	70	Live on tree in brake	Moderate	Fruits

Table 3.6 6 Report on results of aves survey at U-tapao International Airport, 2018

Sequence	Common Name	Scientific Name	Weight (grams)	Behavior	Airport abundance	Food
	(Yellow-VENTED Bulbul)					
31	Streak-eared Bulbul (Streak-eared Bulbul)	*Pycnonotus conradi*	70	Live on tree in brake	Moderate	Fruits
32	Barn Swallow (Barn Swallow)	*Hirundo rustica*	15	Flying in the air to eat bait	High	Insects in the air
33	Common Tailorbird Common Tailorbird	*Orthotomus sutorius*	10	Found along shrubs, jumping and eating along branches	Slightly	Insects
34	Common Myna (Common Myna)	*Acridotheres tristis*	100	Usually co-exist in herds and jumping around the streets, eating a lot of food, including human food scraps.	Moderate	Insects, worms Seeds
35	Great myna (White-vented Myna)	*Acridotheres grandis*	100	Usually co-exist in herds and makes a loud noise, especially when sleeps together by mounting in the evening.	Moderate	Insects, worms Seeds
36	Eurasian Tree Sparrow (European Tree-Sparrow)	*Passer montanus*	20	Commonly found in small herds, feeding on the ground, eating both plants and insects.	Very much	Seeds
37	Plained-backed Sparrow (Plain-backed Sparrow)	*Passer flaveolus*	20	Usually found in small herds, feeding on the ground and fly up to mount on tree.	Slightly	Seeds
38	Baya Weaver (Baya Weaver)	*Ploceus philippinus*	15	Frequently found flying as herd along fields, eating rice and rice seeds	Slightly	Seeds

Table 3.6 6 Report on results of aves survey at U-tapao International Airport, 2018

Sequence	Common Name	Scientific Name	Weight (grams)	Behavior	Airport abundance	Food
				falling on the ground, nesting together on the trees.		
39	Scaly-breasted Munia (Scaly-breasted Munia)	*Lonchura punctulata*	18	Usually found eating in meadows and rice fields, eating grains that falls on the ground.	Slightly	Seeds
40	Anthus refulus (Richard's Pipit)	*Anthus rufulus*	20	Feeding along the lawn and the open area by walking and running to pecking insects on the ground.	Moderate	Insects
41	Black Velcro (Black Baza)	*Aviceda leuphotes*	230	Usually fly in large herd, like to mount on open branches and hover Catch the bait on the trees.	Low	Small animals
42	Spotted Owl Spotted Owlet	*Athene brama*	600	Commonly found in the city, daytime, holding on hollow or shaded trees The night came out to catch the bait in open area.	Low	Small animals
43	Barred Buttonquail (Barred Buttonquail)	*Turnix suscitator*	70	Live and feed on the lawn, along the break.	Slightly	Insects

Source : Airport Standards and Safety Department, Airports of Thailand Public Company Limited, Summary of Bird Hazard Assessment Survey at U-Tapao Rayong-Pattaya International Airport, 2018

- **Aves Crashed by Aircraft Statistics**

According to the record of aves crashed data from January 2017 to July 2019, it was found that the average number of bird aircraft accidents was less than once per month. The highest crash statistics occurred in 2017 for 9 times. According to the data, the highest crashed statistics month was in December. This season, which caused the birds to migrate into the area of U-Tapao Internation Airport, with the majority of bird accidents occurring while landing making it impossible to identify the species can only inspect the carcasses of birds that have landed in the area of U-Tapao International Airport, details as shown in **Figure Table 3.6-7.**

From the inspection of the bird's remains after the accident was reported, the bird remains mostly found were small birds or birds that were feeding in a herd. Some of the bird remains were not found, such as *Hirundo rustica*, *Aerodramus germani*, *Passer montanus*, *Vanellus indicus*, *Anthus rufulus*, etc., as shown in **Figure 3.6-7**.

Table 3.6 7 Statistics of the birds crashed by aircraft, U-Tapao International Airport between 2017-2019

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (times)
2017	1	1	0	0	1	2	1	0	0	0	0	3	**9**
2018	1	0	0	0	1	0	0	0	0	0	0	0	**2**
2019	1	1	0	1	0	0	1	-	-	-	-	-	**4**
Total (times)	**3**	**2**	**0**	**1**	**2**	**2**	**2**	**0**	**0**	**0**	**0**	**3**	**15**

Note : (-) means no data available.

Source: Bird crash statistics, U-Tapao Airport, 2019

For the comparison of total flight volumes and crash record data in each month between 2017-2018, it was found that in 2017 the total number of bird aircraft accidents was 1.12 percent. The percentage statistics of the highest crash in December was 0.42 percent and in 2018, the total number of crash was 0.15 percent. The statistics of the highest crash percentage in May was 0.09 percent, detail as shown in **Table 3.6-8**

Table 3.6-8 Comparison of total number of flights and crash record data between 2017-2018

Month	Year 2017			Year: 2018		
	Number of flights (one way)	Birds crashed by aircraft (times)	Percentage	Number of flights (one way)	Birds crashed by aircraft (times)	Percentage
Jan	765	1	0.13	1,561	1	0.06
Feb	696	1	0.14	1,528	0	0.00
Mar	963	0	0.00	1,561	0	0.00
Apr	1,068	0	0.00	1,254	0	0.00
May	937	1	0.11	1,144	1	0.09
Jun	892	2	0.22	1,117	0	0.00
Jul	1,024	1	0.10	1,187	0	0.00
Aug	1,069	0	0.00	1,224	0	0.00
Sep	967	0	0.00	1,079	0	0.00
Oct	675	0	0.00	1,228	0	0.00
Nov	649	0	0.00	1,357	0	0.00
Dec	710	3	0.42	1,518	0	0.00
Total	**10,415**	**9**	**1.12**	**15,758**	**2**	**0.15**

Source: U-Tapao Airport, 2019

Hirundo Russian

German's Swiftlet (*Aerodramus germani*)

German's Swiftlet (*Aerodramus germani*)

Eurasian Tree Sparrow (*Passer montanus*)

Vanellus indicus

Anthus rufulus

Figure 3.6 7 Bird Species from avian accidents

2) Primary data

2.1) Results of field survey, 1st time (r rainy season)

The 1st survey of wildlife resources in project study areas during the rainy season during 15-17 July 2019 and between 19-22 July 2019, 98 wildlife species, consisting of 4 species of mammals, 82 species of aves, 7 species of reptiles, and 5 species of amphibians, survey area was divided into 2 areas, namely project areas and study project areas and study project areas, detail as follows:

Project area

Survey results of wildlife resources on the project area during rainy season found 69 species of wildlife, consisting of 3 species of mammals, including of *Callosciurus finlaysonii*, *Menetes berdmorei* and *Tamiops macclellandii*, 60 species of aves such as *Anastomus oscitans*, *Microcarbo niger*, *Ploceus philippinus*, *Columba livia*, *Pycnonotus conradi*, *Acridotheres tristis*, *Artamus fuscus*, *Geopelia striata*, *Elanus caeruleus*, 4 species of reptiles, i.e. *Calotes versicolor*, *Hemidactylus platyurus*, *Leiolepis belliana*, *Varanus salvator* and 2 species of amphibians, i.e. *Microhyla mukhlesuri*, *Fejervarya limnocharis* as shown in **Figure 3.6-**8 and **Table 3.6-**9.

Study area of the project

Survey results from wildlife resources in the study area during the rainy season found 94 species of wildlife, consisting of 4 species of mammals, including of *Callosciurus finlaysonii*, *Menetes berdmorei*, *Tamiops macclellandii*, *Hipposideros* sp., 78 species of aves such as *Corvus macrorhynchos*, *Ardea alba*, *Himantopus himantopus*, *Centropus sinensis*, *Athene brama*, *Merops orientalis*, *Dicrurus paradiseus*, etc. 7 species of reptiles such as *Calotes versicolor*, *Xenochrophis flavipunctatus*, *Gekko gecko*, etc. and 5 species of amphibians such as *Hoplobatrachus rugulosus*, *Duttaphrynus melanostictus*, *Kaloula pulchra*, etc., as shown in **Figure 3.6-**8 and **Table 3.6-**9.

Saxicola caprata

Mirafra erythrocephala

Vanellus indicus

Anastomus oscitans

Merops orientalis

Pycnonotus aurigaster

Accipiter badius

Callosciurus finlaysonii

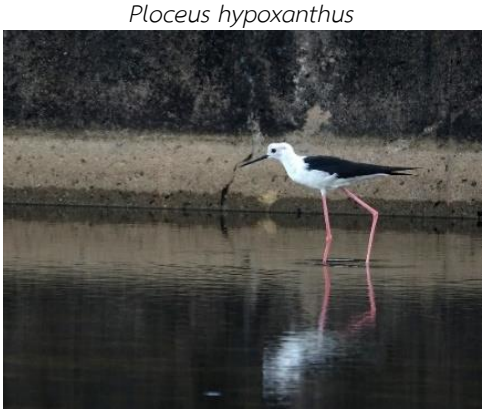
Figure 3.6 8 Wild animals found in project area (rainy season)

Halcyon smyrnensis

Pycnonotus goiavier

Ploceus hypoxanthus

นกสีชมพูสวน (*Dicaeum cruentatum*)



Himantopus himantopus

Glareola maldivarum

Athene brama

Calotes vericolor

Figure 3.6-8 Wild animals found in project area (rainy season)

Table 3.6-9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
	Amphibians											
	Anura Order											
	Bufonidae Family											
1	*Duttaphrynus melanostictus*	Asian common toad	-	LC	LC	-	x	-	x	x	N	P
	Microhylidae Family											
2	*Kaloula pulchra*	House bullfrog	-	LC	LC	-	x	-	x	x	N	N
3	*Microhyla mukhlesuri*	Ornate Narrow-mouthed Frog	-	LC	LC	-	x	x	x	x	N	N
	Dicroglossidae Family											
4	*Fejervarya limnocharis*	Swamp frog	-	LC	LC	-	x	x	x	x	N	P
5	*Hoplobatrachus rugulosus*	Chinese edible frog	-	LC	LC	-	-	-	x	x	-	N
	Total of 5 types of amphibian species											
	Reptiles											
	Squamata order											
	Gekkonidae Family											
1	*Hemidactylus platyurus*	flat-tailed house gecko	-	LC	-	-	x	x	x	x	N	M

Table 3.6-9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
2	*Gekko gecko*	House gecko	-	LC	-	-	x	-	x	x	N	N
	Agamidae											
3	*Calotes versicolor*	Red headed chameleon	C	LC	-	-	x	x	x	x	N	P
4	*Leiolepis belliana*	Leiolepis	-	LC	-	-	x	x	-	x	N	N
	Varanidae Family											
5	*Varanus salvator*	Common Water Monitor	C	LC	LC	-	x	x	-	x	N	N
	Natricidae Family											
6	*Xenochrophis flavipunctatus*	Painted keelbacks	-	LC	LC	-	x	-	x	x	N	N
	Colubridae Family											
7	*Chrysopelea ornata*	The Green Snake	-	LC	-	-	x	-	x	x	N	N
	Total of 7 reptile species											
	Aves											
	Caprimulgiformes Order											
	Caprimulgidae Family											
1	*Caprimulgus macrurus*	Long-tailed stork	C	LC	LC	R	-	-	x	x	-	N
2	*Caprimulgus asiaticus*	Small stork	C	LC	LC	R	-	-	x	x	-	N
	Apodidae Family											

Table 3.6□9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
3	*Aerodramus germani*	Germain's Swiftlet	C	LC	LC	R	x	x	x	x	N	P
4	*Cypsiurus balasiensis*	Asian palm swift	C	LC	LC	R	x	x	x	x	N	N
5	*Apus nipalensis*	Swiftlet	C	LC	LC	R	-	x	-	x	N	N
	Cuculiformes Order											
	Cuculidae Family											
6	*Centropus sinensis*	Great wagtail	C	LC	LC	R	x	x	x	x	P	N
7	*Centropus bengalensis*	Wagtail	C	LC	LC	R	-	x	x	x	P	P
8	*Phaenicophaeus tristis*	Green-billed Malkoha	C	LC	LC	R	x	x	x	x	N	N
9	*Eudynamys scolopaceus*	Cuckoo	C	LC	LC	R	x	x	x	x	N	N
10	*Cacomantis merulinus*	Plaintive cuckoo	C	LC	LC	R	-	x	-	x	N	N
	Columbiformes Order											
	Columbidae Family											
11	*Columba livia*	Wildly Pigeon	-	LC	LC	R	x	x	x	x	M	M
12	*Streptopelia tranquebarica*	Red turtle dove	C	LC	LC	R	x	x	x	x	P	P
13	*Spilopelia chinensis*	Spotted dove	-	LC	LC	R	x	x	x	x	M	P
14	*Chalcophaps indica*	Grey-capped Emerald Dove	C	LC	LC	R	x	x	-	x	N	N

Table 3.6-9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
15	*Geopelia striata*	Zebra dove	-	LC	LC	R	x	x	x	x	M	M
16	*Treron vernans*	Pink-necked Green Bird	C	LC	LC	R	x	-	x	-	N	P
17	*Treron curvirostra*	Thick-billed Green-pigeon	C	LC	LC	R	x	-	x	-	N	N
	Gruiformes Order											
	Rallidae Family											
18	*Amaurornis phoenicurus*	White-breasted waterhen	C	LC	LC	R	x	-	x	x	N	N
19	*Gallicrex cinerea*	Watercock	C	NT	LC	R	x	-	-	-	N	-
	Galliformes Order											
	Phasianidae Family											
20	*Coturnix coromandelica*	Rain quail	C	LC	LC	R	-	-	-	x	-	N
21	*Francolinus pintadeanus*	Chinese Francolin	C	LC	LC	R	-	-	-	x	-	N
22	*Gallus gallus*	Jungle fowl	C	LC	LC	R	x	-	x	-	N	N
	Charadriformes order											
	Turnicidae Family											
23	*Turnix suscitator*	Barred Buttonquail	C	LC	LC	R	x	-	-	-	N	-

Table 3.6-9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
	Recurvirostridae Family											
24	*Himantopus himantopus*	Black-winged Stilt	C	LC	LC	W	-	-	-	x	-	N
	Charadriidae Family											
25	*Vanellus indicus*	Red-wattled Lapwing	C	LC	LC	R	x	x	x	x	M	N
26	*Charadrius alexandrinus*	Kentish Plover	C	LC	LC	W	-	-	x	-	-	N
	Scolopocidae Family											
27	*Actitis hypoleucos*	Black-capped Kingfisher	C	LC	LC	W	-	-	x	-	-	N
28	*Tringa glareola*	Wood Sandpiper	C	LC	LC	W	-	-	x	-	-	N
	Glareolidae Family											
29	*Glareola mldivarum*	Oriental Pratincole	C	LC	LC	B	-	-	-	x	-	N
	Burhinidae Family											
30	*Burhinus indicus*	Indian thick knee	C	NT	LC	R	-	-	x	-	-	N
	Ciconiiformes											
	Ciconiidae Family											
31	*Anastomus oscitans*	Openbill stork	C	LC	LC	R	x	x	x	x	P	P
	Suliformes Order											
	Phalacrocoracidae Family											

Table 3.6-9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
32	*Microcarbo niger*	Little cormorant	C	LC	LC	R	x	x	-	x	N	N
	Pelecaniformes Order											
	Ardeidae Family											
33	*Ixobrychus sinensis*	Yellow Bittern	C	LC	LC	R	x	x	-	x	N	N
34	*Ixobrychus cinnamomeus*	Cinnamon bittern	C	LC	LC	R	-	-	x	x	-	N
35	*Ardeola bacchus*	Chinese Pond-heron	C	LC	LC	W	x	-	x	-	N	N
36	*Ardea alba*	Great White Egret	C	LC	LC	W	x	-	x	x	N	N
37	*Ardea intermedia*	Intermediate Egret	C	LC	LC	W	-	x	x	-	N	N
38	*Egretta garzetta*	Little egret	C	LC	LC	R	x	x	x	x	N	N
39	*Ardea purpurea*	Purple heron	C	VU	LC	R	-	-	x	-	-	N
40	*The Buttorides triala*	Little heron	C	LC	LC	R	-	x	-	x	N	N
	Falconiformes Order											
	Falconidae Family											
41	*Falco tinnunculus*	Common Kestrel	C	LC	LC	W	-	-	x	-	-	N
	Psittaciformes Order											
	Cacatuidae Family											
42	*Nymphiacus hollandicus*	Cockatiel	-	-	LC	I	-	-	-	x	-	N

Table 3.6-9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
	Accipitriformes Order											
	Pandionidae Family											
43	*Pandion haliaetus*	Osprey	C	LC	LC	W	-	x	-	x	N	N
	Accipitridae Family											
44	*Elanus caeruleus*	Black-winged Kite	C	LC	LC	R	x	x	-	x	P	N
45	*Pernis ptilorhynchus*	Oriental Honey Buzzard	C	LC	LC	W	-	-	x	-	-	N
46	*Aviceda leuphotes*	Black baza*	C	LC	LC	W	-	-	-	-	-	-
47	*Accipiter badius*	Bird hawk	C	LC	LC	R	x	x	x	x	P	P
48	*Accipiter Soloensis*	Chinese Goshawk	C	LC	LC	P	-	-	x	-	-	N
49	*Haliastur indus*	Brahminy Kite	C	LC	LC	R	-	x	-	x	N	N
	Strigiformes Order											
	Tytonidae Family											
50	*Tyto javanica*	Barn owl	C	NT	LC	R	-	-	x	x	-	N
	Strigidae											
51	*Glaucidium cuculoides*	Asian Barred Owlet	C	LC	LC	R	x	-	x	-	N	N
52	*Athene brama*	Spotted owl	C	LC	LC	R	-	-	x	x	-	N

Table 3.6-9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
	Bucerotiformes Order											
	Upupidae Family											
53	*Upupa epops*	Common Hoopoe	C	LC	LC	R	x	x	-	x	N	N
	Coraciiformes Order											
	Coraciidae Family											
54	*Coracias affinis*	Indian roller	C	LC	LC	R	x	x	x	x	M	N
	Alcedinidae Family											
55	*Halcyon smyrnensis*	white-throated kingfisher	C	LC	LC	R	x	-	x	x	N	P
56	*Halcyon pileata*	Black-capped Kingfish	C	LC	LC	W	x	-	x	-	N	N
57	*Alcedo atthis*	Common kingfisher	C	LC	LC	W	x	-	x	-	N	N
	Meropidae Family											
58	*Merops orientalis*	*Merops orientalis*	C	LC	LC	R	x	x	x	x	M	P
59	*Merops viridis*	Blue-throated Bee-eater	C	LC	LC	R	-	x	-	x	N	P
	Piciformes Order											
	Megalaimidae Family											
60	*Psilopogon lineatus*	Barbets	C	LC	LC	R	x	x	x	x	N	N

Table 3.6□9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
61	*Psilopogon haemacephalus*	Coppersmith barbet	C	LC	LC	R	x	-	x	x	N	N
	Passiferrmes Order											
	Artamidae Family											
62	*Artamus fuscus*	Ashy wood swallow	C	LC	LC	R	x	x	x	x	M	M
	Aegithinidae Family											
63	*Aegithina tiphia*	Common lora	C	LC	LC	R	x	x	x	x	N	N
	Campephagidae Family											
64	*Pericrocotus divaricatus*	Ashy Minivet	C	LC	LC	W	-	-	x	-	-	N
65	*Lalage melaschistos*	Black-winged Cuckooshrike	C	LC	LC	W	-	-	x	-	-	N
	Laniidae Family											
66	*Lanius cristatus*	Brown shrike	C	LC	LC	W	x	-	x	-	P	N
67	*Lanius collurioides*	Burmese shrike	C	LC	LC	W	-	-	x	-	-	N
	Oriolidae Family											
68	*Oriolus Chinensis*	Black-naped Oriole	C	LC	LC	W	x	-	x	-	N	N
	Dicruridae Family											

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Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
69	*Dicrurus macrocercus*	Black Drongo	C	LC	LC	R	x	-	x	-	M	P
70	*Dicrurus leucophaeus*	Ashy Drongo	C	LC	LC	W	-	-	x	-	-	P
71	*Dicrurus paradiseus*	Greater Racket-tailed Drongo	C	LC	LC	R	-	-	x	x	-	P
72	*Dicrurus hottentottus*	Hair crested drongo	C	LC	LC	R	-	-	x	-	-	N
	Rhipiduridae											
73	*Rhipidura javanica*	Pied Fantail	C	LC	LC	R	x	x	x	x	M	P
	Corvidae Family											
74	*Crypsirina temia*	Racket-tailed Treepie	C	LC	LC	R	x	x	x	x	P	N
75	*Corvus macrorhynchos*	Crow	C	LC	LC	R	x	-	x	x	M	N
	Alaudidae Family											
76	*Mirafra erythrocephala*	Indochinese Bushlark	C	LC	LC	R	x	x	-	x	P	N
	Pycnonotidae Family											
77	*Pycnonotus atriceps*	Black-headed Bulbul	C	LC	LC	R	-	-	x	-	-	N
78	*Pycnonotus flaviventris*	Black-capped Bulbul	C	LC	LC	R	-	x	x	x	N	N
79	*Pycnonotus aurigaster*	Olive-backed Sunbird	C	LC	LC	R	x	x	x	x	N	N
80	*Pycnonotus finlaysoni*	Striated Bulbul	C	LC	LC	R	-	-	x	-	-	N

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Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
81	*Pycnonotus goiavier*	*Pycnonotus goiavier*	C	LC	LC	R	x	x	x	x	P	P
82	*Pycnonotus conradi*	Streak-eared Bulbul	C	LC	LC	R	x	x	x	x	P	P
	Hirundinidae											
83	*Hirundo rustica*	Barn Swallow	C	LC	LC	W	x	x	x	x	M	P
84	*Cecropis daurica*	Red-rumped Swallow	C	LC	LC	W	-	-	x	-	-	P
	Phylloscopidae Family											
85	*Phylloscopus inornatus*	Yellow-browed Leaf Warbler	C	LC	LC	W	x	-	x	x	N	P
86	*Phylloscopus fuscatus*	Dusky Warbler	C	LC	LC	W	x	-	x	-	P	P
87	*Phylloscopus schwarzi*	Radde's Warbler	C	LC	LC	W	-	-	x	-	-	N
88	*Phylloscopus plumbeitarsus*	Two-barred Warbler,	C	LC	LC	W	x	-	-	-	P	-
89	*Phylloscopus tenellipes*	Pale-legged Leaf Warbler	C	LC	LC	W	x	-	x	-	P	P
	Acrocephalidae Family											
90	*Acrocephalus bistrigiceps*	Black-browed Reed Warbler	C	LC	LC	W	-	-	x	-	-	N
91	*Arundinax aedon*	Thick-Billed Warbler	C	LC	LC	W	x	-	x	-	N	N

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			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
92	*Acrocephalus orientalis*	Oriental Reed Warbler	C	LC	LC	W	-	-	x	-	-	P
	Locustellidae Family											
93	*Locustella lanceolata*	Lanceolated Warbler	C	LC	LC	W	-	-	x	-	-	P
	Cisticolidae Family											
94	*Cisticola juncidis*	Cisticola juncidis	C	LC	LC	R	x	x	x	x	N	N
95	*Cisticola exilis*	Bright-capped Cisticola	C	LC	LC	R	-	-	x	x	-	N
96	*Prinia inornata*	Plain Prinia	C	LC	LC	R	x	x	x	x	N	N
97	*Prinia flaviventris*	Yellow-bellied Prinia	C	LC	LC	R	-	-	x	-	-	N
98	*Prinia hodgsonii*	Grey-breasted Prinia	C	LC	LC	R	x	x	x	-	N	N
99	*Orthotomus sutorius*	Common Tailorbird	C	LC	LC	R	x	x	x	x	N	P
100	*Orthotomus atrogularis*	Dark-necked Tailorbird	C	LC	LC	R	x	x	X	x	N	N
	Timaliidae Family											
101	*Timalia pileata*	Chestnut-capped Babbler	C	LC	LC	R	x	x	-	x	N	N
102	*Mixornis gularis*	Pin-Striped Tit Babbler	C	LC	LC	R	x	x	x	-	N	N
	Leiotrichidae Family											

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			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
103	*Garrulax leucolophus*	White-crested Laughingthrush	C	LC	LC	R	x	-	x	x	N	N
	Sturnidae Family											
104	*Acridotheres grandis*	Great Myna	C	LC	LC	R	x	x	x	x	M	M
105	*Acridotheres tristis*	Common Myna	C	LC	LC	R	x	x	x	x	M	M
106	*Gracupica contra*	Asian Pied Starling	C	LC	LC	R	-	-	x	-	-	N
	Monarchidae Family											
107	*Hypothymis azurea*	Black-naped Monarch	C	LC	LC	W	x	-	x	-	P	P
	Muscicapidae Family											
108	*Copsychus saularis*	Oriental Magpie Robin	C	LC	LC	R	x	x	x	x	P	P
109	*Kittacinclar malabarica*	White-rumped Shama	C	LC	LC	R	x	x	-	-	N	-
110	*Muscicapa dauurica*	Asian Brown Flycatcher	C	LC	LC	W	x	-	x	-	N	N
111	*Ficedula albicilla*	Taiga Flycatcher	C	LC	LC	W	x	-	x	-	N	N
112	*Saxicola maurus*	Siberian Stonechat	C	LC	LC	W	x	-	x	-	N	N
113	*Saxicola caprata*	Siberian Stonecha	C	LC	LC	R	x	x	-	x	N	N
114	*Cyanecula svecica*	Bluethroat	C	LC	LC	W	-	-	x	-	-	P

Table 3.6-9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
115	*Calliope calliope*	Siberian Rubythroat	C	LC	LC	W	-	-	x	-	-	P
116	*Cyornis sumatrensis*	Indochinese blue flycatcher	C	LC	LC	R	x	-	-	-	N	-
	Dicaeidae Family											
117	*Dicaeum chrysorrheum*	Yellow-vented Flowerpecker	C	LC	LC	R	x	x	-	x	N	N
118	*Dicaeum minullum*	Plain Flowerpecker	C	LC	LC	R	x	-	x	-	N	N
119	*Dicaeum cruentatum*	Scarlet-backed Flowerpecker	C	LC	LC	R	x	x	x	x	P	P
	Nectariniidae Family											
120	*Chalcoparia singalensis*	Ruby-cheeked Sunbird	C	LC	LC	R	x	-	x	-	N	N
121	*Anthreptes malacensis*	Brown-throated sunbird	C	LC	LC	R	x	x	x	x	N	N
122	*Cinnyris jugularis*	Cinnyris jugularis	C	LC	LC	R	x	x	x	x	N	P
	Passeridae Family											
123	*Passer domesticus*	House Sparrow	C	LC	LC	R	x	-	x	x	N	N
124	*Passer flaveolus*	Plain-backed sparrow	C	LC	LC	R	x	-	-	x	N	N
125	*Passer montanus*	Eurasian Tree Sparrow	-	LC	LC	R	x	-	x	x	N	P

Table 3.6□9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
	Ploceidae Family											
126	*Ploceus hypoxanthus*	Asian Golden Weaver	C	NT	NT	R	-	x	-	x	N	N
127	*Ploceus philippinus*	Baya Weaver	C	LC	LC	R	x	x	-	x	P	N
	Estrildidae Family											
128	*Lonchura punctulata*	Scaly-breasted Munia	C	LC	LC	R	x	x	x	x	M	P
129	*Amandava amandava*	Red Wagtail	C	NT	LC	R	-	-	x	-	-	P
	The family of Motacillidae											
130	*Anthus rufulus*	Anthus refulus	C	LC	LC	R	x	x	x	x	P	N
131	*Anthus hodgsoni*	Garden Bird	C	LC	LC	W	x	x	-	x	N	N
132	*Anthus richardi*	big field ground bird	C	LC	LC	W	-	-	x	-	-	N
	Total 126 kinds of birds											
	Mammals											
	Chiroptera Rank											
	The Hipposideridae Family											
1	*Hipposideros* sp.	The giant bat.	-	-	-	-	-	-	x	x	-	N
	Rodentia Rank											
	The family of Sciuridae		-	-	-	-	-	-	x	x	-	N

Table 3.6□9 Results from the 1st wildlife resources survey in project area and study project area (during rainy season) and 2nd (during dry season)

Sequence No.	The order of the family, scientific name.	Local Name	Status of wildlife				Survey results in the project area		Survey results in the study area		The abundance in the project area[5/]	The abundance in the study area[5/]
			Act 2019[1/]	ONEP 2017[2/]	IUCN 2021[3/]	Season [4/]	Dry season	Rainy season	Dry season	Rainy season	Throughout the year	Throughout the year
2	*Callosciurus funlaysonii*	Multi-coloured squirrel	-	LC	LC	-	x	x	x	x	N	M
3	*Tamiops macclellandii*	Burmese Striped Squirrel	-	LC	LC	-	-	x	x	x	N	P
4	*Menetes berdmorei*	Indochinese Ground Squirrel	-	LC	LC	-	x	x	x	x	N	P
	Includes 4 mammal species.											

Note : 1/ Legal status ((Wildlife Preservation and Protection Act, 2019)
C means protected wildlife - meaning it is not protected by law.
2/ Conservation status by the Office of the Natural Resources and Environmental Policy and Planning, 2017)
VU (Vulnerable) means likely endangered NT (Near Threatened) means near threatened LC (Least Concern) means less concerned.
3/ Conservation status by International Union for Conservation of Nature and Natural Resources (IUCN)
VU (Vulnerable) means likely endangered NT (Near Threatened) means near threatened LC (Least Concern) means less concerned.
4/ Seasonal status
R refers to residential birds (Residents) W means Winter Visitor B means immigrant birds coming to build nests to lay eggs (Breeding Visitor).
P means a passing or resting bird (Passage Migrant) I means a bird that has been imported from a foreign country or has been displaced from the container (Introduced).
5/ Abundance
N means less abundance P means moderate abundance, M meaning high abundance.

2.2) Results of 2nd Field Survey (dry season)

The 2nd survey of wildlife resources in the study area (during dry season) between 15-18 November 2019 and 18-20 December 2019,135 species of wildlife were found in the project area, comprising 4 species of mammals, 119 species of birds, 7 species of reptiles and 5 species of amphibians. and the study area of the project, as follows:

Project area

Survey results of wildlife resources on the project area during dry season, 96 wildlife species were found, consisting of 2 types of mammals, namely*: Callosciurus finlaysonii* and *Menetes berdmorei*, 83 species of birds, such as *Anastomus oscitans*, *Microcarbo niger*, *Columba livia*, *Pycnonotus conradi*, *Acridotheres tristis*, *Amaurornis phoenicurus*, *Halcyon smyrnensis*, *Gallicrex cinerea*, *Artamus fuscus*, (*Geopelia striata*, *Elanus caeruleus* etc., 7 reptiles species such as *Chrysopelea ornata*, *Xenochrophis flavipunctatus*, *Gekko gecko*, *Hemidactylus platyurus*, *Varanus salvator* and etc. and 4 amphibians species, namely, *Duttaphrynus melanostictus*, *Microhyla mukhlesuri*, *Kaloula pulchra*, *Fejervarya limnocharis*as shown in **Figure 3.6-9** and **Table 3.6-9**.

Study area of the project

Survey results of wildlife resources in the study project area during dry season, 116 wildlife species were found, consisting of 4 types of mammals, including *Callosciurus filaysonii*, *Menetes berdmorei*) *Tamiops macclelandii* and *Hipposideros* sp.,102 types of birds, such as *Lalage malachistos*, *Charadrius alexandrinus, Accipiter soloensis, Phylloscopus inornatus, Centropus sinensi*, *Aegithina tiphia*, *Athene brama*,etc., 5 types of reptiles such as *Calotes versicolor*, *Gekko gecko*, *Xenochrophis flavipunctatus*, etc. and 5 types of amphibians such as *Hoplobatrachus rugulosus*, *Duttaphrynus melanostictus*, *Kaloula pulchra*, etc. as shown in **Figure 3.6-9** and **Table 3.6-9**.

Chalcoparia singlesalensis

Ashy wood swallow (*Artamus fuscus*)

Ixobrychus sinuses

Elanus caeruleus

Ardeola bacchus

Aegithina tiphia

Ficedula alicilla

Hemidactylus platyurus

Figure 3.6 9 Wild animals found in project area (dry season)

Acridotheres grandis

Crypsirina temia

Psilopogon lineatus

Lalage melaschistos

Phaenicophaeus tristis

Dicrurus hottentottus

Dicrurus leucophaeus)

Tamiops macclellandii

Figure 3.6-9 Wild animals found in project area (dry season)

2.3) Number of types and types of wildlife

Project area

According to the field survey in the project area, 107 types of wildlife were found, comprising of:

- 4 types of amphibians, including *Duttaphrynus melanostictus* and *Kaloula pulchra*, *Microhyla mukhlesuri* and *Fejervarya limnocharis*
- 7 species of reptiles, including *Chrysoplea ornata*, *Xenochrophis flavipunctatus*, *Gekko gecko*, *Calotes versicolor*, *Hemidactylus platyurus*, *Leiolepis belliana*) and *Varanus salvator*
- 93 types of birds, such as *Anastomus oscitans*, *Ixobrychus sinensis c*, *Pandion haliaetus*, *Phaenicophaeus tristis*, *Upupa epops*, *Crypsirina temia*, *Pycnonotus aurigaster*, *Cisticola juncidis*, *Timalia pileata*, *Dicaeum chrysorrheum*, *Saxicola caprata*, etc.
- 3 types of mammals, including *Callosciurus finlaysonii*, *Menetes berdmorei* and *Tamiops macclellandii*

Study area of the project

Based on field survey in the study area, 144 types of wildlife were found, comprising of:

- Five types of amphibians, including the *Duttaphrynus melanostictus*, *Hoplobatrachus rugulosus, and the Kaloula pulchra, Microhyla mukhlesur,* and *Fejervarya limnocharis*
- 7 species of reptiles, including *Hemidactylus platyurus*, *Calotes versicolor*, *Gekko gecko*, *Leiolepis belliana*, *Xenochrophis flavipunctatus* Varanus salvator[/g5], and *Chrysopelea ornata*
- 128 type of birds, *Anthus hodgsoni*, *Passer montanus*, *Passer domesticus, Garrulax leucolophus*, *Pycnonotus conradi*, *Mirafra erythrocephala*, *Corvus macrorhynchos*, (*Dicrurus paradiseus*, *Psilopogon haemacephalus*, *Centropus sinensis*, *Amaurornis phoenicurus*, *Anastomus oscitans*, *Egretta garzetta*, etc.
- 4 types of mammals, including *Callosciurus finlaysonii*, *Menetes berdmorei*, *Tamiops macclellandii,* and *Hipposideros* sp.

2.4) Wildlife animals adundance

Project area

- Most wildlife animals have low abundance, with 98 types comprising of
  - 4 types of amphibians,including *Microhyla mukhlesuri*, *Fejervarya limnocharis*), *Duttaphrynus melanostictus* and *Kaloula pulchra*

- 7 species of reptiles, including *Gekko gecko*, *Calotes versicolor*, *Hemidactylus platyurus*, *Leiolepis, belliana*, *Xenochrophis flavipunctatus*, *Chrysopelea ornata* and *Varanus salvator*
- 60 types of birds, such as *Egretta garzetta*, *Microcarbo niger*, *Microcarbo niger* , *Streptopelia tranquebarica*, *Chalcophaps indica*, *Eudynamys scolopaceus*, *Pycnonotus melanicterus*, *Dicaeum chrysorrheum*, *Psilopogon lineatus*, *Accipiter badius*, *Upupa epops*, *Halcyon pileata*, etc.
- 3 types of mammals,including *Callosciurus finlaysonii*, *Menetes berdmorei* and *Tamiops macclellandii*

- The wildlife animals have a moderate abundance, with 19 types consisting of

  19 species of birds, such as *Ploceus philippinus*, *Anastomus oscitans*, *Lanius cristatus*, *Anthus rufulus, Dicaeum cruentatum*, *Copsychus saularis*, *Pycnonotus conradi*, etc.

- The wildlife animals have a high abundance, with 14 types consisting of
  - 14 types of birds, such as *Lonchura punctulata*, *Acridotheres tristis*, *Columba livia*, *Geopelia strata*, *Vanellus indicus*, Coracias affinis*Merops orientalis*, etc.

Study area of the project

- Most wildlife animals have low abundance, with 98 types comprising of
  - 3 types of amphibians,including *Kaloula pulchra*, *Microhyla mukhlesuri,* and *Hoplobatrachus rugulosus*
  - 5 types of reptiles, including *Gekko gecko*, *Leiolepis belliana*, *Xenochrophis flavipunctatus*, *Chrysopelea ornata* and *Varanus savaltor*.
  - 89 types of birds, e.g.*Amaurornis phoenicurus*, *Garrulax lecucolophus, Athene brama, Centropus sinensis*, *Chalcophaps indica*, *Glareola maldivarum*, *Ixobrychus sinensis*, *Pandion haliaetus*, *Halcyon pileata*, *Aegithina tiphia*, *Oriolus chinensis*, *Pycnonotus finlaysoni*, *Arundinax aedon*), etc.
  - 1 type of mammals, i.e. *Hipposideros* sp.

- The wildlife animals have a moderate abundance, with 38 types consisting of
  - 2 types of amphibians, e.g.*Fejervarya limnocharis*and *Dutttaphrynus melanotictus*
  - 1 type of reptiles which is *Calotes versicolor*)
  - 33 types of birds, such as *Aerodramus germani*, *Spilopolia chinensis*, *Anastomus oscitans*, *Halcyon smyrensis*, *Merops orientalis*, *Dicrurus macrocercus*, *Rhipidura javanica*, *Pycnonotus conradi*, *Cinnyris jugularis*, *Passer montanus*, etc.

- 2 types of mammals, *namely Callosciurus finlaysonii* and *Tamiops macclellandii*

- The wildlife animals have a high abundance, with 7 types consisting of
  - 1 type of reptile, namely*: Hemidactylus paltyurus*
  - 5 types of birds, including *Columba livia*, *Geopelia striata*, *Artamus fuscus*, *Acridotheres grandis* and *Acridotheres tristis*.
  - 1 type of mammals, namely *Callosciurus finlaysonii*

2.5) Status of wildlife animals

Project area

- **Seasonal status** found that all mammals, reptiles, and amphibians were surveyed in the study area and were all endemic animals, different from birds that received seasonal status classification, comprising of :
  - 74 species of residential birds (R), such as *Cypsiurus balasiensis*, *Cacomantis merulinus, Treron vernans*, *Amaurornis phoenicurus*, *Turnix suscitator*, *Glaucidium cuculoides*, *Upupa epops*, *Halcyon smyrnensis*, *Artamus fuscus*, *Pycnonotus aurigaster*, *Prinia inornata*, etc.
  - 19 types of migratory birds (W), namely, *Pandion haliaetus*, *Lanius cristatus*, *Oriolus chinensis*, *Phylloscopus inornatus*, *Phylloscopus tenellipes*, *Arundinax aedon*, *Hypothymis azurea*, *Ficedula albicilla*,etc.

- **Status protected by law**. This study did not find any wildlife reserved species protected, found only 91 protected wildlife types consisted of
  - Two types of reptiles, namely *Calotes versicolor* and *Varanus salvator*.
  - 89 types of birds, such as *Centropus sinusis*, *Microcarbo niger*, *Tyto alba*, *Ploceus philippinus*, *Accipiter badius*, *Pycnonotus melanicterus*, *Crypsirina temia*, *Artamus fuscus*, *Anthreptes malacensis*, *Kittacinacla malabarica*, etc.

- **Status for conservation according to ONEP (2017)** In this study, a total of 2 types of wildlife classified as near threatened (NT) and 104 types of Least Concern (LC) were found, details are as follows:
  - Four types of amphibian are in the state of least concern (LC), including *Kaloula pulchra*, *Fejervarya limnocharis*, *Microhyla mukhlesuri*, *Dutttaphrynus melanostictus.*
  - There are 7 reptiles species in the least concern group (LC), such as *Gekko gecko*, *Calotes versicolor, Leiolepis belliana*, *Varanus salvator*, etc.
  - Two types of birds are in near threatened status (NT), namely, *Gallicrex cinerea*, *Ploceus hypoxanthus,* and 90 types are in the least concerned(LC) group status such as *Chalcophaps indica*, *Centropus bengalensis*, *Gallus*

gallus, *Elanus caeruleus, Ixobrychus sinensis*, *Upapa epops*, *Oriolus chinensis*, *Mirafra erythrocephala*, *Pycnonotus aurigaster*, etc.

- There are 3 types of mammals in least concern (LC) status, namely, *Callosciurus finlaysonii*), *Tamiops macclellandii,* and *Menetes berdmorei*.

- **Conservation status according to IUCN. (2019)** Study of wildlife animals in the study area found that the wildlife animals that live in the study area has been classified as Near Threatened (NT) for 1 types and has been classified as Least Concern (LC) for 101 types. Details are as follows:

  - Four types of amphibian are in the state of least concern (LC), including *Kaloula pulchra*, *Fejervarya limnocharis*, *Microhyla mukhlesuri*, *Dutttaphrynus melanostictus.*
  - There are two types of reptiles that are in Least Concern (LC) status, namely *Varanus salvator*, *Xenochrophis flavipunctatus*, etc.
  - There are 1 type of birds are near threatened (NT) status, i.e (*Ploceus hypoxanthus*]and 92 types in least concern (LC) status for example *Centropus sinensis*, *Aerodramus fuciphagus*, *Treron vernans*, *Ardea intermedia*, *Hailastur indus*, *Artamus fuscus*
  - The mammals are in the state of Least Concern (LC) group of 3 types, including the multicolored squirrel (*Callosciurus filaysonii*), *the Tamiops macclelandii,* and the *Mentes berdmorei*.

Study area of the project

- **Seasonal status** The study found that amphibians, reptiles, and mammals of all types surveyed in the study area were all endemic animals, different from birds that received seasonal status, comprising of:

  - 92 species of residential birds (R) such as *Aerodramus germani*, *Eudynamys scolopaceus*, *Cacomantis merulinus*, *Francolinus pintadeanus*, *Anastomus oscitans*, *Ardea purpurea*,*Accipiter badius*, *Dicrurus hottentottus*, *Prinia hodgsonii*, *Caprimulgus asiaticus*, etc.
  - 38 types of migratory birds (W) such as*Himantopus himantopus*, *Tringa glareola*, *Pandion haliaetus*, *Halcyon pileata*, *Pericrocotus divaricatus*, *Lanius collurioides*, *Acrocephalus orientalis*, *Calliope calliope*, etc.
  - 1 type of migratory birds pass (P) i.e. *Accipiter soloensis*
  - There is 1 type of birds that migrate into the area to build nest for lay eggs in rainy season (B), namely, *Glareola maldivarum.*
  - 1 type of imported bird from foreign countries or off-cage (I), namely, *Nymphicus hollandicus*

- **Status protected by law**. This study did not find any wildlife reserved species protected, found only 124 protected wildlife types consisted of

- Two types of reptiles, namely*Calotes versicolor*and*Varanus salvator*.
- 122 species of birds, such as *Caprimulgus macrurus*, *Coturnix coromandelica*, *Himantopus himantopus*, *Glareola maldivarum*, *Burhinus indicus*, *Tyto javanica*, *Athene brama*, *Pycnonotus atriceps*, etc.

- **Status for conservation according to ONEP form(2017)** This study found 2 types of wildlife classified as vulnerable (VU), 4 types of near threatened (NT) and 136 types of wildlife are in least concern (LC) group status. Details are as follows:

  - Five types of amphibians are in least concern (LC) status, including *Kaloula pulchra*, *Fejervarya limnocharis*, *Hoplobatrachus rugulosus*, *Microhyla mukhlesuri,* and *Duttaphrynus melanostictus*
  - There are 7 types of reptiles are in the least concern status (LC), such as *Gekko gecko*, *Calotes versicolor*, *Leiolepis belliana*, *Varanus salvator*, etc.
  - There are 2 types of birds in vulnerable (V) status which are *Riparia chinensis* and *Ardea purpurea*. There are 4 types in near threatened (NT), namely, *Burhinus indicus*, *Tyto javanica*, Ploceus hypoxanthus and *Amandava amandava* and there are 121 types are in the Least Concern (LC) status, e.g.*Chalcophaps indica*, *Centropus bengalensis*, *Gallus gallus*, *Elanus caeruleus*, *Ixobrychus sinensis*, *Upupa epops*, *Oriolus chinensis Mirafra erythrocephala*, *Pycnonotus aurigaster*, etc.
  - There are 3 types of mammals in least concern (LC) status, namely, *Callosciurus finlaysonii*, *Tamiops macclellandii,* and *Menetes berdmorei*.

- **Conservation status according to IUCN. (2019)** Study of wildlife animals in the study area found that the wildlife animals that live in the study area has been classified as Near Threatened (NT) for 1 type and has been classified as Least Concern (LC) status for 136 types. Details are as follows:

  - Five types of amphibians are in least concern (LC) status, including *Kaloula pulchra*, *Fejervarya limnocharis*, *Hoplobatrachus rugulosus*, *Microhyla mukhlesuri,* and *Duttaphrynus melanostictus*
  - There are two types of reptiles in the least concern status (LC), namely *Varanus salvator*, *Xenochrophis flavipunctatus*,etc.
  - There are 1 type of birds are near threatened (NT) status, i.e (*Ploceus hypoxanthus*) and 92 types in least concern (LC) status for example *Centropus sinensis*, *Aerodramus fuciphagus*, *Treron vernans*, *Ardea intermedia*, *Hailastur indus*, *Artamus fuscus*
  - There are 3 types of mammals in least concern (LC) status, namely, *Callosciurus finlaysonii*, *Tamiops macclellandii,* and *Menetes berdmorei*.

2.6) Relationships between wildlife animals and habitat

Project area

The project construction area was not found in forest condition. The northern area is a wasteland with dense vegetation and grasslands. Many species of wildlife inhabit and feed such as reptiles, birds and mammals such as *Calotes versicolor*, *Hemidactylus platyurus*, *Leiolepis belliana*, *Phaenicophaeus tristis*, *Chalcophaps indica*, *Crypsirina temia*, *Callosciurus finlaysonii*, *Menetes berdmorei*, *Tamiops macclellandii*, etc. The southern area is a large agricultural area. Therefore found wildlife that lives and feeds on various types of reptiles, birds and mammals such as *Calotes versicolor*, *Hemidactylus platyurus*, *Leiolepis belliana*, *Mirafra erythrocephala*, *Anthus rufulus*, *Pandion haliaetus*, *Elanus caeruleus*, *Menetes berdmorei*. The natural water source is a creek that It is a habitat for amphibians and some reptiles, such as *Fejervarya limnocharis*, *Microhyla mukhlesuri*, *Varanus salvator*, etc. And it is a habitat and living place of predatory birds such as *Anastomus oscitans*, *Ergretta garzetta*, *Microcarbo niger*, etc. In addition, the banks of the creek are also home to some mammals such as *Callosciurus finlaysonii*, *Menetes berdmorei*, *Tamiops macclellandii*, etc.

Study area of the project

The study area has various conditions, including forest areas, urban areas, and water areas. Forest areas found were Khao Huai Mahad National Reserved Forest area. Khoa Nung Yong forest and Khao Krok forest and rehabilitated forest areas around the old mines on Khao Phlu Ta Luang. Wild animals that live and feed in forest areas such as reptiles, birds and mammals live and feed on many species such as *Chrysopelea ornata*, *Leiolepis belliana*, *Dicrurus paradiseus*, *Dicrurus paradiseus*, *Callosciurus finlaysonii*, *Tamiops macclellandii*, etc. Community areas were found as large city community, therefore reptiles, birds and mammals live and feed on many species were found such as *Calotes versicolor*, *Hemidactylus platyurus*, *Hemidactylus platyurus*, *Passer domesticus*, *Columba livia*, *Copsychus saularis*, *Callosciurus finlaysonii*, etc. As for water sources, there are both natural water sources such as creeks and man-made water sources such as reservoirs, which are home to amphibians. some reptiles such as *Fejervarya limnocharis*, *Microhyla mukhlesuri*, *Varanus salvator*, etc. It was also habitat and living place of predatory birds such as *Anastomus oscitans*, *Ergretta garzetta*, *Microcarbo niger*. In addition, the banks of creeks or reservoirs are also home to some mammals such as *Callosciurus finlaysonii*, *Menetes berdmorei*, *Tamiops macclellandii*, etc.

2.7) Summary of field survey results

Based on the 2 field surveys, i.e. 1st time was during 15-17 July 2019 and 19-22 July 2019 and 2nd time was during 15-18 November 2019 and 18-20 December 2019, the number of species and levels of wildlife abundance can be summarized, divided into 2 areas, namely project areas and project study areas, as detailed in **Table 3.6-**10

Table 3.6-10 Summary of the number of species and abundance levels of wildlife animals

wildlife groups	Project area		Study area of the project	
		Level of wildlife abundance		Level of wildlife abundance

	Species Number	Most abundance.	Moderate abundance	Less abundance	Species Number	Most abundance	Moderate abundance	Less abundance
Mammals	3	0	0	3	4	1	2	1
Aves	93	14	19	60	126	5	33	88
Reptiles	7	0	0	7	7	1	1	5
Amphibians	4	0	0	4	5	0	2	3
Total	**107**	**14**	**19**	**74**	**142**	**7**	**38**	**97**

Source: Based on the 1st project survey, during 15-17 July 2019 and during 19-22 July 2019 and 2nd, during 15-18 November 2019 and 18-20 December, 2019

When considering wildlife in near threatened (NT) status, it was found that there are 6 types of wildlife threatened by the classification of bird status in accordance with Office of Natural Resources and Environmental Policy and Planning (ONEP) 2017 and International Union for Conservation of Nature and Natural Resources (IUCN) status classifications. The areas identified are shown in **Figure 3.6-10** and details are as follows:

- *Gallicrex cinerea*status according to the classification of ONEP is a group that is near threatened (NT) and IUCN classification status is the least concerned (LC) status. It was found in the area on the east of the project as the area is open meadow next to trees and near a water source.
- *Burhinus quincus*status according to the classification of ONEP is a group that is near threatened (NT) and IUCN classification status is the least concerned (LC) status. It was found in the air site area and the forest on the east of runway 1 which was an area that used to be built before, but now it has become a wasteland with vegetation interspersed with open areas with concrete slopes. causing standing water during the rainy season.
- *Ardea purpurea*status according to the classification of ONEP is a group that is vulnerable (VU) and IUCN classification status is the least concerned (LC) status. IT was found in he northern part of runway 1 which the area is an open grassland, cut short. The north side is adjacent to Road No. 3, Sukhumvit Road and has a small water channel. There is standing water during the rainy season.
- *Tyto javanica*status according to the classification of ONEP is a group near threatened (NT) and IUCN classification status is the least concerned (LC) statys. It was found in Airside area as the forest on the east side of Runway 1 which was an area that used to be built before but has now become a wasteland with dense vegetation. interspersed with open, concrete slopes and a landing for old, unused planes.
- *Ploceus hypoxanthus*status according to the classification of ONEP is a group that is near threatened (NT) and IUCN classification status is a group that is near threatened (NT) and found in a building area.
- *The Amandava amandava*status according to the classification of the ONEP, it is a group that is near threatened (NT) and IUCN classification status is the least concerned (LC) status. It was found in the area to the north of the runway 1, which is open field and meadow.

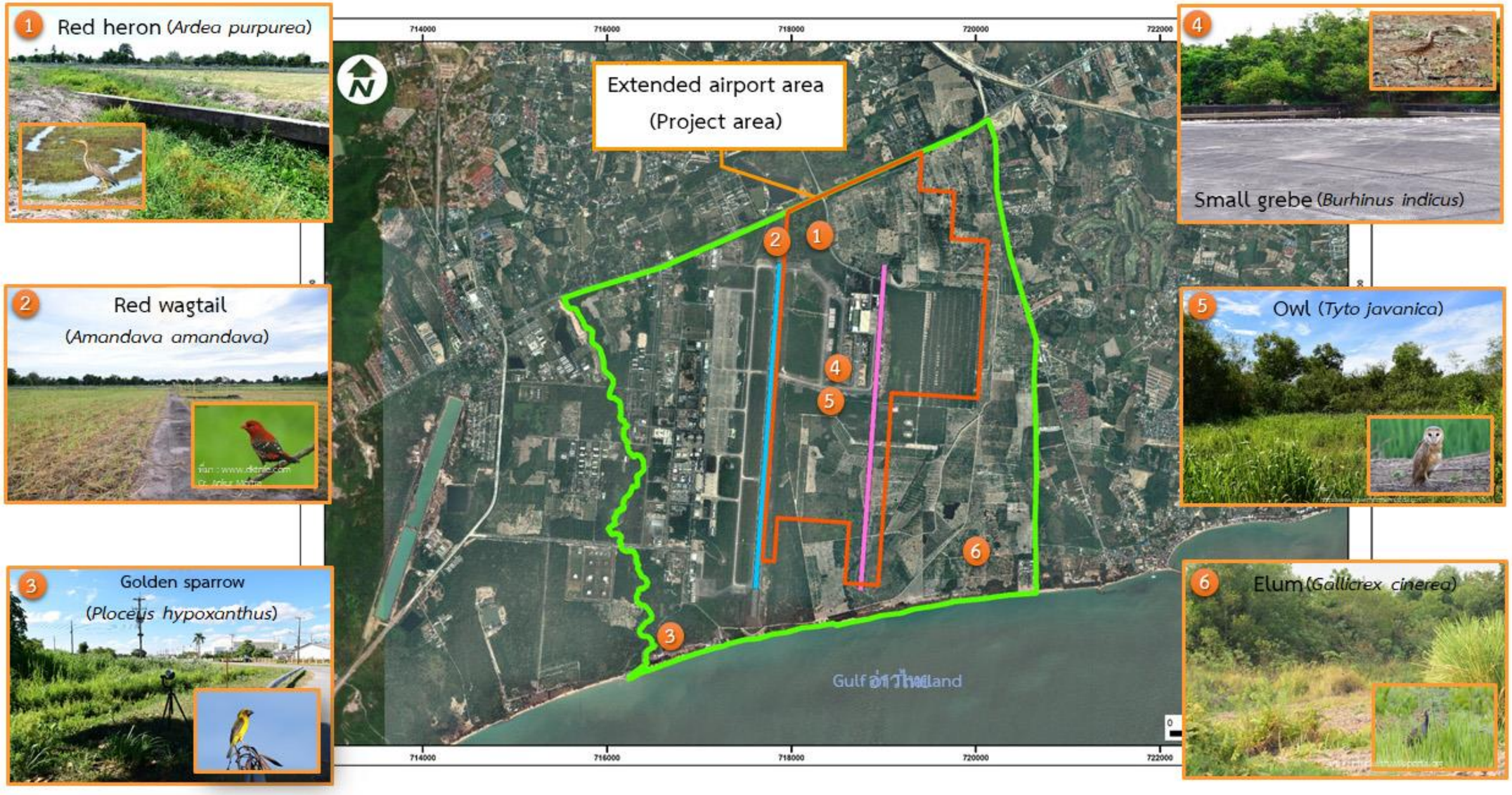


Figure 3.6 10 The conditions at which wildlife is discovered in the threatened group

3.6.2 Aquatic Ecology

3.6.2.1 Surface Water Ecology

(1) Scope of Study

Collect soil composition data from secondary data that survey surface water sources in the study area, as well as conduct field surveys in the study area to use as basic data to support assessment of the potential impacts of the project.

(2) Research Method

Conduct field survey as follows:

- **Surface Water Ecology Sampling points** are based on water sources in the study area. The sample collection points are specified as 3 points in Khlong Bang Phai and 1 point in Khlong Phala (added according to the public's comment on the 1st hearing of the comment, including consideration of the impact of the project operations), which is the same points as the surface water sample coollection points. Details are shown in **Table 3.5-22** and **Figure 3.5-24**. The sample collection is shown in **Figure 3.6-**11 Freshwater Ecology
- **Sample collection period** 2 times i.e. 1st time during rainy season on 18 July 2019 and 2nd time during dry season on 31 October 2019
- **Index Surveyed and analyzed** include type, amount, density, abundance, and variety of species.

Sample collection method

1) Plankton

- Collect phytoplankton and zooplankton samples using cone Plankton Net. The diameter of the net is approximately 30 centimeters and made with 20 micron mesh cloth for phytoplankton sample collection and 70 micron mesh for zooplankton sample collection. The end of cloth cone has a bulb to support the amount of the Plankton when filtered. Samples were collected by scooping water from the surface (about 0-30 cm deep), volume 50-100 liters, and poured into plankton bags.
- Preserve the plankton sample by adding 100% concentrated formalin solution to the sample bottle. Shake gently until the sample has a concentration of approximately 7-10 % of formalin and send the analytical laboratory to determine the type and amount of phytoplankton and zooplankton according to the standard method in APHA, AWWA and WEF "Standard Methods for the Examination of Water and Wastewater, 23rd Edition, 2017.

- Calculate the species diversity index of phytoplankton and zooplankton by using the equation Shannon–Wiener Index (Shannon and Wiener, 1963)[1] as follows:

$$H = \sum_{i=1}^{s} (n_i / n) \ell n (n_i / n)$$

When H = species diversity index
s = number of types or group numbers of plankton
n = Total number of plankton
n_i = number of each type of plankton

- For the criteria to consider the species diversity index , refer to the suggestion of Wilhm and Dorris in 1968, which define the criteria for considering the diversity index, as detailed in **Table 3.6-**11

Table 3.6-11 Criteria for Determining Diversity Index

Diversity index(H)	Criteria for consideration
H < 1	Water sources are not suitable for habitat of living things.
1 < H < 3	Water sources are qualified for habitat of living thins
H > 3	Water source suitable for the growth of living things.

2) Benthos

- Collect soil samples using Petersen Grab, scoop on the surface of the soil, and then sift with a standard sieve no.35 (0.50 millimeters channel) which is the size that can distinguish type and volume of Macro Fauna ranging from 0.5-1.0 millimeters according to the standard method in APHA, AWWA and WEF: "Standard Methods for the Examination of Water and Wastewater", 23rd Edition, 2017.
- Place the soil sample on the sieve in a sealed, conditioned zip bag with 100% formalin solution, by gently adding formalin solution to the soil sample, so that the soil sample has a concentration of approximately 7-10% of formalin solution. Then, analyze the type and quantity in the laboratory.
- Calculate the species diversity index of benthos by using the Shannon–Wiener Index equation (Shannon and Wiener, 1963) as well as the plankton.

[1] Shannon, E.R. and Wiener, W., The mathematical theory of Communication, University of Ilinoise press, Urbana llinois, 1963.

3) Aquatic Plant

- While collecting the plankton samples and benthos, the species and the amount of aquatic plants found at each points were observed in area boundary of approximately 100 square meters.

4) Fish

- Fish samples are taken using a 2.5 meter radius net, as well as inquiries from the people who live or do fishery in the vicinity of the sample collection points.

Collect a plankton sample using Plankton Net

Collect the plankton samples by putting in the container (glass bottle)

Collect benthos using Petersen Grab

Benthos samples

Collect fish samples using a net.

Fish samples

Figure 3.6 11 Freshwater EcologySample Collection

(3) Results of the Study

Analysis of the elements of fresh water sources, namely, phytoplankton, zooplankton, benthos, water plants, and fish, by conducting 2 seasonal analysis, namely during the rainy season, on 18 July 2019, for 3 stations, including Khlong Bang Phai above the water discharge, Khlong Bang Phai at the end of the water discharge , and Khlong Bang Phai at water discharge points and during dry season on 31 October 2019, for 4 stations including Khlong Bang Phai above the water discharge, Khlong Bang Phai at the end of the water discharge, Khlong Bang Phai at water discharge points and Khlong Phala , details as shown in **Table 3.6-** 12 (details shown in **Appendix 3-7**) are summarized as follows:

1) Phytoplankton

1.1) W1 : Khlong Bang Phai, above the water discharge point

During the rainy season, a total of 16 types of phytoplankton were found, with a total of 16,241,714 units per cubic meter with a diversity index at 1.00, the 1st most common genus is green seaweed. The genus *Scenedesmus* has an abundance of 11,077,500 units per cubic meter, accounting for 68.2 percent. Secondly, the euglenoid algae of the genus *Phacus*were found to have an abundance of 2,961,000 units per cubic meter, accounted for 18.2 percent, and green algae of the genus *Pediastrum* had an abundance of 1,711,500 units per cubic meter, accounting of 10.5% respectively. In the dry season, 25 species of phytoplankton were found, with a total abundance of 4,518,528 units per cubic meter and had a diversity index of 2.37. The first genus was green algae*Scenedesmus* had an abundance of 1,724,793 units/m3. accounted for 38.2%, followed by euglenoid algae, genus *Phacus*, with an abundance of 406,707 units per cubic meter. accounted for 9.0 percent, and euglenaid genus*Euglena*, with an abundance of 357,000 units per cubic meter,accounted for 7.9 percent, respectively.

For the diversity index of phytoplankton was equal to 1.00-2.37. When considering the diversity index according to the criteria of Wilhm and Dorris (1968), it indicates that the area is a water source of moderate quality and also have conditions suitable for the living of aquatic life. The predominant phytoplankton species were green algae, genus *Scenedesmus*, which are plankton found in medium quality water bodies. This corresponds to the type and quantity of benthos species found in the area.

1.2) W2 : Khlong Bang Phai, at the end of the water discharge point

During the rainy season, all 15 types of phytoplankton were found, with a total of 8,554,052 units per cubic meter with a Diversity Index of 0.96 by the 1st most common genus, namely green seaweed, genus *Scenedesmus* has an abundance of 6,891,716 units per cubic meter, equivalent to 80.6%. Secondly, diatoms genus*Surirella* had an abundance of 353,600 units per cubic meter, representing 4.1% and euglenoid algae genus*Euglena*has an abundance of 258,284 units per cubic meter, accounting for 3.0% respectively. During the dry season, all 23 types of phytoplankton were found having a total abundance of 2,199,960 units per cubic meter and with a diversity index equal to 2.55, the 1st most common genus is the Blue-green Algae genus*Oscillatoria* has an abundance of 506,660 units per cubic meter, accounting for 23.0 percent. Secondly, green

seaweed and genus *Scenedesmus* has abundance of 358,660 units per cubic meter, equivalent to 16.3 percent. In addition, the genus of *Pediastrum* has an abundance of 205,340 units per cubic meter, accounting for 9.3 per cent, respectively.

For the phytoplankton diversity index was equal to 0.96-2.55. When considering the diversity index based on the Wilhm and Dorris (1968), it can be indicated that the area is low-to-medium quality water source and is not suitable for aquatic life in the rainy season. The phytoplankton, which is commonly found in the area, namely green seaweed, *Scenedesmus*, and *Oscillatoria*, which are found in moderate quality water, consistent with the type and quantity of surrounding soil and benthos. This may come from such water sources as a reservoir for effluent from communities that live upstream and effluent from airport activities.

1.3) W3 : Khlong Bang Phai, at the sea discharge point

During the rainy season, all 14 types of phytoplankton were found having a total abundance of 2,556,632 units per cubic meter with a diversity index was equal to 1.28, the most common genus, is diatoms *Chaetoceros* has an abundance of 1,690,000 units per cubic meter, accounting for 66.1%, Secondly, genus diatom*Pleurosigma* has abundance of 374,400 units per cubic meter, equivalent to 14.6 percent and green algae genus *Scenedesmus* has an abundance of 128,284 units per cubic meter, equivalent to 5.0% respectively. During the dry season, all 21 phytoplanktons were found with total abundance of 1,052,689 units per cubic meter and with a diversity index equal to 2.20. The 1st most common genus is Blue-green algae *Oscillatoria* has an abundance of 395,637 units per cubic meter, equivalent to 37.6 percent. Secondly, *Synedra* diatoms had been found with an abundance of 170,863 units per cubic meter, equivalent to 16.2% and green algae genus *Scenedesmus* has an abundance of 131,263 units per cubic meter, accounting for 12.5%, respectively.

The diversity index of phytoplankton is 1.28-2.20. When considering the diversity index according to Wilhm and Dorris (1968), it indicates that the area is a moderate quality water source and has suitable conditions for the livelihood of aquatic organisms. The phytoplankton is characterized by diatoms genus *Chaetoceros,*and *Oscillatoria*, which are plankton mostly found in water source close to sea coast. This is consistent with water quality which was found that this water source area was influenced by seawater.

1.4) W4 : Khlong Phala

During the dry season, the total number of 25 types of phytoplankton was found with an abundance of 5,031,650 units per cubic meter, with a diversity index of 2.36. The 1st most found was Euglenoid algae genus *Euglena* has an abundance of 1,770,825 units per cubic meter, accounting for 35.2%. Secondly, Euglenoid algae was found genus of *Trachelomonas* has an abundance of 1,276,650 units per cubic meter, accounting for 25.4%. And green algae genus*Closterium* has an abundance of 446,675 units per cubic meter, accounting for 8.9% respectively.

For the diversity index of phytoplankton equals to 2.36. When considering the diversity index ,taccording to the criteria of Wilhm and Dorris (1968), it indicates that the area is a moderate quality water source and has suitable living conditions for aquatic organisms. The

outstanding plankton found is Eugeloid genus *Euglena*, which is plankton mostly found in water source with abundant organic matter.

2) Zooplankton

2.1) W1 : Khlong Bang Phai, above the water discharge point

During the rainy season, a total of 6 types of zooplankton were found, with an abundance of 37,800 units per cubic meter with Diversity Index of 1.33, with the 1st most common genus being Protozoa genus *Centropyxis* having an abundance of 18,900 units per cubic meter, accounting for 50.0%. Secondly is Copipod in the Nauplius phase has an abundance of 9,450 units per cubic meter, equivalent to 25.0 percent and Protozoa in the genus of *Difflugia*, with a content of 5,260 units per cubic meter, accounting for 13.9 percent, respectively. During the dry season, 13 types of zooplankton were found with an abundance of 36,000 units per cubic meter with a diversity index of 2.16, the 1st most common genus is Rotfer genus *Rotaria* and Copipod, in Nauplius phase, with an abundance of 8,406 units per cubic meter, accounting for 23.4 percent. Followed by Protozoa genus*Arcella*, which has an abundance of 4,806 units per cubic meter, equivalent to 13.4 percent and genus*Centropyxis* has an abundance of 3,600 units per cubic meter, accounting for 10.0% respectively.

For the diversity index of zooplankton was equal to 1.33-2.16 based on Wilhm and Dorris (1968) criteria. It indicates that the said area is a moderate quality water source and has a suitable condition for living aquatic organisms.

2.2) W2 : Khlong Bang Phai, at the end of the water discharge point

During the rainy season, all 4 types of zooplanktons were found having an abundance of 20,524 units per cubic meter with a Diversity Index of 0.94, the first most common genus, is Protozoa. The genus of *Centropyxis* has an abundance of 14,000 units per cubic meter, accounting for 68.2 percent. Secondly, Protozoa, the genus of *Difflugia* and Copipod in the Nauplius phase with an abundance of 2,800 units per cubic meter, equivalent to 13.6% which equals to Protozoa, genus of*Paramecium* which has an abundance of 924 units per cubic meter, equivalent to 4.5 fraction. During the dry season found the total of 9 types of zooplankton, with a total abundance of 20,979 units per cubic meter with a diversity index equal to 2.04 The first most common genus is the Copipod in the Nauplius phase, with an abundance of 4,893 units per cubic meter, equivalent to 23.3%. Secondly, Austracod has an abundance of 3,507 units per cubic meter, equivalent to 16.7% and Copipod group of Calanoid, Protozoa, a genus of *Difflugia*has an abundance of 2,793 units per cubic meter, equivalent to 13.3% are the same.

For the index value of animal plank diversity index equals 0.94-2.04 based on Wilhm and Dorris (1968) criteria, it indicates that the area is a low-to-medium quality water source and is not suitable for aquatic life activity during the rainy season.

2.3) W3 : Khlong Bang Phai, at the sea discharge point

During the rainy season, Total of 8 types of zooplanktons were found with an abundance of 123,454 units per cubic meter with a diversity index of 1.00, the first most common genus was Copipod in the Nauplius phase, with an abundance of 93,432 units per cubic meter, equivalent to 75.7%. Secondly, Protozoa, the genus of *Tintinnopsis,* and Rotifer, the genus of*Brachionus* has an abundance of 6,318 units per cubic meter, accounting to 5.1% equally, and

Protozoa, the genus of *Favella*, Sea worm larvae and round caterpillar group had an abundance of 4,750 units per cubic meter, accounting for 3.8% equally. During the dry season, a total of 7 zooplankton had an abundance of 30,022 units per cubic meter with a diversity index equal to 1.79, the first most common genus, is the Copipod in the Nauplius phase, with an abundance of 9,639 units per cubic meter, equivalent to 32.1%, followed by round caterpillars which had an abundance of 5,661 units per cubic meter, accounting for 18.9% and Copipod group pf Calanoid, Mallusca, the genus of Bivalvia, had an abundance of 3,961 units per cubic meter, accounting for 13.2% equally.

For the diversity index of zooplankton was equal to 1.00-1.79 based on Wilhm and Dorris (1968) criteria. It indicates that the said area is a moderate quality water source and has a suitable condition for living aquatic organisms.

2.4) W4 : Khlong Phala

During the dry season, the total of 9 types of zooplankton was found, with a total abundance of 153,372 units per cubic meter with a diversity index of 1.71. The first most common genus is Copepod in the Nauplius phase, with a total abundance of 59,974 units per cubic meter, accounting for 39.1%, followed by Rotifer the genus of*Rotaria* which had an abundance of 29,500 units per cubic meter, accounting for 19.2% and Protozao, the genus of *Centropyxis*had an abundance of 21,624 units per cubic meters, accounting for 14.1% respectively.

For the diversity index of zooplankton is 1.71 based, when considering on Wilhm and Dorris (1968) criteria, it can be indicated that the area is a quality water source and has a suitable condition for living aquatic organisms.

3) Benthos

3.1) W1 : Khlong Bang Phai, above the water discharge point

According to the analysis of benthos test results in the rainy season, 6 types of benthos were found with an abundance of 49 units per square meter. The most common genus was freshwater larvae, the genus of *Chironomidae* had an abundance of 14 units per square meter, accounting of 28.6%. Secondly, small blistered scallops, the genus of*Tarebia*, periwinkle, the genus of*Filopaludina*, sand shells, the genus of*Corbicula*,white beetle larva, Family Baitidae and Ostracod with an abundance of 7 units per square meter, accounting for 14.3% equally. During the dry season, 4 types of benthos were found, with the total abundance of 42 units per square meter. The most common genus were freshwater earthworm, Family Naididae had an abundance of 21 units per square meter, accounting for 50.0%. Secondly, the sandshells, the genus of *Corbicula*and white beetle larva, Family Baetidae, and shrimp embryo, Family Pasiphaeidae, had an abundance of 7 units per square meter, accounting of 16.7% equally.

3.2) W2 : Khlong Bang Phai, at the end of the water discharge point

According to the analysis of benthos test results in the rainy season, there were 5 types of benthos, with the total abundance of 63 units per square meter. The most common genus was sandshells, the genus of *Corbicula*, freshwater larvae, the genus of *Chironomidae*, gnat larva, the genus of *Bezzia*, and white beetle larva, Family Baetidae, with an abundance of 14 units per square meter, accounting of 22.2% equally, followed by white beetle larva, Family Caenidae with an abundance of 7 units per square meter, account of 11.1% During dry season, 1 type of freshwater

larvae was found, i.e. freshwater larvae, the genus of*Chironomus*, total density of 7 units per square meter.

3.3) W3 : Khlong Bang Phai, at the sea discharge point

According to the analysis of benthos test results in the rainy season, there were 3 types of bentos found with a total abundance of 35 units per square meter, with the most common genus is Family Penaeidae and rock barnacle, the genus of *Balanus* which had an abundance of 14 units per square meter, accounting of 40.0%. Secondly, hermit crab embryo of the Family Diogenidae had an abundance of 7 units per square meter, accounting of 20.0%. During dry season, 5 types were found with the total abundance of 98 units per square meter, accounting of 35%, with the most common genus is Family Nereididae which had an abundance of 35 units per square meters, accounting of 35.7%. Secondly, freshwater larvae, the genus of *Chironomus*which had an abundance of 28 units per square meter, accounting of 28.6 percent and shrimp embro, Family Pasiphaeidae with an abundance of 21 units per square meter, accounting of 21.4% respectively.

3.4) W4 : Khlong Phala

Based on the analysis of the results of the benthos test during dry season, 1 type was found, namely, freshwater earthworm. Family Naididae, the total amount of abundance was 7 per square meter.

Table 3.6 12 Analysis results of soil surface water organisms in the study area of the project in the rainy season and dry season

Composition of living organisms	W1 : Khlong Bang Phai, above the water discharge points		W2 : Khlong Bang Phai, at the end of the water discharge points		W3 : Khlong Bang Phai, at the sea discharge points		W4 : Khlong Phala	
	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season
Phytoplankton								
Total abundance (units per cubic meter)[1/]	16,241,714	4,518,528	8,554,052	2,199,960	2,556,632	1,052,689	-	5,031,650
Species Number	16	25	15	23	14	21	-	25
Diversity index	1.00	2.37	0.96	2.55	1.28	2.20	-	2.36
The first most common genus found	*Scenedesmus*	*Scenedesmus*	*Scenedesmus*	*Oscillatoria*	*Chaetoceros*	*Oscillatoria*	-	*Euglena*
The second most common genus found	*Phacus*	*Phacus*	*Surirella*	*Scenedesmus*	*Pleurosigma*	*Synedra*	-	*Trachelomonas*
The third most common genus found	*Pediastrum*	*Euglena*	*Euglena*	*Pediastrum*	*Scenedesmus*	*Scenedesmus*	-	*Closterium*
zooplankton								
Total abundance (units per cubic meter)[2/]	37,800	36,000	20,524	20,979	123,454	30,022	-	153,372
Species Number	6	13	4	9	8	7	-	9
Diversity index	1.33	2.16	0.94	2.04	1.00	1.79	-	1.71
The first most commonly genus found	*Centropyxis*	*Rotaria*, Nauplius of Copepod	*Centropyxis*	Nauplius of Copepod	Nauplius of Copepod	Nauplius of Copepod	-	Nauplius of Copepod
The second most common genus found	Nauplius of Copepod	*Arcella*	*Difflugia,* Nauplius of Copepod	Ostracod	*Tintinnopsis*, *Brachionus*	Unknown Nematoda	-	*Rotaria*
The third most common genus found	*Difflugia*	*Centropyxis*	*Paramecium*	Cananoid Copepod, *Difflugia*	*Favella*, Polychaete Larva, Unknown Nematoda	Calanoid Copepod, Bivalvia Larva	-	*Centropyxis*
Benthos								
Total abundance (units per square meter)	49	42	63	7	35	98	-	7
Species Number	6	4	5	1	3	5	-	1
Genus/group found	*Chironomus*	Family Naididae	*Corbicula*, *Chironomus*, *Bezzia*, Family Baitidae	*Chironomus*	Family Penaeidae, *Balanus*	Family Nereididae	-	Family Naididae

Source: United Analyst and Engineering Consultant Company Limited

Note : [1/] Refers to cell per cubic meter or filament per cubic meter or colony per cubic meter.

[2/] refer to individual per cubic meter or cell per cubic meter.

During the rainy season, samples were collected on 18 July 2019

During dry season, sample collection was conducted on 31 October 2019

Summary of analysis of freshwater organisms at the present found that plankton during rainy season has a higher abundance than during dry season. This is because rainwater removes sediment or organic matter along the banks of canals into water bodies, causing an increase in the number of some types of plankton. As a result, the diversity index of plankton during the rainy season decreased, however, the genus of plankton found in both seasons was not different. It is a genus that can be found in common or contaminated water bodies. This is consistent with the results of the survey of benthic species found that can live in water bodies with low to moderate water quality.

4) Aquatic plants

4.1) W1 : Khlong Bang Phai, above the water discharge point

According to the survey during the rainy season, 10 types of aquatic plants were found, namely *Colocasia esculenta*, *Ipomoea aquatica*, *Actinosciprus, grossus*, *Marsilea crenata*, *Mimosa pigra*, *Jussiaea repens*, *Ceratopteris thalictroides*, *Brachiaria mutica*, *Eichornia crassipes*, *Typha angustifolia*. During dry season, 10 aquatic plants wer found such as *Colocasia esculenta*, *Lepironnia articulata*, *Marsilea crenata*, *Jussiaea repens*, *Brachiaria mutica*, *Leersia hexandra*, *Phragmites karka*, *Polygonum tomentosum*, *Polygonum barbatum*, *Eichornia crassipes* which mostly were river edge plants found on general natural water source as shown in **Figure 3.6-**12.

4.2) W2 : Khlong Bang Phai, at the end of the water discharge point

According to the survey during the rainy season, 6 types of aquatic plants were found,namely, *Ipomoea aquatica*, *Actinosciprus, grossus*, *Jussiaea rapens*, *Brachiaria mutica*, *Eichornia crassipes*, *Typha angustifolia*. During dry season, 9 types of aquatic plants were found such as *Ipomoea aquatica*, *Ipmoea pes-caprae*, *Actinoscirpus grossus*, *Mimosa pigra*, *Brachiaria mutica*, *Leersia hexandra*, *Phragmites karka*, *Polygonum barbatum*, *Eichornia crassipes* which mostly were river edge plants found on general natural water source and habitat near sea coast, as shown in **Figure 3.6-**12.

4.3) W3 : Khlong Bang Phai, at the sea discharge point

According to the survey in the rainy season, 3 types of aquatic plants were found, i.e., *Ipomoea pes-caprae*, *Actinoscirpus grossus*, *Rhizophora apiculata*. During dry season 6 species of aquatic plants were found such as Ipomoea pes-caprae, *Actinoscirpus grossus*, *Brachiaria mutica*, *Leersia hexandra*, *Rhizophora apiculata*, *Rhizophora mucronata*, which mostly were river edge plants found on general water resources and habitat near sea coast, as shown in **Figure 3.6-**12.

4.4) W4 : Khlong Phala

According to the survey during dry season, 9 types of aquatic plants were found, i.e., *Ipomoea aquatica*, *Cyperus pilosus*, *Neptunia oleracea*, *Nymphaea lotus*, *Ludwigia adcendens*, *Jussiaea repens*, *Brachiaria mutica*, *Leersia hexandra*, and *Salvinia cucullata*, which mostly were river edge plants found in general water source as shown in **Figure 3.6-**12.

Rainy season (on 18 July 2019) Dry season (on 31 October 2019)

W1 point : Khlong Bang Phai, above the water discharge point

Rainy season (on 18 July 2019) Dry season (on 31 October 2019)

W2 point: Khlong Bang Phai, at the end of the water discharge point

Rainy season (on 18 July 2019) Dry season (on 31 October 2019)

W3 point: Khlong Bang Phai, at the sea discharge point

W4 point: Khlong Phala (dry season) (on 31 October 2019)

Figure 3.6 12 Conditions of water source and aquatic plants in the study area

5) Fish

5.1) W1 : Khlong Bang Phai, above the water discharge point

According to the survey in the rainy season, there were 3 types of fish with total density of 75 fish per rai with total fertility of 9.654 kilograms per rai. The most common types of fish found were *Barbonymus gonionotus*, *Oreochromis niloticus* and *Hemibagrus spilopterus* respectively. During the dry season,3 types of fish were found with total density of 48 fish per rai with total fertility of 8.162 kilograms per rai, the most common types of fish found were *Mystacoleucus* sp., *Sikukia* sp. and *Chitala ornata*) as shown as in **Figure 3.6-**13 Fish type

5.2) W2 : Khlong Bang Phai, at the end of the water discharge point

According to the survey in the rainy season, there were 3 types of fish with total density of 54 per rai with total fertility of 35.792 kilograms per rai. The most common type of fish found were *Barbonymus goonionotus*, *Lutjanus argentimaculatus* and *Hemibagrus spilopterus*, respectively. During the dry season, 5 types of fish were found with total density of 124 fish per rai and with fertility of 1.053 kilograms per rai, the most common type of fish found were *Sikukia* sp. followed by *Puntius spilopterus*, *Barbonymus goonionotus*, *Mystacolecus* sp. and *Hemibagrus* sp., respectively, as shown in **Figure 3.6-**13 Fish type

5.3) W3 : Khlong Bang Phai, at the sea discharge point

According to the survey in the rainy season, all 5 types of fish had total density of 27 fish per rai and had a fertility of 1.817 kilograms per rai. The most common type of fish found were*Liza subviridis*, *Glossogobius sp.*, *Leiognathus* sp., *secutor* sp, *Lutjanus russllii*, respectively. During dry season, all 12 fish types had total density of 2,667 fish per rai and had a fertility of 1.255 kilograms per rai. The most common type of fish found were *Opsarius pulchellus*, followed by *Gerres* sp., *Scatophagus argus*, *Acanthogobius* sp. *Dermogenys pusilla*, *Atherinomorus* sp., *Mystacoleacus* sp., *Oreochromis niloticus*, *Stolephorus* sp., *Stigmatogobius* sp., *Lutjanus russlii*and *Liza subviridis*, respectively, as shown in **Figure 3.6-**13 Fish type

5.4) W4 : Khlong Phala

According to the survey during the dry season, the 5 types of fish were found with total density of 2,333 fish per rai and a fertility value of 17.785 kilograms per rai. The most common type of fish found were*Trichopsis viiaia*, followed by *Oreochromis niloticus*, *Rasbora borapetensis,* Channa striata *and* Trichopodus trichopterus, respectively as shown in **Figure 3.6-**13 Fish type.

Barbonymus gonionotus

Oreochromis niloticus

W1 point : Khlong Bang Phai, above the water discharge point

Lutjanus argentimaculatus

Hemibagrus spilopterus

W2 point: Khlong Bang Phai, at the end of the water discharge point

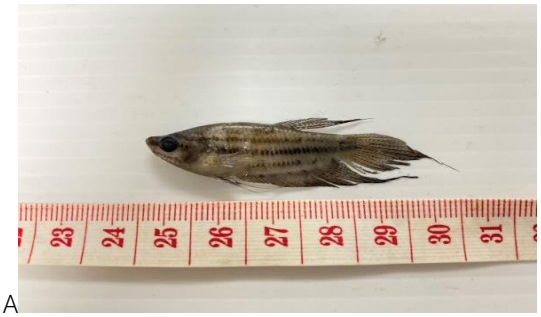
Lutjanus russllii

Liza subviridis

W3 point : Khlong Bang Phai, at the sea discharge point

Rasbora borapetensis

A



Trichopsis viiaia

W4 point : Khlong Phala

Figure 3.6 13 Fish typesamples found at the study area

3.6.2.2 Marine Ecology

(1) Scope of Study

Collect data of aquatic organisms from secondary data that survey the area of seawater, as well as conduct field surveys in the study area, to serve as basic data to support assessment of the impact that may arise from the project.

(2) Research Method

1) Secondary data

- Collect information of phytoplankton, zooplankton and benthos from related reports.
- Coral and other organisms information in the area surrounding the project from Marine and Coastal Resources Research and Development Center of the Eastern Gulf of Thailand and east coast of Gulf of Thailand.
- Information on the areas of Chonburi and Rayong from Department of Marine and Coastal Resources.

2) Primary data

The sample collection of Marine Ecology of the project is aimed at obtaining baseline data prior to the construction of the project. The sample collection points in this phase of the study will be designated as Monitoring points in the next operation phase. For the survey of Marine Ecology of the project, the details are as follows:

- **Seawater Ecology Sample Collection Points** 6 aquatic sampling points were designated, which were the same points as the marine water quality sample collection points. Marine Ecology Sample collection points are shown inFigure 3.6-14
- **Duration of sample collection** 2 times i.e. 1st time in rainy season, 19 July 2019 and dry season, 1 November 2019
- **Index Surveyed and analyzed** include type, amount, density, abundance, and variety of species.
- **Sample collection method**
  - **Plankton**: Collection of Marine Ecology samples to analyze the type and volume of plankton, carried out by using cone Plankton Net. The diameter of the net is approximately 30 centimeters. The Plankton Net drawn bag for the collection of phytoplankton made with 20 micron mesh cloth and 70 micron mesh for zooplankton collection. The end of cloth cone has a bulb to support the amount of the Plankton when filtered. Sample were collected by measuring the transparency of seawater at the sample collection points first, then collecting the samples by dragging Plankton Net at the depth level measuring the transperency. Sample of plankton collected and

filtered were put in the bottle. Then, the sample state was kept by adding Buffered Formalin in the bottle until the sample had concentration of 5% for phytoplankton and 7% for zooplankton, shook it softly to mix it and submitted to laboratory.

- Calculate the species diversity index of phytoplankton and zooplankton by using the Shannon–Wiener Index equation (Shannon and Wiener, 1963).[2]
- The criteria for the determination of the diversity index are based on Wilhm and Dorris' recommendations in 1968, which set the criteria for the determination of the index. The diversity index is the same as the topic of surface water ecology.
- **Benthos**, samples of benthos for analysis of benthos type and amount were taken separately from soil sediment samples collected from the sea floor using the Petersen Grab instrument, with size of 8.0x 8.5 inch, sieve the sample through a 0.5 millimeter sieve. Put soil sediment sample filtered into the bottle, sample state was kept by adding concentrated formalin solution in the sample bottle, with approximately 10 percent of formaldehyde solution in the soil sample, closed the mouth of the bottle tightly and submitted for classifying the type and amount of benthos in labarotory.

[2] Shannon, E.R. and Wiener, W., The mathematical theory of Communication, University of Ilinoise press, Urbana llinois, 1963.

SW1 : The point affected by the project on the south side of runway 1, 300 meters from the coast

SW1 : points affected by the project on the south side of runway 1, 300 meters from the coast

SW3 : points affected by the project on the south-east side of runway 2, 300 meters from the coast

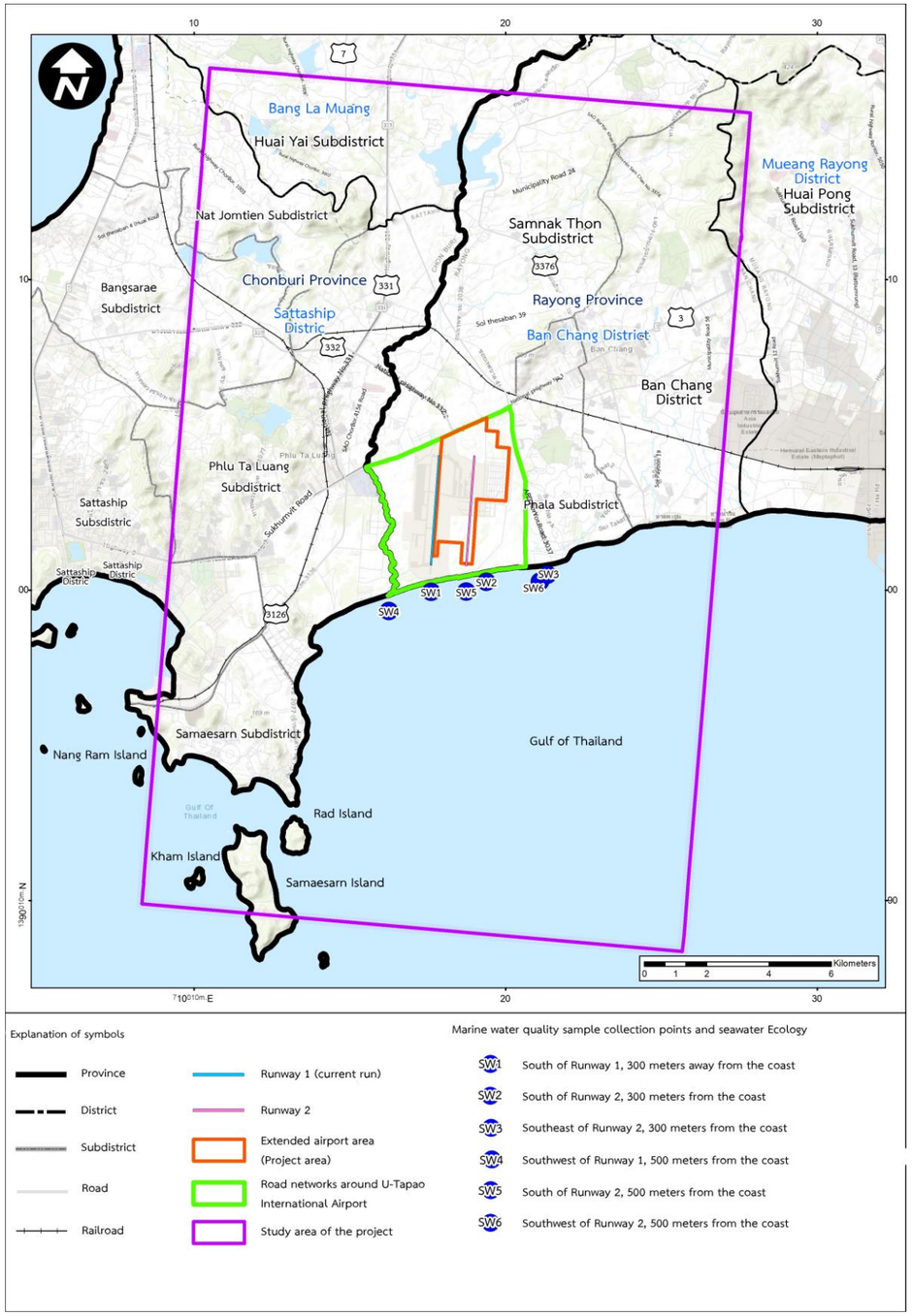


Figure 3.6 14 marine water quality and Marine Ecology sample collection points of the project

SW4 : points that may not be directly affected by the project on the southwest side of runway 1, 500 meters from the coast.

SW5 : Points that may not be directly affected by the project on the south side of the runway 2, 500 meters from the coast

SW6 : Points that may not be directly affected by the project on the south-east side of runway 2, 500 meters from the coast .

(3) Results of the Study

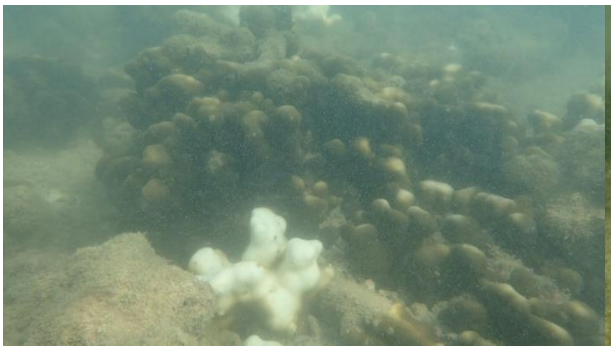
1) Secondary data

1.1) Coral information in the area surrounding the project.

Collecting coral reef information surrounding the project area from Marine and Coastal Resources Research and Development Center of the Eastern Gulf of Thailand. It was found that, from monitoring the bleeched coral situation due to climate change in the Baan Phala beach, Ban Chang District, Rayong, on 7 July 2019, at the depth level of 1.5-3.0 meters, seawater temperature was 30.3 degrees Celsius. It was found that 30% of the corals were live, 60% died, and 10% were sandy. Most corals were pale about 50 percent, 10% completely bleached, and 10% died from bleaching. Live Corals that are faded and bleached, including *Porites* sp., *Favites* sp., *Favia* sp. and *Tubinaria* sp. as shown in **Figure 3.6-15**

Coral conditions in the beach area

Bleached Coral



Tubinaria sp.

Favites sp.

Source: Marine and Coastal Resources Research and Development Center, Eastern Gulf of Thailand (SUT), 2019

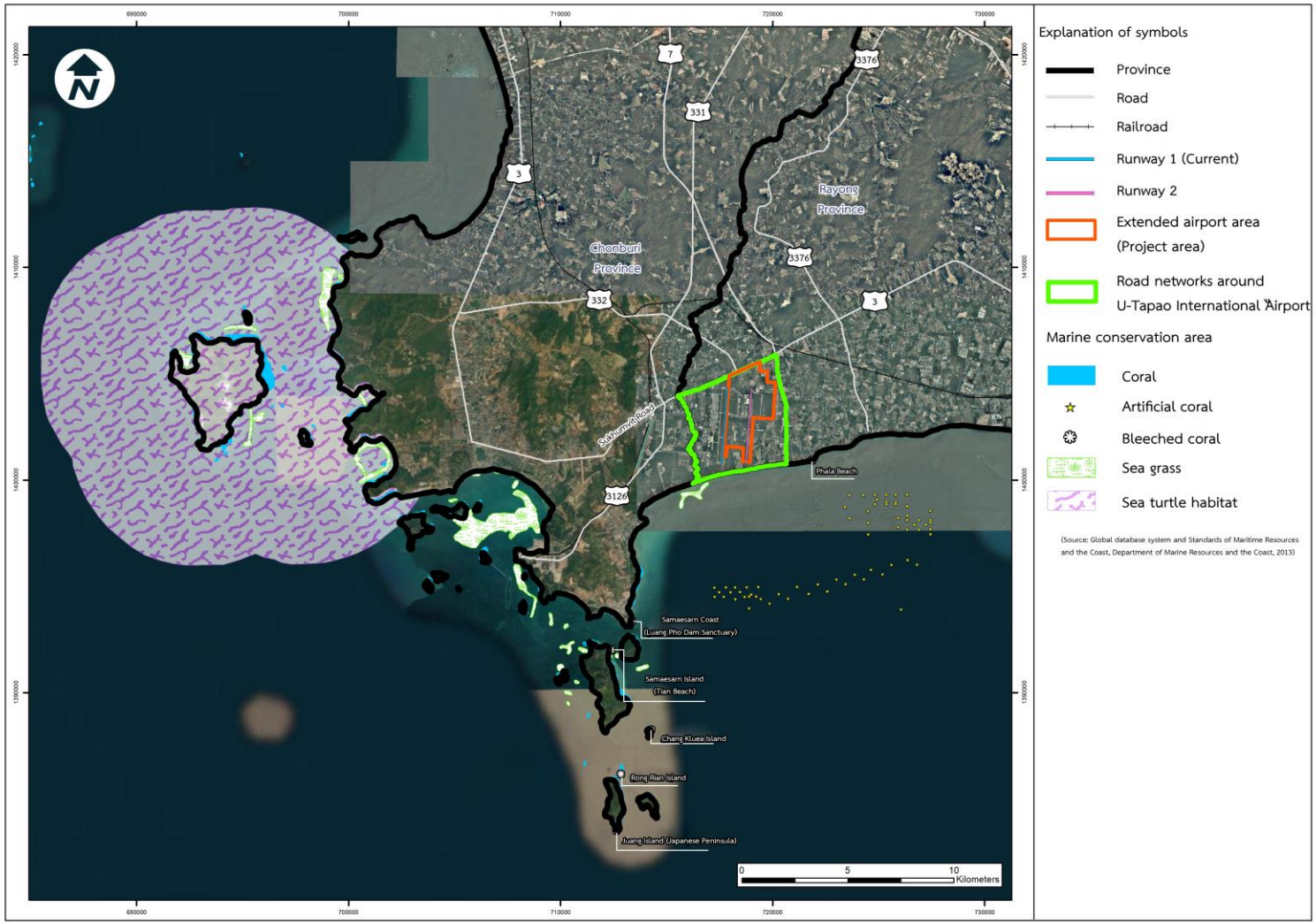
Figure 3.6-15 Coral samples in the beach area of Phala Beach, Ban Chang District, Rayong

1.2)Rare marine resources and creatures information

Based on the information on marine resources and rare marine creatures, Department of Marine and Coastal Resources 2013 as shown in **Figure 3.6-16** details as follows:

- **Seagrass source** near the project area are areas in the south of runway 1, about 1,000 meters away, and about 1,500 meters away from runway and driveway 2.
- **Coral reef source** near the project area include Samaesarn Island, which has a reef area of 339.1 Rai, Rad Island with a reef area of 116.8 Rai, Jarn Island with a reef area of 86.5 Rai, and a Rong Nang-Rong Khon Island with a reef area of 31.9 Rai.

  The habitats of rare marine creatures are located near the project area, namely the habitats of sea turtles, Kram Yai Island area which is about 13 kilometers away from the project area.



Source: Central database system and data standards for marine and coastal resources, Department of Marine and coastal resources

Figure 3.6 16 Map of rare marine resources and marine creatures

- **Sea Cow**

According to the evidence of sea cow finding in the Gulf of Thailand area, it was found that sea cow lived from Chonburi, Rayong, Chantaburi to Trat in the east seas side. For the Gulf of Thailand in the west area, sea cow were found in Chumphon, Surat Thani, Nakhon Si Thammarat and Pattani provinces. The database of the Department of Marine Resources and Coast of Thailand in the year 1979-2003 indicated that the remains of sea cow died due to being trapped in floating nets were found in Rayong at 16%, followed by 9% in Trat Province, where sea cow remains were found in 9 provinces in the Gulf of Thailand, namely Trat, Chanthaburi, Rayong, Chonburi, Chumphon, Surat Thani, Nakhon Si Thammarat, Songkhla and Pattani in January. 2003-2004: Dugong was found at Makhampom Bay, Rayong, and at Ban Saphan Hin, Ban Mai Rot, Trat Province. According to the Department of Marine and Coastal Resources in 2009, rare sea creatures populations in the sea cow group were assessed on the Gulf of Thailand, it indicated that the population is about 35, which is less than the population of seacow in the Andaman Sea. The population of sea cow found is divided into the eastern Gulf of Thailand from Chonburi Province to Trat, 20 sea cows were found in the central Gulf of Thailand from Prachuap Khiri Khan to Surat Thani, 10 were found and the lower Gulf of Thailand from Nakhon Si Thammarat Province to Narathiwat, 5 were found. From the Marine Resources Research and Development Institute, Coastal and mangrove forests In 2010, sea cows were found on seagrass beds in the Rock Garden Resort area (Ao Makham Pom), Klaeng District, Rayong.

From the Marine and Coastal Resources Status Report 2007-2011 in the Gulf of Thailand, a total of 14-21 sea cows were found at Mai Rood Beach and Koh Kood, Trat and Pak Nam Prasae, Rayong and Chanthaburi which had constant population of sea cow. While in the upper area of Gulf of Thailand, 4-6 sea cows were found in the area of Sattahip Bay, Chonburi. While in the central Gulf of Thailand, 2-3 sea cows are found in Thung Kha-Swee Bay, Chumphon Province, and 20-30 sea cows in Phum Riang Bay, Chaiya District, Surat Thani Province (Ao Donsak) and Nakhon Si Thammarat (Ao Khanom), and 1-2 sea cows were found in lower area in the Gulf of Thailand as in Pattani Bay, Pattani.

The survey reports of the Department of Maritime and Coast Resources, according to the survey report in the fiscal year 2018-2019, it was found that in the area of responsibility of the Marine Resources Research and Development Center and the Eastern Gulf Coast, the population of 16 sea cows were found in Chonburi (Sattahip Bay) and the sea cows were not found in the upper Gulf of Thailand. Details are shown in **Table 3.6-**13 and the spread of the population in the sea grass source in the 2018-2019 as shown in **Figure 3.6-**17**.**

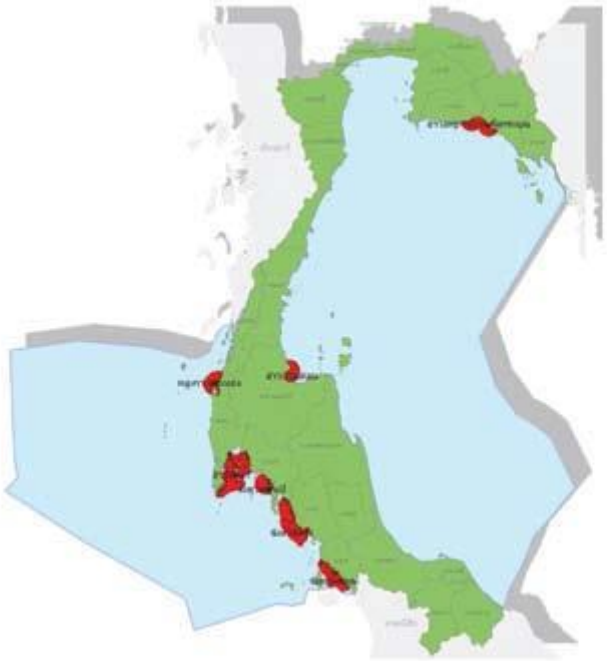
Table 3.6-13 Statistics of the natural sea cow population 2018-2019

Responsible area	Province	Number (sea cow)
Marine Resources Research and Development Center and the East coast of Gulf of Thailand	- Trat Province (Mai Rood Beach and Kood Island)	5
	- ChanthaburiProvince (Kung Kraben Bay)	3
	- Rayong(Makham Po Bay, Pak Nam Prasae)	5

	- Chonburi(Sattahip Bay)	3
Marine Resources Research and Development Center and the upper coast of Gulf of Thailand	- Not found in upper Gulf of Thailand area	0

Source: Annual Report 2019, Department of Marine and Coastal Resources

The spread of sea cow population in the sea grass source, 2019



The spread of sea cow population in the sea grass source, 2019

Source: Department of Marine and Coastal Resources, 2019

Figure 3.6 17 Spread of sea cow population in sea grass sources, 2018-2019

2) Primary data

Analysis of elements of seawater organisms, namely phytoplankton, zooplankton, and benthos, by examining 6 points, which are the same points as marine water quality measurement points, which were surveyed during the rainy season on 19 July 2019 and dry season on 1 November 2019 as detailed in **Table 3.6-**14 (details shown in **Appendix 3-8**) are summarized as follows:

2.1) Phytoplankton

SW1 : points affected by the project on the south side of runway 1, 300 meters from the coast

During the rainy season, 30 species of phytoplankton were found, with a total abundance of 4,373,791 units per cubic meter. The most common genus was diatoms in the genus of *Rhizosolenia* had an abundance of 2,092,219 units per cubic meter, representing 47.8 percent, followed by diatoms of genus *Chaetoceros*, with an abundance of 555,477 units per cubic meter, accounting of 12,7%, and diatoms of genus *Thalassionema* with an abundance of 520,998 units per cubic meters, accounting of 11.9%, respectively with diversity index was 1.93.

During the dry season, 26 types of phytoplankton were found, with the total abundance of 1,326,699 units per cubic meter. The most common genus found was diatom of genous *Chaetoceros* had an abundance of 461,901 units per cubic meter, accounting of 34.8%, followed by dinoflangelate, the genus of *Peridinium*, with an abundance of 324,021 units per cubic meter, accounting of 24.4% and blue green algae in the genus of *Oscillatoria*with a total abundance of 129,057, accounting of 9.7 percent, respectively with the diversity index of 2.10.

SW2 : points affected by the project on the south side of runway 2, 300 meters from the coast

During the rainy season, 30 types of phytoplankton were found, with a total abundance of 6,926,786 units per cubic meter. The most common genus found, namely diatoms,*Rhizosolenia*, with an abundance of 3,387,648 units per cubic meter, accounting of 48.9%, followed by diatoms,*Guinardia*, with an abundance of 857,891 units per cubic meter, accounting of 12.4% and diatom, the genus of*Thalassionema*which had an abundance of 855,202 units per cubic meters, accounting for 12.3%, respectively, with diversity index of 1.90.

During the dry season, 28 species of phytoplankton were found, with a total abundance of 1,551,506 units per cubic meter. The most common genus found was diatoms, the genus of*Chaetoceros* with an abundance of 444,444 units per cubic meter, accounting of 28.6%, followed by dinoflangelate, the genus of*Peridinium*, with an abundance of 358,007 units per cubic meter, accounting of 23.1% and diatom, the genus of*Cyclotella* with an abundance of 182,873 units per cubic meter, accounting of 11.8%, respectively with diversity index of 2.25.

SW3 : points affected by the project on the south-east side of runway 2, 300 meters from the coast.

During the rainy season, 30 types of phytoplankton were found. The total abundance was 3,840,695 units per cubic meter. The most common genus found was diatoms, the genus of*Rhizosolenia*, which had an abundance of 1,874,059 units per cubic meter, accounting of

48.8%, followed by diatoms, the genus of*Thalassionema*, with an abundance of 482,596 units per cubic meter, accounting of 12.6% and diatom, the genus of*Chaetoceros*, which had an abundance of 434,799 units per cubic meter, accounting of 11.3%, respectively, with diversity index of 1.91.

During the dry season, 28 types of phytoplankton were found, with the total abundance of 1,971,700 units per cubic meter. The most common genus found was dinoflangelate, the genus of*Peridinium*, with an abundance of 552,096 units per cubic meter, accounting of 28.0%, followed by diatoms, the genus of*Cyclotella*, with an abundance of 383,302 units per cubic meter,accounting of 19.4%, and diatom, the genus of *Chaetoceros* which had an abundance of 267,799 units per cubic meter, accounting of 13.6, respectively, with diversity index of 2.41.

SW4 : points that may not be directly affected by the project on the southwest side of runway 1, 500 meters from the coast.

During the rainy season, 30 types of phytoplankton were found, with the total abundance of 6,244,676 units per cubic meter. The most common genus found, namely diatoms,*Rhizosolenia* with an abundance of 2,669,891 units per cubic meter, accounting of 42.7%, followed by diatoms, the genus of *Chaetoceros*, with an abundance of 935,777 units per cubic meter, accounting of 15.0% and diatom, the genus of *Guinardia*, with an abundance of 477,607 units per cubic meter, accounting of 7.6%, respectively, with diversity index of 2.21.

During the dry season, 28 species of phytoplankton were found, with a total abundance of 1,348,026 units per cubic meter. The most common genus found was diatom, the genus of*Chaetoceros* with an abundance of 359,615 units per cubic meter, accounting of 26.7%, followed by dino flangelates, the genus of *Peridinium*, with an abundance of 301,483 units per cubic meter, accounting of 22.4% and diatom, the genus of *Cyclotella*with an abundance of 130,053 units per cubic meter, accounting of 9.6%, respectively, with diversity index of 2.42.

SW5 : Points that may not be directly affected by the project on the south side of the runway 2, 500 meters from the coast.

During the rainy season, 30 species of phytoplankton were found, with a total abundance of 6,341,559 units per cubic meter. The most common species found was diatoms, the genus of *Rhizosolenia* with an abundance of 2,779,995 units per cubic meter, accounting of 43.9%, followed by diatoms of genus *Chaetoceros*, with an abundance of 795,816 units per cubic meter, accounting of 12.5% and diatom, the genus of *Thalassionema* with an abundance of 655,469 units per cubic meter, accounting of 10.3%, respectively, with diversity index of 2.21.

During the dry season, 25 speciesof phytoplankton were found, with a total abundance of 1,018,545 units per cubic meter. The most common genus found was diatoms, the genus of *Chaetoceros*with an abundance of 324,855 units per cubic meter, accounting of 31.9%, followed by dinoflangelate, the genus of *Peridinium*, with an abundance of 246,635 units per cubic meter, accounting of 24.2% and diatom, the genus of *Cyclotellato*, with an abundance of 146,423 units per cubic meter, accounting of 14.4%, with diversity index of 2.19.

SW6 : Points that may not be directly affected by the project on [2]the south-east side of runway 2, 500 meters from the coast

During the rainy season, 30 species of phytoplankton were found with a total abundance of 5,957,529 units per cubic meter. The most common genus found was diatom, the genus of *Rhizosolenia* with an abundance of 2,523,567 units per cubic meter, accounting of 42.4 percent, followed by diatom, the genus of*Chaetoceros*, with an abundance of 928,662 units per cubic meter, accounting of 15.6% and diatom, the genus of*Thalassionema* with an abundance of 532,484 units per cubic meter, accounting of 8.9%, respectively, with diversity index of 2.18.

During the dry season, 30 types of phytoplankton were found, with the total abundance of 1,756,844 units per cubic meter. The most common genus found was dinoflangelate, the genus of *Peridinium* which had an abundance of 390,908 units per cubic meter, accounting of 22.2%, followed by diatom, the genus of *Cyclotella*, with an abundance of 262,515 units per cubic meter, accounting of 14.9% and diatom, the genus of *Guinardia*, with an abundance of 200,155 units per cubic meter, accounting of 11.4%, respectively, with diversity index of 2.65.

2.2) Zooplankton

SW1 : points affected by the project on the south side of runway 1, 300 meters from the coast

During the rainy season, 11 species of zooplankton were found, a total abundance of 115,236 units per cubic meter. The most common genus found was the Nauplius of Copepod, with an abundance of 37,245 units per cubic meter, accounting of 32.3%, followed by Copepod group of Harpacticoida, with an abundance of 15,097 unit per cubic meter, accounting of 13.1% and Bivalvia Larva, with an abundance of 14,599 unit per cubic meter, accounting of 12.7%, respectively, with diversity index of 2.01.

During the dry season, 9 species of zooplankton were found, with a total abundance of 418,269 units per cubic meter. The most common genus found was Nauplius of Copepod, with an abundance of 126,351 units per cubic meter, accounting of 30.2%, followed by Gastropod larva with an abundance of 106,912 units per cubic meter, accounting of 25.6% and Copepod group of Calanoida, with an abundance of 57,995 units per cubic meter, accounting of 13.9, respectively, with diversity index of 1.86.

SW2 : points affected by the project on the south side of runway 1, 300 meters from the coast

During the rainy season, 13 species of zooplankton were found with a total abundance of 373,183 units per cubic meter. The most common genus found were Nauplius of Copepod, with an abundance of 76,990 units per cubic meter, accounting of 20.6 percent, followed by Protozoa, the genus of *Tintinnopsis*, which had an abundance of 58,891 units per cubic meter, accounting of 15.8% and Copepod group of Harpacticoida with an abundance of 56,173 units per cubic meter, accounting of 15.0%, respectively, with diversity index of 2.23.

During the dry season, 10 species of zooplankton was found, with the total abundance of 317,990 units per cubic meter. The most common genus found was Nauplius of

Copepod, with the total abundance of 104,430 units per cubic meter, accounting of 32.8 percent, followed by a Gastropod larva, with a total abundance of 70,139 units per cubic meter, accounting of 22.1% and Copepod group of Calanoida which had an abundance of 40,576 units per cubic meter, accounting of 12.8%, respectively, with diversity index of 1.87.

SW3 : points affected by the project on the south-east side of runway 2, 300 meters from the coast.

During the rainy season, 13 types of zooplankton with total abundance of 263,693 units per cubic meter. The most common genus found, namely, Protozoa, the genus of *Tintinnopsis,* which had an abundance of 41,435 units per cubic meter, accounting of 15.7%, followed by Nauplius of Copepod with an abundance of 30,786 units per cubic meter, accounting of 11.7% and Gastropod larva which had an abundance of 29,678 units per cubic meter, accounting of 11.2%, respectively, with diversity index of 2.36.

During the dry season, 15 types of zooplankton were found, a total abundance of 535,608 units per cubic meter. The most common genus found is the Nauplius of Copepod and Copepod group of Calanoida with an abundance of 154,285 units per cubic meter, accounting for 28.8% equally, followed by Bivalvia Larva having an abundance of 41,333 units per cubic meter, accounting of 7.7% and Gastropod larva with an abundance of 32,552 units per cubic meter, accounting for 6.1%, respectively, with a diversity index of 2.02.

SW4 : points that may not be directly affected by the project on the southwest side of runway 1, 500 meters from the coast.

During the rainy season, 9 types of zooplankton were found, with a total abundance of 217,883 units per cubic meter, The most common genus found were Nauplius of Copepod, with an abundance of 77,975 units per cubic meter, accounting of 35.8%, followed by Copepod group of Calanoida with an abundance of 36,989 units per cubic meter, accounting of 17.0% and Gastropod larva, with an abundance of 25,840 units per cubic meter, accounting of 11.9%, respectively with diversity index of 1.89.

During the dry season, 12 species of zooplankton were found, with an abundance of 64,396 units per cubic meter. The most common species found was Nauplius of Copepod, with an abundance of 23,779 units per cubic meter, accounting of 36.9%, followed by Cordata in genus of *Oikopleura* with an abundance of 7.431 units per cubic meter, accounting of 11.5% and Copepod group of Calanoida, with an abundance of 7,186 units per cubic meter, accounting of 11.2, respectively, with diversity index of 1.99.

SW5 : Points that may not be directly affected by the project on the south side of runway 2, 500 meters from the coast

During the rainy season, 11 species of zooplankton were found, a total abundance of 242,840 units per cubic meter. The most common species found was the Nauplius of Copopod with an abundance of 72,989 units per cubic meter, accounting of 30.1%, followed by Gastropod larva with an abundance of 35,307 units per cubic meter, accounting of 14.5% and Bivalvia Larva which had abundance of 32.917 units per cubic meter, accounting of 13.5%, respectively, with diversity index of 2.09.

During the dry season, 13 types of zooplankton were found, a total abundance of 145,940 units per cubic meter. The most common genus found were the Nauplius of Copepod, with an abundance of 60,828 units per cubic meter, accounting of 41.7%, followed by Gastropod larva which had an abundance of 24,912 units per cubic meter, accounting of 17.1% and Bivalvia larva with an abundance of 12,661 units per cubic meter, accounting of 8.7%, respectively, with a diversity index of 1.86.

SW6 : Points that may not be directly affected by the project on the south-east side of runway 2, 500 meters from the coast

During the rainy season, 11 species of zooplankton were found, with an abundance of 274,690 units per cubic meter. The most common species found was Nauplius of Copopod, with an abundance of 87,242 units per cubic meter, accounting of 31.8% , followed by Gastropod larva with an abundance of 36,920 units per cubic meter, accounting of 13.4% and Bivalvia larva with an abundance of 32,866 units per cubic meter, accounting of 12.0%, respectively, with diversity index of 2.07.

During the dry season, 11 species of zooplankton were found, with a total abundance of 247,294 units per cubic meter. The most common genus was Nauplius of Copepod, with total abundance of 78,185 units per cubic meter, accounting of 31.6%, followed by Gastropod larva with an abundance of 44,485 units per cubic meter, accounting of 18.0% and Copepod group of Cyclopoida with an abundance of 34,024 units per cubic meter, accounting of 13.8%, respectively, with diversity index of 1.93.

2.3) Benthos

SW1 : points affected by the project on the south side of runway 1, 300 meters from the coast

During the rainy season, 2 types of benthos were found, with a total abundance of 91 units per square meter. The most common genus found was Amphyocxus in the genus of *Branchiostoma*, which had an abundance of 56 units per square meter, accounting of 61.5%, and Clypeasteridae, with an abundance of 35 units per square meter, accounting of 38.5%respectively.

During the dry season, 4 species of benthos were found, with the total abundance of 126 units per square meter. The most common genus found was Clypeasteridae which had an abundance of 63 units per square meter, accounting of 50.0%, followed by Orbiniidae, which had abundance of 49 units per square meters, accounting of 38.9% and Opheliidae, Pilargidae which had abundance of 7 units per square meter, accounting of 5.5% equally.

SW2 : points affected by the project on the south side of runway 2, 300 meters from the coast.

During the rainy season, there were 3 types of benthos found with a total of abundance of 49 units per square meter. The most common genus found were Orbiniidae which had an abundance of 35 units per square meter, accounting of 71.4%, followed by Nereididae and Ostracod, which had an abundance of 7 units per square meter, accounting of 14.3%.

During the dry season, 4 types of benthos were found, with a total abundance of 161 units per square meters. THe most common genus found were Opheliidae, Clypeasteridae which had an abundance of 56 units per square meter, accounting of 34.8 equally, followed by Orbiniidae, with an abundance of 42 units per square meter, accounting of 26.1% and Pilargidae with an abundance of 7 units per square meter, accounting of 4.3% respectively

SW3 : points affected by the project on the south-east side of runway 2, 300 meters from the coast.

During the rainy season, 6 types of benthos were found with a total abundance of 112 units per square meter. The most common genus found was amphipod, Aoridae family which had an abundance of 35 units per square meter, accounting of 31.3%, followed by barnacles, the genus of *Balanus* which had an abundance of 28 units per square meter, accounting of 25.0% and sea worm, the genus of Orbiniidae, which had an abundance of 21 units per square meter, accounting of 18.7% respectively.

During the dry season, 10 types of menthos were found, with a total abundance of 161 units per square meter. The most common genus found barnacles, the genus of *Bananus* which had abundance of 63 units per square meter, accounting of 39.1%, followed by sea worm, the genus of Pilargidae which had an abundance of 21 units per square meter, accounting of 13.0% and sea worm, the genus of Sphaerodidae, Orbiniidae and Amphipod, the genus of Aoridae which had an abundance of 14 units per square meter, accounting of 8.7% equally and sea worm, the genus of Opheliidae, the genus of Nereididae, clams, the genus of Veneridae, Ostracod and Clypesteridae which had an abundance of 7 units per square meter, accounting of 4.3% equally.

SW4 : points that may not be directly affected by the project on the southwest side of runway 1, 500 meters from the coast.

During the rainy season, 2 types of benthos were found, with a total of abundance of 21 units per square meter. The most common genus found was Clypeasteridae which had an abundance of 14 units per square meter, accounting of 66.7%, and sea worm, the genus of Opheliidae, which had an abundance of 7 units per square meter, accounting of 33.3 respectively.

During the dry season, 9 types of benthos were found, with a total abundance of 105 units per square meter. The most common genus found was Clypeasteridae which had an abundance of 28 units per square meter, accounting of 26.7 and sea worm, the genus of Orbiniidae which had an abundance of 21 units per square meter, accounting of 20.0 %, and sea worm, the genus of Pilargidae, which had an abundance of 14 units per square meter, accounting of 13.3% respectively.

SW5 : Points that may not be directly affected by the project on the south side of the runway 2, 500 meters from the coast.

During the rainy season, 3 types of benthos were found, with total abundance of 63 units per square meter. The most common genus found was barnacles, the genus of *Balanus* which had an abundance of 28 units per square meter, accounting of 44.5%, followed by Amphyoxus, the genus of *Branchiostoma*which had an abundance of 21 units per square meter, accounting of

33.3% and sea worm, the genus of Spionidae, which had an abundance of 14 units per square meter, accounting of 22.2% respectively.

During the dry season, 10 species of benthos were found, with a total abundance of 161 units per square meter. The most common genus found were Opheliidae which had an abundance of 28 units per square meter, accounting of 17.4% equally, followed by sea worm, the genus of Lumbrineridae, Pilargidae, Amphipod, the genus of Aoridae and barnacles, the genus of *Balanus* which had an abundance of 14 units per square meter, accounting of 8.7 equally.

SW6 : Points that may not be directly affected by the project on the south-east side of runway 2, 500 meters from the coast

During the rainy season, three types of benthos were found. The total abundance was 63 units per square meter, the most common genus was barnacles, the genus of*Balanus* and two clams, the genus of Chamidae which had an abundance of 28 units per square meter, accounting of 44.5% equally, followed by a crab in the family of Portunidae, which had an abundance of 7 units per square meter, accounting of 11.0%.

During the dry season, 12 species of benthos were found, a total abundance of 189 units per square meter. The most common genus found was sea worm, the genus of Pilargidae, which had an abundance of 42 units per square meter, accounting of 22.2%, followed by sea worm, the genus of Nereididae and Amphipod, the genus of Aoridae with an abundance of 28 units per square meters, accounting of 14.8% equally and Amphioxus, the genus of *Branchiostoma*which had an abundance of 21 units per square meter, accounting of 11.1 respectively.

Table 3.6-14 Results of analysis of aquatic organisms in the study area of the project in the rainy season and dry season

Aquatic elements	Analysis results											
	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season
	SW1		SW2		SW3		SW4		SW5		SW6	
Phytoplankton												
Species Number	30	26	30	28	30	28	30	28	30	25	30	30
The abundance (units per cubic meter)[1/]	4,373,791	1,326,699	6,926,786	1,551,506	3,840,695	1,971,700	6,244,676	1,348,026	6,341,559	1,018,545	5,957,529	1,756,844
Diversity index	1.93	2.10	1.90	2.25	1.91	2.41	2.21	2.42	2.21	2.19	2.18	2.65
The most common genus found	*Rhizosolenia*	*Chaetoceros*	*Rhizosolenia*	*Chaetoceros*	*Rhizosolenia*	*Peridinium*	*Rhizosolenia*	*Chaetoceros*	*Rhizosolenia*	*Chaetoceros*	*Rhizosolenia*	*Peridinium*
The second most common genus found	*Chaetoceros*	*Peridinium*	*Guinardia*	*Peridinium*	*Thalassionema*	*Cyclotella*	*Chaetoceros*	*Peridinium*	*Chaetoceros*	*Peridinium*	*Chaetoceros*	*Cyclotella*
The third most common genus found	*Thalassionema*	*Oscillatoria*	*Thalassionema*	*Cyclotella*	*Chaetoceros*	*Chaetoceros*	*Guinardia*	*Cyclotella*	*Thalassionema*	*Cyclotella*	*Thalassionema*	*Guinardia*
Zooplankton												
Species Number	11	9	13	10	13	15	9	12	11	11	11	11
The abundance (units per cubic meter)[2/]	115,236	418,269	373,183	317,990	263,693	535,608	217,883	64,396	242,840	247,294	274,690	247,294
Diversity index	2.01	1.86	2.23	1.87	2.36	2.02	1.89	1.99	2.09	1.93	2.07	1.93
The most common genus found	Nauplius of Copepod	Nauplius of Copepod	Nauplius of Copepod	Nauplius of Copepod	*Tintinnopsis*	Nauplius of Copepod, Calanoid Copepod	Nauplius of Copepod	Nauplius of Copepod	Nauplius of Copepod	Nauplius of Copepod	Nauplius of Copepod	Nauplius of Copepod
The second most common genus found	Harpacticoid Copepod	Gastropod Larva	*Tintinnopsis*	Gastropod Larva	Nauplius of Copepod	Bivalvia Larva	Canaloid Copepod	*Oikopleura*	Gastropod Larva	Gastropod Larva	Gastropod Larva	Gastropod Larva
The third most common genus found	Bivalvia Larva	Canaloid Copepod	Harpacticoid Copepod	Canaloid Copepod	Gastropod Larva	Gastropod Larva	Gastropod Larva	Canaloid Copepod	Bivalvia Larva	Cyclopoid Copepod	Bivalvia Larva	Cyclopoid Copepod
Benthos												
Species Number	2	4	3	4	6	10	2	9	3	12	3	12
The abundance (units per square meter)	91	126	49	161	112	161	21	105	63	189	63	189
Genus/Genus found as dominant species	*Branchiostoma*	Family Clypeasteridae	Family Orbiniidae	Family Clypeasteridae, Opheliidae	Famiky Aoridae	*Balanus*	Family Clypeasteridae	Family Clypeasteridae	*Balanus*	Family Pilargidae	*Balanus*,Family Chamidae	Family Pilargidae

Note : [1/]Refers to cells per cubic meter or filament per cubic meter.
[2/]refer to individual per cubic meter or cell per cubic meter.
SW1 : points affected by the project on the south side of runway 1, 300 meters from the coast
SW2 : points affected by the project on the south side of runway 2, 300 meters from the coast.
SW3 : points affected by the project on the south-east side of runway 2, 300 meters from the coast
SW4 : points that may not be directly affected by the project on the southwest side of runway 1, 500 meters from the coast
SW5 : Points that may not be directly affected by the project on the south side of the runway 2, 500 meters from the coast
SW6 : Points that may not be directly affected by the project on the south-east side of runway 2, 500 meters from the coast
During the rainy season, samples were collected on 19 July 2019
During dry season, samples were collected on 1 November 2019)
Source: United Analyst and Engineering Consultant Company Limited

The analysis results of ocean-based components at present-day show that plankton during the rainy season has a higher abundance than during dry season. Because surface water with higher soil sediment or organic matter flows into the ocean causing increases in the number of some types of plankton. This results in a drop in the plankton diversity index during the rainy season. However, the genus of plankton found in both seasons is not different. It is a common genus that can be found on the sea coast, which is consistent with the benthos survey result which can be found in sea coast area.

3.7 Value of human exploitation

3.7.1 Waste management

3.7.1.1 Scope of Study

Study and collect secondary data about the airport's waste and hazardous waste disposal services, including the storage and disposal of waste/sewage by related agencies, the condition of problems and capacity to provide services, as well as future plans to manage wastewater, treatment systems, and wastewater treatment efficiency of the airport as basic information to support the assessment of the impact that may arise from project development.

3.7.1.2 Research Method

(1) Solid waste management

- Collect the volume and type of waste and hazardous waste occurring in the project area, including from other related activities, as well as the collection, transportation and disposal methods of waste, solid waste and hazardous waste, using data statistics that have been collected to provide basic information to forecast the quantity and nature of solid waste and hazardous waste generated by the construction and activation of runway and driveway 2.
- Collect information on the management system and potential of the waste management system that are currently operating, including hazardous substances such as oil and others.

(2) Wastewater Management

- Collect wastewater management data in project area.
- Collect information on the current wastewater treatment systems of U-Tapao International Airport.

3.7.1.3 Results of the Study

(1) Management of solid waste in the study area

1) Hazardous Waste Management, Rayong Province

The solid waste problem of Rayong Province is a major problem in the province level because the volume of solid waste increases every year. The amount of solid waste is about 962 tons per day or 351,094 tons per year. There are systems for disposal. The waste is in the sanitation of 3 local administrative organizations, namely:

- Rayong Provincial Administrative Organization, with an area of about 429 rai, the amount of waste from waste approximately 250 tons per day, the comprehensive range of disposal by composting and recycling the materials.
- Nakhon Rayong Municipality, with an area of approximately 100 rai, the amount of solid waste imported approximately 105 tons per day, was eliminated by dumping.
- Klaeng subdistrict Municipality, which has an area of about 80 rai. The amount of solid waste entered is approximately 51 tons per day. There was the separation of recyclable waste, organic waste composting, animal husbandry and biological-gas fermenting, and the community waste disposal system.

From the STD 2014-2018, it was found that in 2019, there was the highest amount of solid waste was 989 tons per day, followed by 2015 with 973 tons of solid waste per day. And in 2018, 968 tons of solid waste per day. Details are shown in **Table 3.7-1**

Table 3.7-1 Solid Waste Volume, Rayong Province, 2014-2018

Area	Solid waste volume (tons per day)				
	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018
In Municipality	560	586	578	610	630
Outside the municipality	382	387	319	379	338
Total	**942**	**973**	**897**	**989**	**968**

Source: National Statistical Office of Thailand (Searched on October 31, 2019)

2) Industrial Waste Management in Chonburi

Chonburi has rapidly increased solid waste as a result of the expansion of the city community. This is caused by many causes, such as the people who lack consciousness and awareness of the impacts of solid waste. The local government organizations are lack of personnel/funds/tools/good management, local waste collection and disposal is not effective, etc. causing solid waste problems in municipality, as it impacts on the environment and quality of life of population by which Chonburi has 7 from 99 local government organization that have capacity and system to dispose community solid waste i.e. Chonburi Provincial Administrative Organization, Pattaya City, Laem Chabang Municipality Si Racha Town -Municipality, Saensuk Municipality, Ban Bueng Municipality and Khet Udomsak Subdistrict Municipality Many of which have full system performance

problems which are unable to support the amount of solid waste any more causing problems with smuggling of solid waste and industrial waste in the provincial area. At present, Chonburi province still faces problems with no landfill sites because the land is expensive. It was also opposed by local population which in the future is expected to seriously affect the quality of life of the people.

According to the 2014-2018 statistics on the amount of solid waste in Chonburi, the maximum total amount of waste in 2016 was 2,620 tons per day. Later, 2018 there was a waste of 2,591 tons per day and in 2017, the amount of solid waste was 2,547 tons per, details as shown in **Table 3.7-2.**

Table 3.7-2 Solid Waste Volume, Chonburi, 2014-2018

Area	Solid waste volume (tons per day)				
	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018
In Municipality	1,953	2,041	2,117	2,046	2,202
Outside the municipality	445	446	503	501	389
Total	**2,398**	**2,487**	**2,620**	**2,547**	**2,591**

Source: National Statistical Office of Thailand (Searched on October 31, 2019)

3) Managing solid waste within U-Tapao International Airport

The management of solid waste at U-Tapao International Airport will be divided into 2 areas, namely the U-Tapao International Airport area and the Naval Aviation Division, with details as follows:

U-Tapao International Airport

The solid waste that occurs at U-Tapao International Airport comes from 2 parts, namely, air solid waste (segregated according to airline standards) and solid waste from terminals and office buildings (segregated by office maids). The types of solid waste that occur are normal waste and hazardous waste. The amount of solid waste is divided into 2 periods i.e. normal period (March-October) which has the amount of solid waste occurs approximately of 1,000-1,200 kilograms per day and during the High Season (November-February), the amount of solid waste occurs in approximately of 2,000 kilograms per day for collecting solid waste from the current U-Tapao International Airport as shown in **Figure 3.7-1** with the following details:

- One 6-wheeled garbage truck (**Figure A**) is a garbage truck that can be lifted and placed at the garbage collection points as required which is used for loading the container to collect the solid waste to the waste segregation plant.
- One 6-wheeled solid waste truck (**Figure B**), with a capacity of 6 cubic meters, is a waste truck capable of lifting a set of waste containers from the vehicle and can change other types of tank sets.
- 5 containers of solid waste containers, each with a capacity of 6 cubic meters. For current use, there will be 2 points for bins in the terminal and office building area, 1 bin each point, and 3 tanks will be reserved for future use.

- A 60-litre waste bin (**Figure C** and **D**) for various points within the terminal building.

The collection operations of solid waste for U-Tapao International Airport are currently about 1-2 times a day in the terminal area, and 1 time per day in the office building. The collected solid waste will be taken to the waste segregation plant of a private company that receives concessions from the Royal Thai Navy which is responsible for segregating in the Khao Tabaek KM.8 area which is about 6 kilometres from U-Tapao International Airport. There is also a waste water treatment facility (Leachate) in the said area.

(a) Container-lifting waste truck

(b) Hooked Waste Truck

(c) Trash bins within Terminal 2

(d) Trash bins within Terminal 2

Figure 3.7-1 Waste Management System of U-Tapao International Airport

Naval Aviation Division

The solid waste that occur within the area of Naval Aviation Division is from the residences, restaurants, convenience stores within Naval Aviation Division, offices, which solid waste found is plastics, glass, cans, food scraps, clothing, wood scraps, and paper scraps. Hazardous waste, such as light bulbs, cans of paint and spray, oil containers, and used oil, are also found. At present, solid waste collection is carried out every day. (Monday-Friday) 1-2 times a day (**Figure 3.7-2**) can be summarized as follows.

- Two 6-wheel compacted waste trucks with a capacity of 12 cubic meters. They are waste trucks equipped with a waste compactor at the back of the solid waste collection set to collect more solid waste than general waste trucks
- 650 containers of 200-litre waste receptacles for collecting solid waste.

Figure 3.7-2 Waste collection vehicle in the Naval Aviation Division

In this regard, the total volume of solid waste from the report of Naval Aviation Division began collecting statistical data of solid waste on a monthly basis. In 2019, it was found that from January to July, there was a waste in the range of 70,380-86,820 kilograms per month or about 2.27-3.110 tons per day. Details are shown in **Table 3.7-**3. The collected solid waste will be taken to the waste segregation plant of a private company that receives concessions from Royal Thai Navy, which is responsible for segregating the waste from Khao Tabaek which is about 6 kilometers from airport.

Table 3.7□3 Report of the volume of solid waste from Navy Aviation Division, 2019

Sequence	Month	Solid waste volume	
		kilograms	tons per day
1	January	70,380	2.27
2	February	86,820	3.10
3	March	73,335	2.37
4	April	77,550	2.59
5	May	70,970	2.29
6	June	74,330	2.48
7	July	72,077	2.33

Source: Naval Aviation Division, 2019

(2) Wastewater Management

1) Waste water management in Rayong province

In Rayong province, there were 2 wastewater treatment systems, but only 1 system was operated. In 2017, there was a wastewater volume of 105,033.45 cubic meters per day. The amount of wastewater supported by the wastewater treatment system was 64,000 cubic meters per day, but there was only 2,529 cubic meters per day. On average, there was less than 15 percent of wastewater entering the system. Details are shown in **Table 3.7-4**

2) Wastewater management in Chonburi

In Chonburi, there are 8 wastewater treatment systems which 2 systems did not operate. In 2017, the amount of wastewater was found about 222,457.35 cubic meters per day with the amount of wastewater that can be supported by the wastewater treatment system was 206,900 cubic meters per day, but only 134,680 cubic meters of wastewater in treatment system. On average, there are 4 out of 8 sites with less than 50 percent of wastewater entering the system and there is 1 site with more wastewater support capacity than the system wastewater treatment system, namely Pattaya City Wastewater Treatment System (Soi Wat Nong) (wastewater into the system, 120 percent), details as shown in **Table 3.7-**4**.**

Table 3.7□4 Amount of wastewater generated and amount of wastewater that entered the wastewater treatment system in Rayong and Chonburi, 2017

Province	Number of population (persons) [1/]	The amount of wastewater that was generated (cubic meters per day)[2/]	Amount of dirt (kg BOD)[3/]	The amount of wastewater treated (cubic meters per day)[4/]	Volume of wastewater at the system Wastewater treatment handled(cubic meters per day)[4/]
Rayong	700,223	105,033.45	12,604.01	2,529	64,000
Chonburi	1,483,049	222,457.35	26,694.88	134,680	206,900

Source: Environmental Quality Situation Report of the Eastern Region, 2018, Bureau of Community Wastewater Pollution Control Department

[1/] Year 2017 (Department of Administrative Affairs)

[2/] Project to develop and improve data on the rate of wastewater and the amount of contamination of community sources Pollution Control Department, 2010 equal to 150 liters/person/day

[3/] Project to develop and update wastewater rate and soil content of community-type sources, Pollution Control Department, 2010 using the BOD Loading value of 120 milligrams per liter

[4/] Report of the situation of the collective wastewater treatment system of the community, 2018, Water Quality Management Division, Pollution Control Department

3)Water management at U-Tapao International Airport

U-Tapao International Airport

The original wastewater treatment system of U-Tapao International Airport, constructed by the United States since 1965 is asewagetreatmentpond(Lagoon Treatment System) located southwest of runway 1 (located near the current Activated Sludge (AS) system as shown in

Figure 3.7-*3*, which has been in use until 1970. Wastewater treatment systems were not usable. waste water from various activities of U-Tapao International Airport. Therefore, it is collected by gravity into the wastewater intake pipe of the old wastewater treatment system. But the wastewater is not collected into the wastewater treatment system at all. Wastewater is discharged into natural drainage trough in the airport area, which connects to Khlong Bang Phai and flows into the sea.

After that in 2019, a new wastewater treatment system was built to be as Activated Sludge (AS) system of 75 cubic meters per day, located on the southwest of runway 1. It can support wastewater from Terminal 2 and buildings at the airport, with a wastewater volume of approximately 50 cubic meters per day. The treatment system can support sufficiently, as shown **Figure 3.7-4**

However, when the expansion of U-Tapao International Airport is developed, a wastewater treatment system will be built and located in the central public utility systems area which is located outside the project area. The idea is to use the road on the east side of U-Tapao International Airport as the Main Utility Corridor (outside the project area) to lay the system of wastewater collection pipe by installing pipes as an underground system to provide services in the project areas, such as Terminal 3, supporting areas, business area in front of the Gateway and Cargo for the former aviation zone will continue to use the current infrastructure by separating from the extended airport as shown in **Figure 3.7-*3***.

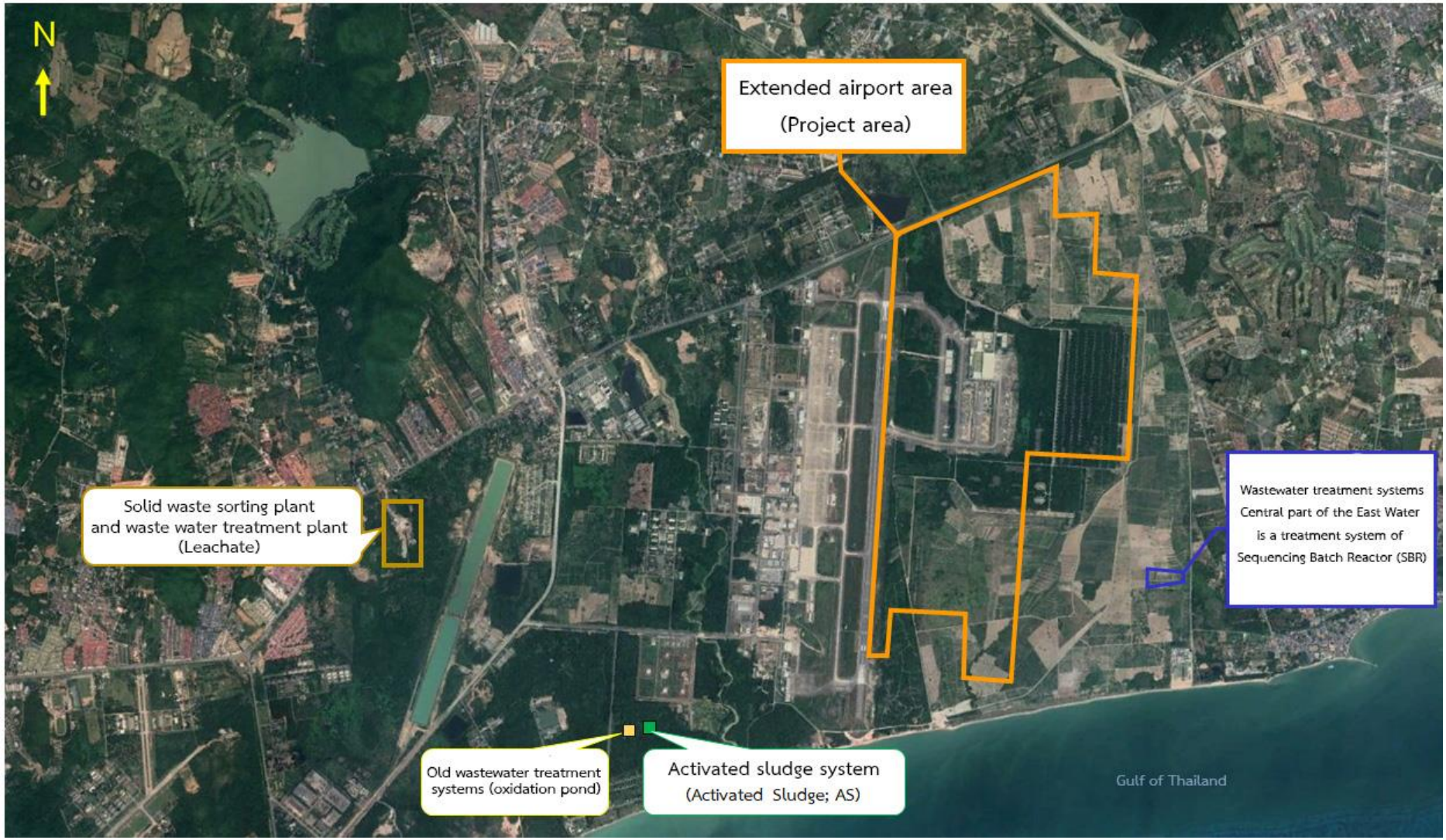


Figure 3.7□3 Location of the wastewater treatment system (Failed) Active Sludge (AS) wastewater treatment system in use today. Waste segregating plant and Leachate treatment plant

(a) Affluid-activated sludge (AS) systems

(b) Chemical filling tank

(c) Aeration Tank

(d) Drainage wells

Figure 3.7 4 Current wastewater treatment system of U-Tapao International Airport

3.7.2 Land use

3.7.2.1 Scope of Study

Collect land use data from the study area from secondary data, as well as additional field surveys to support basic data in predicting the potential impact of the project.

3.7.2.2 Research Method

(1) Secondary data

Collect relevant documentation related to the city plan and land use data from local administrative organisations, the Department of Civil Works and City Plan, City Plan Requirements in the study area, as well as regulations and legal requirements related to the use of other land, aerial photographs information before and after construction of U-Tapao International airport.

(2) Primary data

Conducted a field survey between 9-20 September 2019, divided the study into 2 parts, namely, U-Tapao International Airport area and study area, which conducted a thorough field survey on land and community sources. Using the basic land utilization data collection methods of the Department of Land Development of Rayong and Chonburi. Aerial photographs of the Department of Military Map and Satellite Photos from Google Earth 2019, by using computer programs in the information system, together with the visual interpretation. Land classification is divided into 24 types which adapted from Land Use Classification of Department of Land Development 2009 and land use schedule as classified annexed to the Ministerial Regulation To come into force in the City Plan of Chonburi Province, 2017 and Rayong Province, 2017.

In preparation of the data for land use studies, information related to land use was collected in the study area, which includes:

1) Land use data of Department of Land Development Department, 2018
2) Military Map Department Terrain Map Scale 1: 50,000 Series Sequence L7018
3) Aerial photographs of the Military Map Department at the study area, taken in 2019 and revised the Geometric Correction, which adjusted the locational errors and adjusted the size to align with the terrain map of the Department of Military Map in a 1:50,000 scale for accuracy. The following procedures are performed:
    - Preparation of the information to be used in the translation, namely the terrain map of the Department of Military Map, a 1:50,000 scale, and a photo of Department of Military Map in 2019.
    - Satellite image translation to classify the type of land use as required, using a color intensity of Grey Tone, Density, Texture, Shape, Pattern, Size, Shadow, Site and Associated Features.
    - Visual interpretation by categorizing land use into the following 4 main categories:
        - Agricultural area
        - Water source area
        - Community area and building
        - Other areas, such as wasteland, perennials, etc.
    - Prepare a map of basic land use which is derived from the military's aerial photographs 2019 of Department of Military Map and data collected.

- Take the basic land use map and check the actual land conditions and bring it back to adjust the information to be the most accurate and up-to-date.

3.7.2.3 Results of the Study

(1) Secondary data

In accordance with the announcement of the Eastern Region Special Development Zone Policy Committee, Re: Land Use Chart and Infrastructure and public utility systems Development Chart, Eastern Region Special Development Area, 2019 (as **Appendix 3-9**) shall apply the land use map and the infrastructure and public utility systems development chart in the Eastern Region Special Development Area in Chachaoengsae, Bangkok, Samutprakarn, Chonburi and Rayong within the boundaries of the map shown at the end of this announcement except for the areas within the following boundaries to use according to the purpose of that land in accordance with applicable laws, rules, regulations, ordinances or notifications which is not subject to the use of the land specified in this announcement, such as the royal court area and the area that has been used or reserved for the benefit of the military service.

According to Section 3, Plans and Requirements, Part 1, Land Utilization Chart, Section (4) Land category of KorGor., designated as a brown land in the special economic promotion zone for special business with the objective of supporting the important project in developing the Eastern Region Special Development Zone according to the policy of Eastern Region Special Development Zone, classified as B.K.-1 to B.K.-5 as shown in **Figure 3.7-5**

Class KorGor.-1 to KorGor.-5 land designated as brown is land in the special economic promotion zone for special business as follows:

KorGor.-1 Promotion Zone: High-speed rail links 3 airports
KorGor.-2 Promotion Zone: Industrial Promotion and Digital Innovation Zone and Eastern Economic Corridor Innovation Zone
KorGor.-3 Promotion Zone: Eastern Economic Corridor Innovation Zone
KorGor.-4 Special Economic Promotion Zone : Integrated Medical Innovation Zone Thammasat (Pattaya)
KorGor.-4 Promotion Zone: Eastern Aviation City

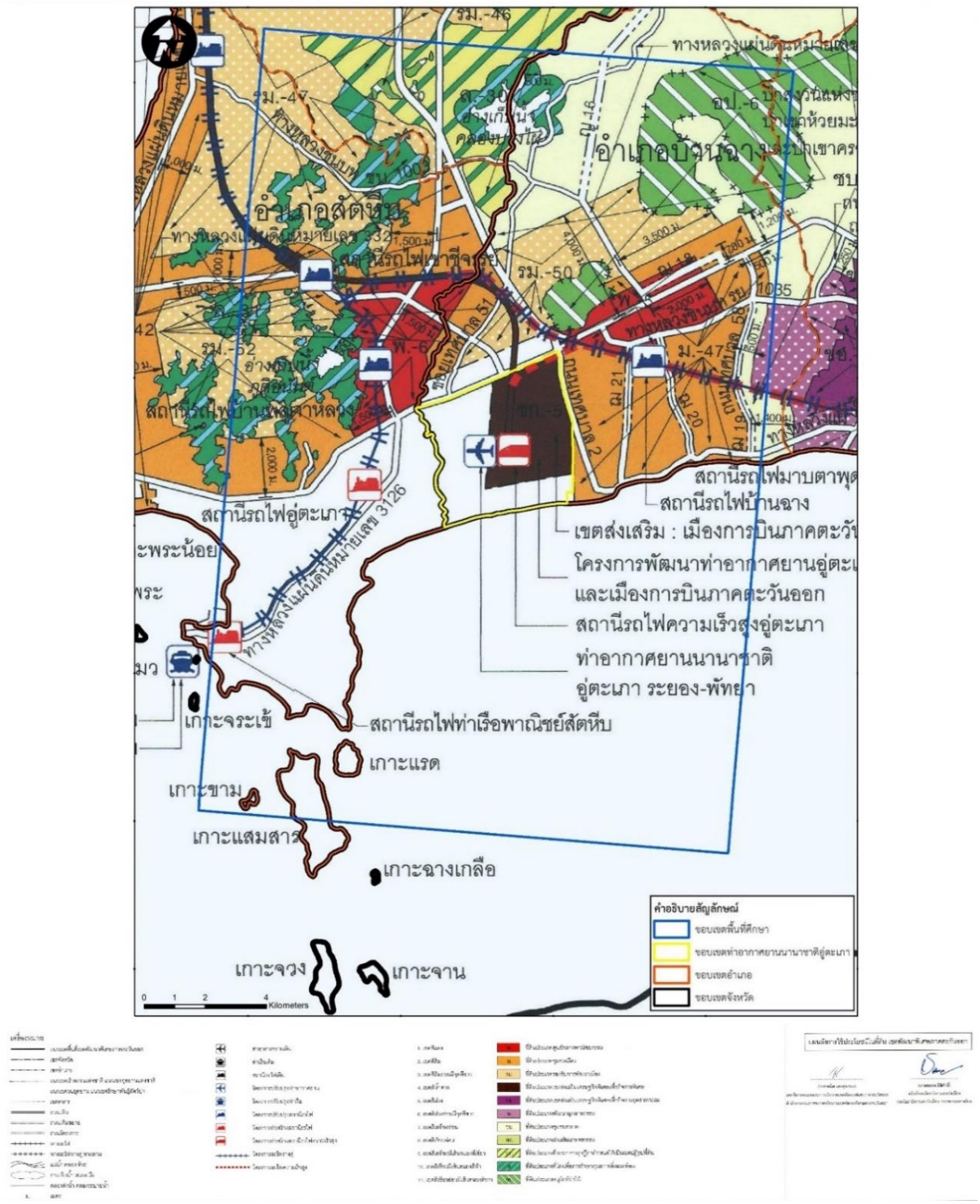


Figure 3.7 5 Land Utiliztion Chart at the end of the announcement of Eastern Special Development Zone Policy Committee on land use plan and infrastructure and public utility systems development plans, Eastern Special Development Zone, 2019 in the project study area

Total City Plan

1) Rayong

The ministerial regulation apply to the city plan of Rayong 2017 (Volume 134, Section 9, A announced in the Government Gazette on January 19, 2017). In accordance with this ministerial regulation, there are policies and measures for the efficient use of transportation network land and public services, which can support and be consistent with the expansion of the community in the future, as well as promoting and developing the economy. Details are as follows:

- Promote and develop Rayong as centre for industrial, agriculture, trade, services and tourism
- Promotes and develops residential and commercial activities in accordance with the expansion of the community and the economy of the province.
- Promote and develop Rayong as an important tourist attraction to be in line with being a tourism centre
- Promote and develop social services, public utilities and public facilities that are adequate and meet standards
- Conserving natural resources and the environment

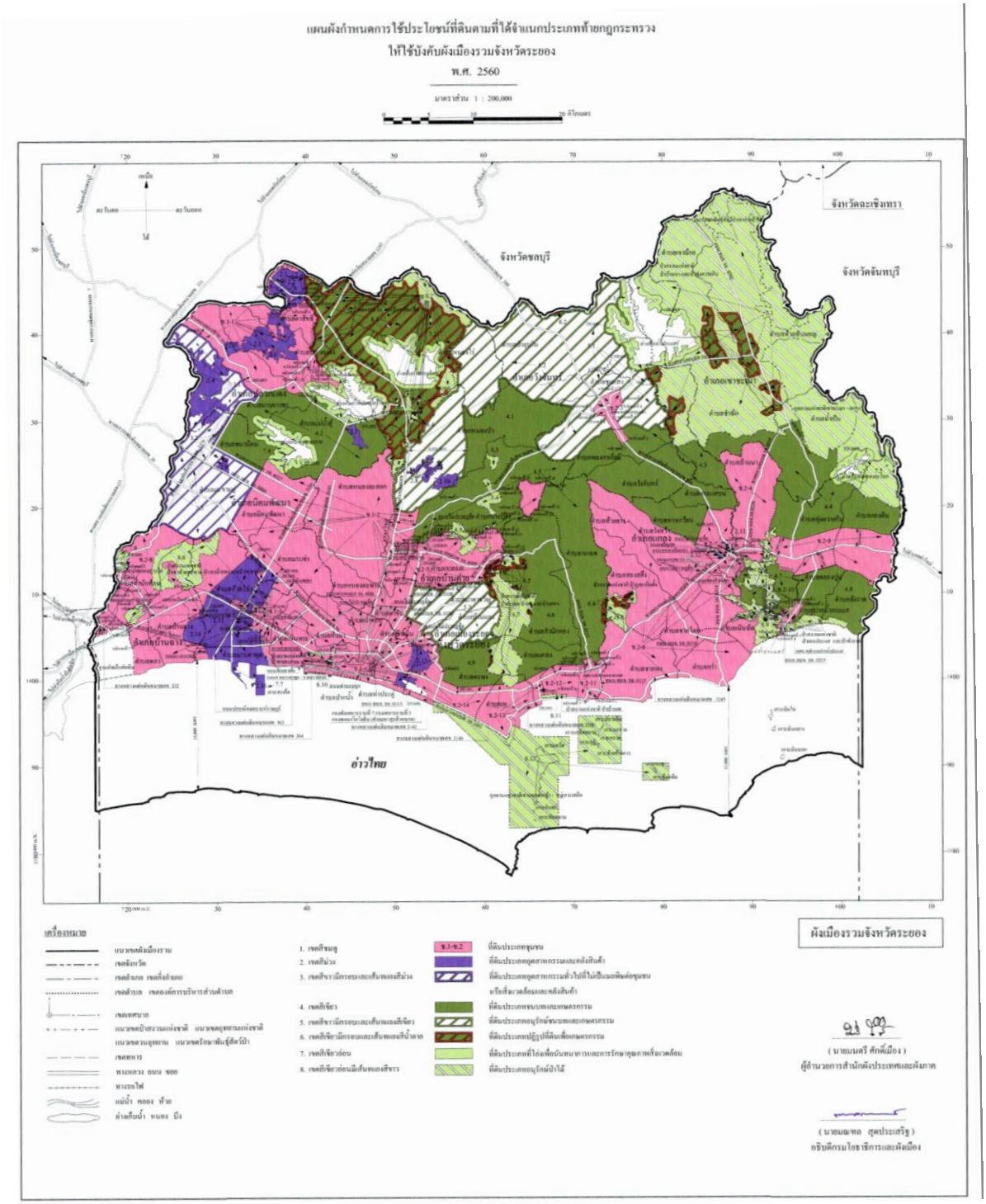
Details of the land use schedule plan as classified at the end of the ministerial regulation shall be applied to the city plan of Rayong, 2017, shown in **Figure 3.7-6**

2) Chonburi

The ministerial regulation shall apply to the city plan, Chonburi, 2017 (Volume 134, section 49 A, announced, in the Government Gazette, on 3 May 2017). In accordance with this ministerial regulation, there are policies and measures to organize, land, use transportation network, and public services to be more effective and consistent with the expansion of the community in the future, as well as promoting and developing the economy, with the following details:

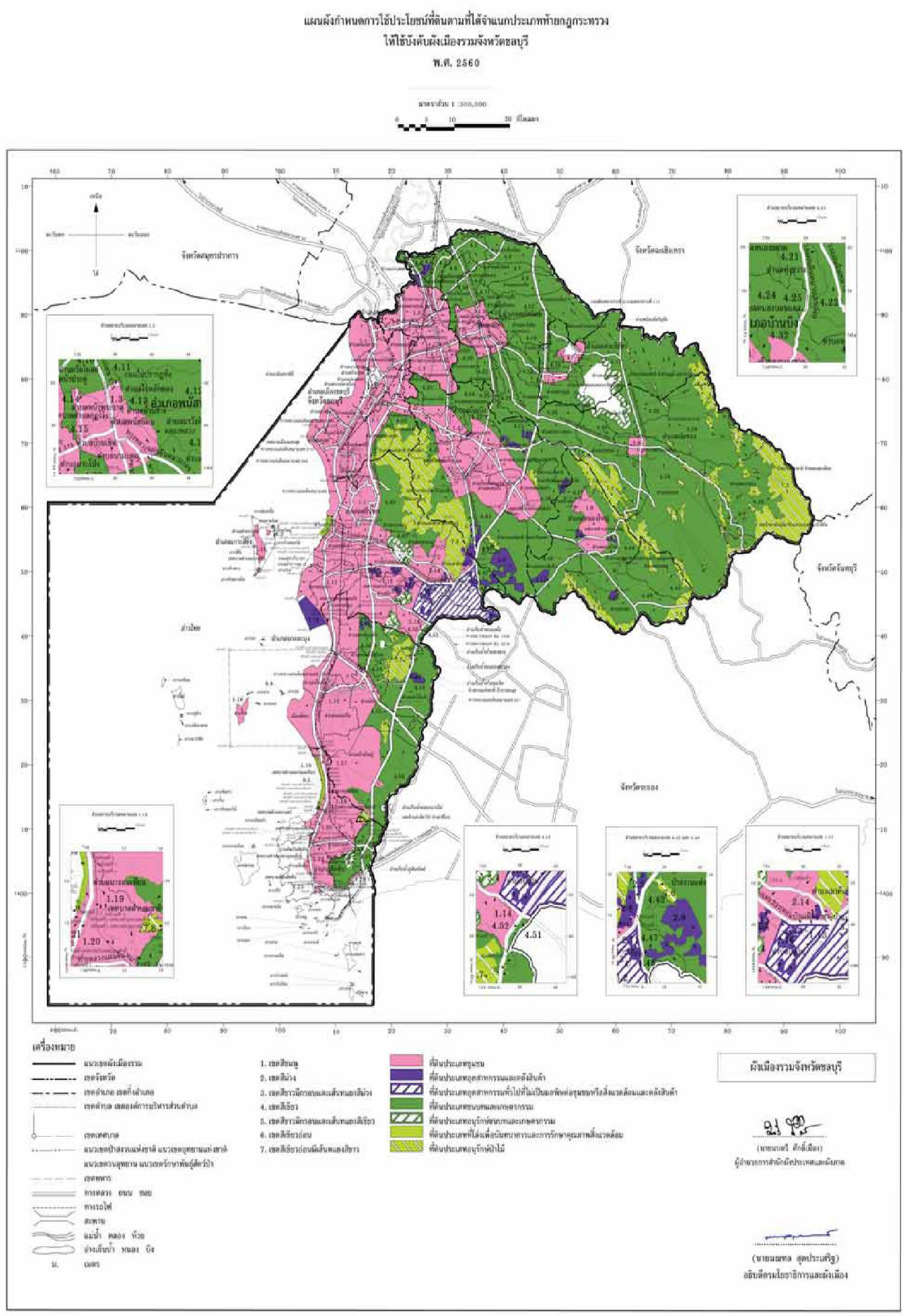
- Promote and develop Chonburi as a centre for industrial, agricultural and tourism sectors.
- Promoting and developing Chonburi in trade, investment, industrial, agricultural and tourism in order to comply with the development of Eastern Seaboard Development Project.
- Promote and develop social services and public utilities and public facilities to be sufficient and meet with standard
- Conserving natural resources and the environment

Details of the land use map according to the classification at the end of the ministerial regulation shall be applied to the city plan of Chonburi, 2017 as shown in **Figure 3.7-7**



Source: Office of Public Works and Town & City Plan, Rayong (Retrieved on 15 November 2019).

Figure 3.7 6 Land Utilization Schedule as classified by the end of the ministerial regulation to be in effect. The City Plan of Rayong, 2017



Source: Office of Public Works and City Plan, Chonburi Province (Retrieved on 15 November 2019).

Figure 3.7 7 Land Utilization Schedule as classified by the end of the ministerial regulation, to be in effect. The City Plan of Chonburi, 2017

Land use of Rayong and Chonburi provinces

The land use of Rayong and Chonburi provinces between 2016-2018 (Source: Department of Land Development, 2019) found that land use areas have been divided into 5 categories, namely community and building areas, agricultural areas, forest areas, water areas, and miscellaneous areas which can be summarized as follows:

- **Rayong**

The land use in Rayong was mostly found that in 2018, agriculture use, with the largest number of 1,508,258 rai (67.92%), followed by a community and building area of 329,629 rai (14.86%), and forest areas in the amount of 174,604 rai (7.86 percent). Compared with land use in 2016, it was found that agricultural areas dropped by 2.01%. The community areas increased by 5.93% and forest areas decreased by 3.22%, details as shown in **Table 3.7-**5 Land utilization.

- **Chonburi**

The land use in Chonburi was mostly found that in 2018, agriculture use with the largest number of 1,561,590 rai (57.24%), followed by a community and building area of 602,742 rai (22.11%) and forest areas in the amount of 311,641 rai (11.44%). Compared to land use in 2016, it was found that agricultural areas dropped by 4.11%, community and building areas increased by 7.84% and forest areas increased by 2.55%, details as shown in **Table 3.7-5** Land utilization.

Table 3.7□5 Land utilizationtypes of Rayong and Chonburi, 2016 and 2018

Province	Year	Land use area (rai)				
		Community area and buildings	Agricultural area	Forest area	Water area	Miscellaneous area
Rayong	2016	311,180 (14.02)	1,539,213 (69.30)	180,286 (8.13)	82,761 (333.74)	106,560 (4.81)
	2018	329,629 (14.86)	1,508,258 (67.92)	174,604 (7.86)	85,429 (3.85)	122,080 (5.51)
Percentage change		**5.93**	**-2.01**	**-3.22**	**3.22**	**14.56**
Chonburi	2016	558,935 (20.49)	1,628,574 (59.73)	303,903 (11.14)	67,207 (2.47)	168,256 (6.17)
	2018	602,742 (22.11)	1,561,590 (57.24)	311,641 (11.44)	79,142 (2.91)	171,760 (6.30)
Percentage change		**7.84**	**-4.11**	**2.55**	**17.76**	**2.08**

Source: Division of Land Use Policy and Planning Department of Land Development (http://www1.ldd.go.th/WEB_OLP/report_research_E.html)

(2) Primary data

Conducted a field survey between 9 2-20 September 2019 with the following summary:

1) Land use in U-Tapao International Airport area, comprising of:

- The military use area is approximately 3,946.43 rai or 6.31 square kilometers, currently a building area and military agency.
- The current airport area, approximately 2,724.14 rai or 4.36 square kilometers, is currently the passenger terminal area and all useful aviation areas are currently available.
- The airport area has an extension of approximately 4,290.47 rai or 6.86 square kilometers. Currently, it is an area for aviation use and free space.
- The Airport City area and supporting areas are approximately 1,813.78 rai or 2.90 square kilometers. Currently, it is a space and a waiting area for development, which is utilized and managed by the EECO and it will be delivered to the private sector as a joint venture.

The entire area is located in the Phala subdistrict, Ban Chang District, Rayong. The use of the area in the U-Tapao International Airport area is shown in **Figure 3.7-8** U-Tapao International Airport Area Utilization while the current conditions of land use are shown in **Figure 3.7-10**

2) Utilization of study area land around U-Tapao International Airport

Land use survey is a study of land use conditions surrounding U-Tapao International Airport currently using aerial photograph from Department of Military Map, together with images from Google Earth 2019, using computer programs for surveying in the Geographic Information System, together with visual interpretation.

Then, a land use study was conducted in the surrounding areas that are within the distance of the border of U-Tapao International Airport to the east and west of 6 kilometers each, and the north and south sides of 10 kilometers each around. U-Tapao International Airport has an area of approximately 276,388.89 rai or 442.31 square kilometers located in the administrative area of 10 sub-districts, 4 districts, 2 provinces, namely Samnak Thon Sub-district, Ban Chang subdistrict, Phala Subdistrict, Ban Chang District, Huai Pong Sub-district, Mueang Rayong District, Rayong and Huai Yai Sub-district Bang Lamung District, Na Jomtien Subdistrict, Bang Saray Subdistrict, Sattahip Subdistrict, Phlu Ta Luang Subdistrict, Samaesarn Subdistrict, Sattahip District, Chonburi by categorizing the land use into 24 categories, which have been modified from the land use classification according to the Land Use Classification of the Department of Land Development, 2009 and the land use schedule according to Classified in the end of the Ministerial Regulation to come into force in the total city plan of Chonburi Province, 2017 and Rayong, 2017.

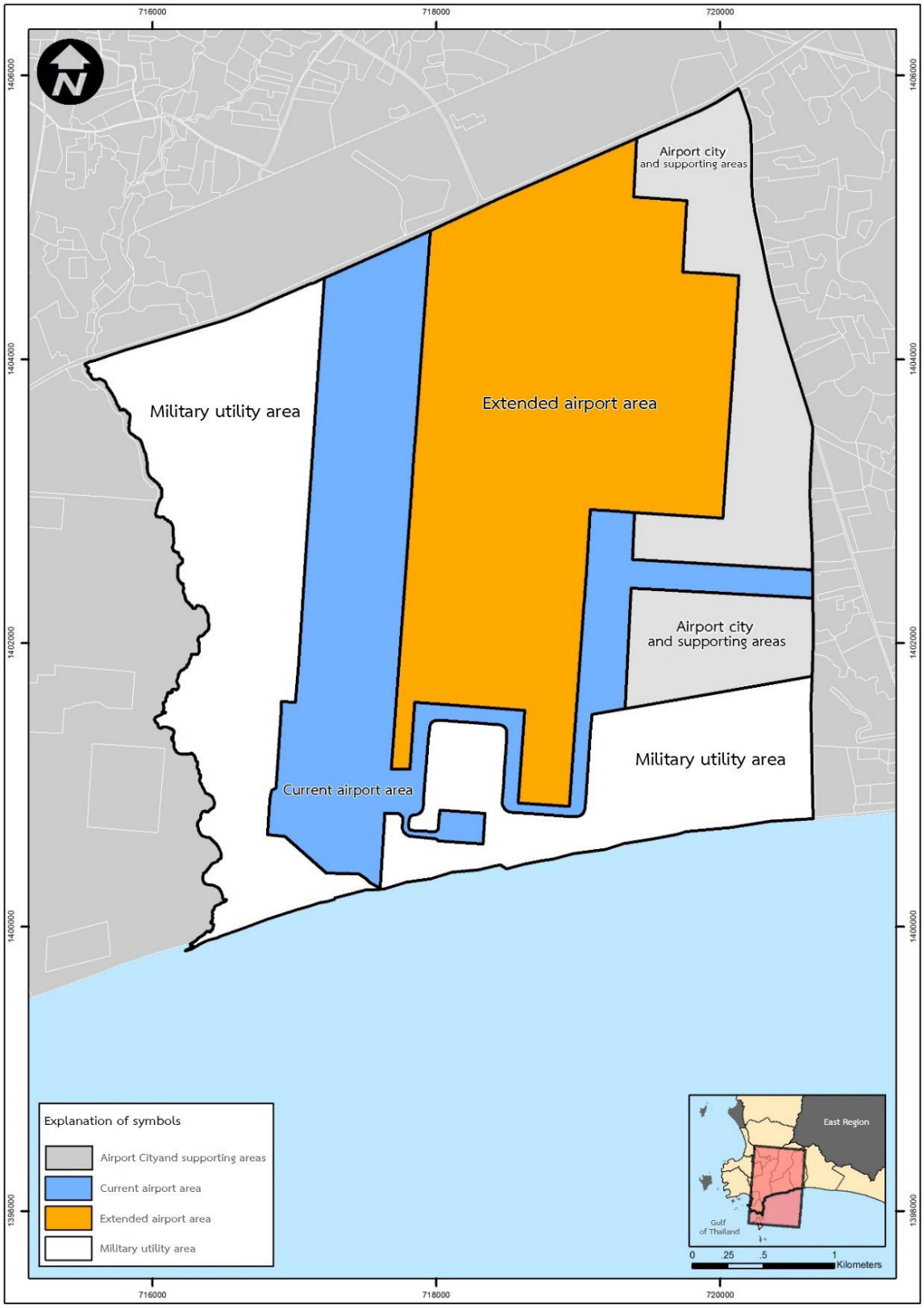
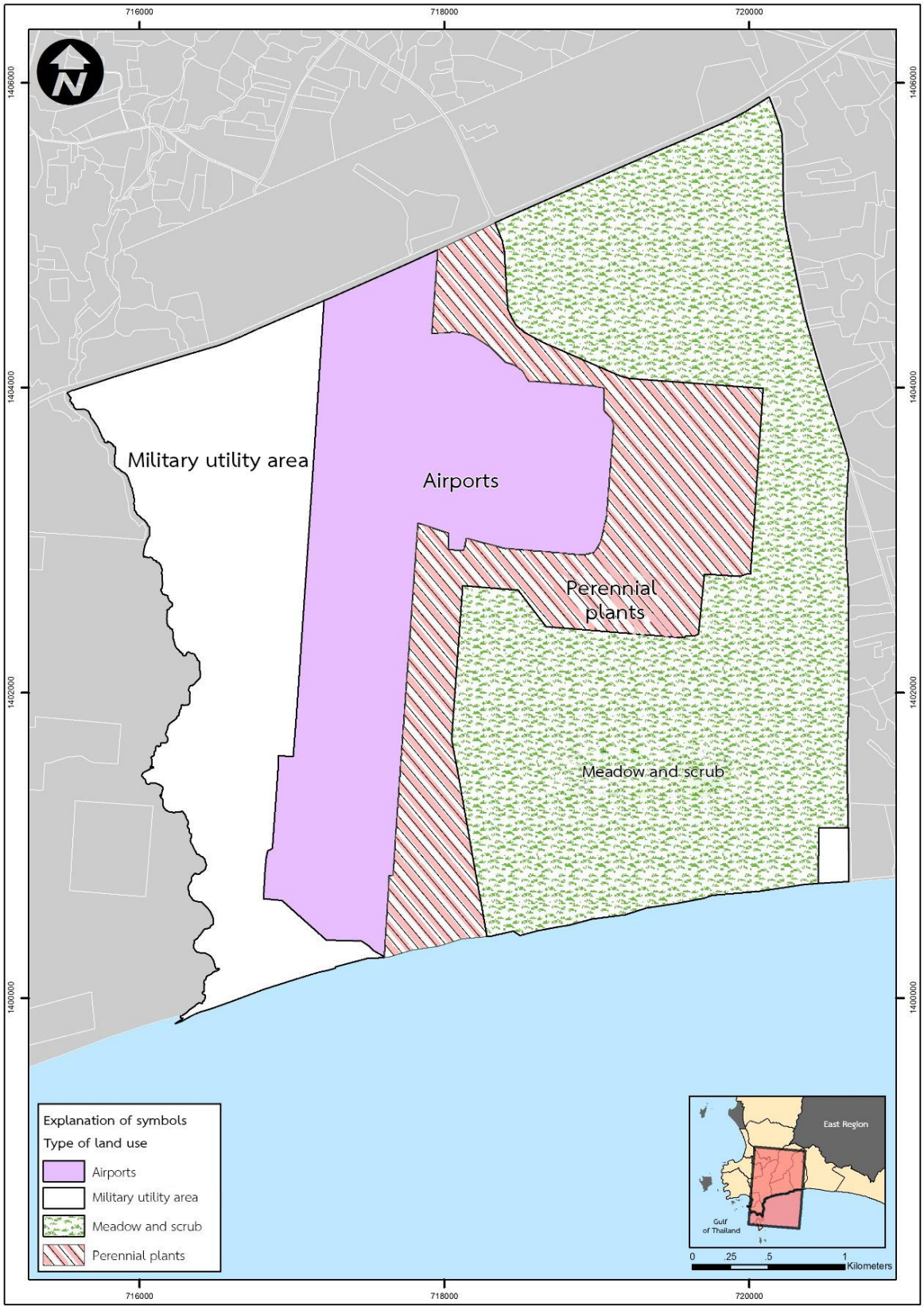


Figure 3.7 8 U-Tapao International Airport Area Utilization Format



Source: 2019 photo transformation with a survey in 2010

Figure 3.7-9 Current Status of Land Utilization in U-Tapao International Airport Area

It consists of the top 10 types of land use as follows:

- Deciduous forest, approximately 33,492.22 rai, or 12.12 percent of the study area.
- Field crops, approximately 30,102.05 rai, accounting for 10.89 percent of the study area.
- Village allocated approximately 24,059.07 rai, or 8.70 of the study area.
- Military use area, approximately 19,390.12 rai, or 7.02 percent of the study area.
- Meadows and groves were approximately 17,292.67 rai, accounting for 6.26% of the study area.
- Approximately 14,635.44 rai, representing 5.30% of the study area.
- Approximately 12,599.08 rai of fruit trees, representing 4.56% of the study area.
- Built water sources, approximately 4,868.96 rai, or 1.76% of the study area.
- Approximately 3,438.84 rai of the industrial area of the study area
- The commercial district (commercial) is approximately 2,858.95 rai, or 1.03% of the study area.
- The marine area of 101,086.53 rai is 36.57 percent of the study area.

Details of land use are shown in **Table 3.7-**6 and **Figure 3.7-**10

Land use according to the City Plan Act

U-Tapao International Airport is located in Phala Subdistrict. and Ban Chang District, Rayong and adjacent to the area of Phlu Ta Luang subdistrict, Sattahip District, Chonburi which determines the type of land use in the Rayong City Plan, namely the Rayong Comprehensive City Plan, 2017, and the type of land use in the Chonburi City Plan, which is the Combined City Plan of Chonburi, 2017, with Detailed classification of land use in each city plan area in **Figure 3.7-**11.

Table 3.7-6 Land use categories surrounding U-Tapao Airport in 2019

Sequence No.	Land use category	Area (rai)	Area (square meters)	Percentage
Agricultural area				
1	Field crops	30,102.05	48.16	10.89
2	Perennial Trees	14,635.44	23.42	5.30
3	Fruits	12,599.08	20.16	4.56
4	Pastures and Sheds	221.80	0.35	0.08
5	Aquaculture facility	124.33	0.20	0.04
6	Horticulture	94.35	0.15	0.03
7	Rice field	45.21	0.07	0.02
Community area and building				
8	Village	24,059.07	38.49	8.70
9	Military use area	19,390.12	31.02	7.02
10	Industrial area	3,438.84	5.50	1.24
11	Government sites and institutions	2,891.65	4.63	1.05
12	City and commercial areas	2,858.95	4.57	1.03
13	Golf Course	2,654.12	4.25	0.96
14	Transport Station	2,499.23	4.00	0.90
15	Other structures	1,567.65	2.51	0.57
Water area				
16	Generated water sources	4,868.96	7.79	1.76
17	Natural water sources	386.35	0.62	0.14
Forest area				
18	Deciduous forest	33,492.22	53.59	12.12
19	Planted forests	47.59	0.08	0.02
Other areas				
20	Meadow and scrub	17,292.67	27.76	6.26
21	Other areas (Reclaimed area, materials pile area)	1,012.14	1.62	0.37
22	Mines and wells	802.99	1.28	0.29
23	Beach	145.43	0.23	0.05
24	Lowland area	72.12	0.12	0.03
25	Marine area	101,086.53	161.74	36.57
Total		**276,388.89**	**442.31**	**100.00**

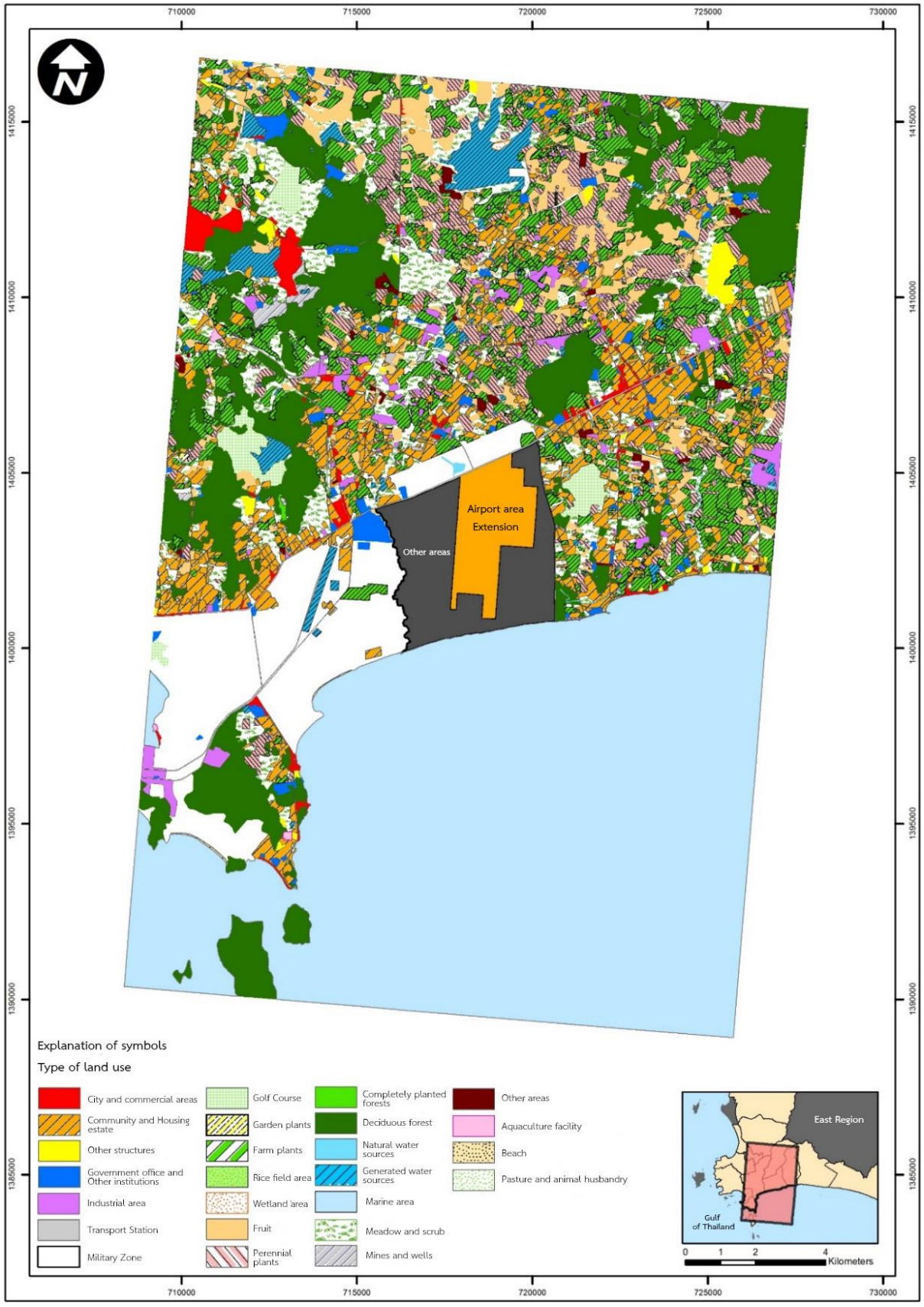
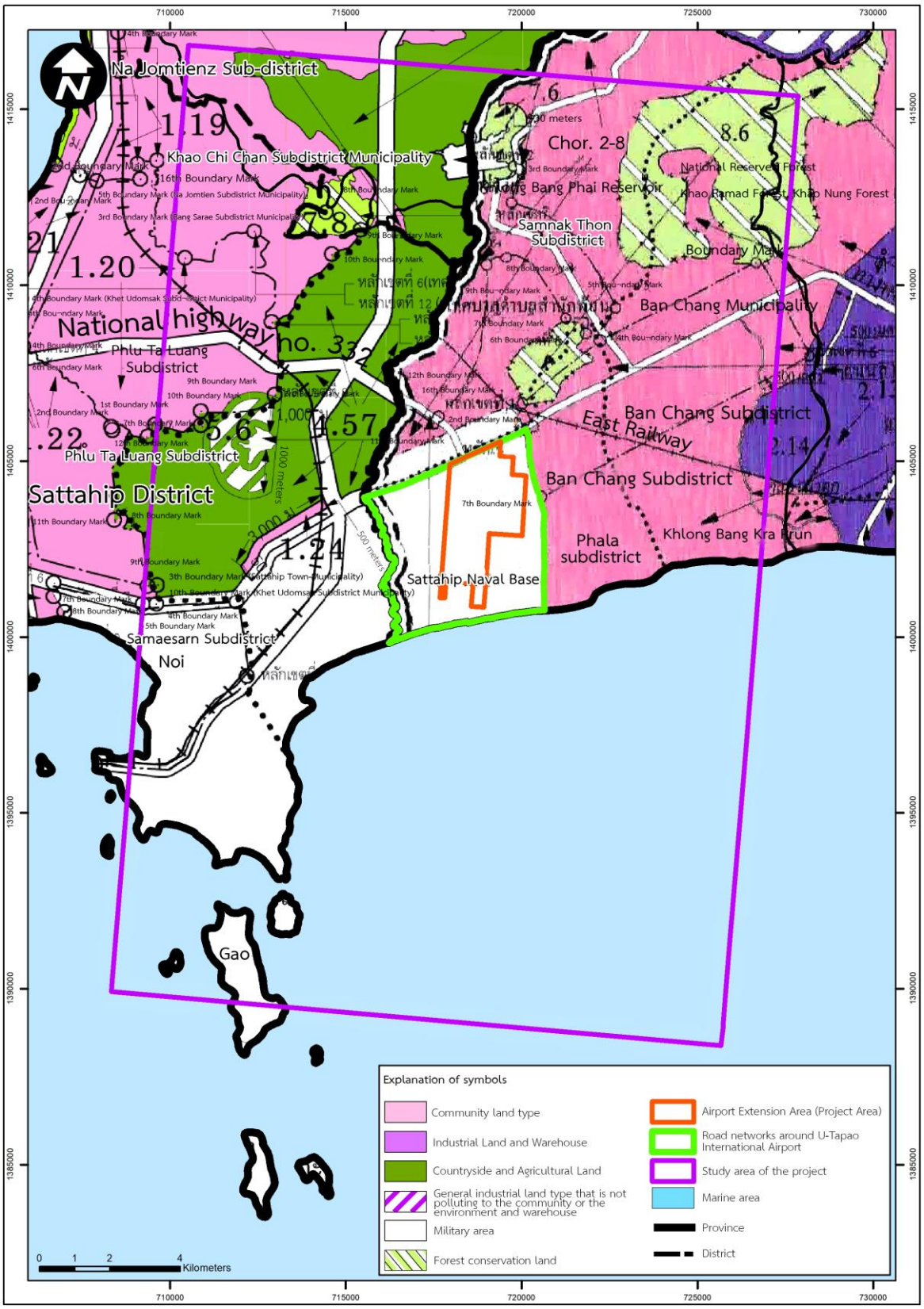


Figure 3.7 10 Plan showing the type of land use for study areas surrounding U-Tapao International Airport, 2019

From the examination of the nature of settlements and land use control according to the ministerial regulation to enforce the city plan, including 2 issues, the airport area and the area around the airport have land use as follows:

The area of U-Tapao International Airport location is located in city plan area of Rayong in 2017, in the area of grey. It is designated as the military area, the north side is connected to the highway number 3, and the highway number 7 (Motorway), the south is adjacent the Gulf of Thailand, the east side is connected to Thesaban 2 Road, Phala Subdistrict, Ban Chang District, and the west side is connected to Khlong Bang Phai and Sattahip Naval Base.

- **Northern area** Area contiguous to the airport via National Highway No. 3, Highway No. 332 and Intercity Highway No. 7 (Motorway) to Samnak Thon Subdistrict, Ban Chang District, located in the Rayong Comprehensive City Plan 2017 in the pink area which is designated as community land which is a community and residential area with low to moderate density. It is characterized by settlements along the length of the road (Linear Settlement) and the light green area with white diagonal lines. Designated as a forest conservation land in the area of Khao Krok Tabaek and the National Forest Reserve.
- **Southern area**is the sea and beach area of the Gulf of Thailand that is connected to the airport of Phala Subdistrict, Ban Chang District, in the Comprehensive City Plan Area of Rayong Province, 2017, which is under the supervision of the Sattahip Naval Base.
- **Eastern area** The area connected to the airport via National Highway No. 3 and Intercity Highway No. 7 (Motorway) to Ban Chang Subdistrict, Ban Chang District, is in the Rayong Province Total City Plan 2017 in the pink area which designated as community land. It is a medium to high density community and residential area. It is a cluster settlement pattern in the town of Ban Chang. Along National Highway No. 3, Sukhumvit Road and National Highway No. 3376, there is a longitudinal settlement of the road (Linear Settlement Pattern).
- **Western area**, next to Khlong Bang Phai and the south side of National Highway No. 3, National Highway No. 3126, heading into the Sattahip Naval Base area. It is an area of Sattahip Sub-district, Sattahip District, in the City Plan Area of Chonburi Province, 2017, designated as a military area type of land use. The north side of National Highway No. 3 is a green area which is designated as rural and agricultural land. There are settlements along National Highway No. 3 and National Highway No. 332, which continue from the expansion of urban communities in the area of Na Jomtien Subdistrict, Sattahip District, Chonburi Province.



Source: Adapted from the Government Gazette, Volume 136, Special Section 301 D, Announcement of the Eastern Economic Corridor Policy Committee Re: Land Utilization Plan and infrastructure and public utility systems development plans Eastern Special Development Zone, 2019

Figure 3.7-11 Land Utilization Chart at the End of the Announcement of the Committee on East Region Special Development Areas, Re: Land Utilization Chart and Infrastructure and Public Utility Systems, East Region Special Development Area, 2017

3.7.3 Transportation

3.7.3.1 Scope of Study

Collect transportation network data, ground traffic volume, and future transportation system development plans to serve as basic data to anticipate the potential impact of project development.

3.7.3.2 Research Method

Collect secondary data as follows:

(1) Ground transportation

- Traffic volume information on transport routes related to the project from the report of average daily traffic on highways. of the Office of Safety Director, Department of Highways during the year, 2014-2019
- Calculate traffic volume to road capacity ratio or V/C Ratio as assessed by equation

$$\text{V/C Ratio} = \frac{\text{Traffic Volume (PCU/hr.)}}{\text{Road Capacity (PCU/hr.) x No. of Lane}}$$

- Each vehicle type requires a weighted value from the Passenger Car Unit (PCU) value as Passenger Car Equivalents (PCE) as detailed in**Table 3.7-**7
- Road traffic analysis and service level analysis use the principles of Highway Capacity Manual 2010 (HCM 2010) to know the level of service (Level of Service: LOS) of the road project and check the sufficiency of the traffic lanes to suit the anticipated traffic volume by ensuring that the service level of the route is within the specified criteria.

Table 3.7-7 Type of Vehicle with Passenger Car Unit (PCU)

Vehicle Type	PCU (Passenger Car Unit)
Motorcycle	0.333
Cars with no more than 7 passengers	1.00
Cars with more than 7 passengers	1.00
Mini bus	1.50
Mid-sized buses	1.50
Big bus	2.10
4-Wheeled Mini Truck	1.00
6 Wheeled Medium Truck	2.10
10 Wheeled Large Truck	2.50
Tow Truck	2.50
Semi-Tow Truck	2.50

Source: Analysis report calculates traffic congestion index and traffic congestion. Office of Safety Director, Department of Highways, Year 2019

For road capacity or load capacity, the terms of the Department of Highway Engineering as detailed in **Table 3.7-8** will Table 3.7-8

Table 3.7-8 Road Capacity

Road type	Vehicle Support capacity (C)
Freeway	2,200 PCU/Lane/hr.
Multiple Lane Highway	2,000 PCU/Lane/hr.
2 Lanes Highway, 2 Direction	2,000 PCU/hr.
3 Lanes Highway, 2 Direction	4,000 PCU/hr.

Source: Division of Engineering, Department of Highway, 2019

Analysis of traffic conditions to assess the mobility of the traffic on the transport routes in the study area including the assessment of the impact of transportation will analyze the condition of mobility in traveling traffic flow efficiency by using the service level of the communication network (Level of Service: LOS) as an indicator according to traffic engineering theory Service Level Assessment and the traffic volume capacity of the road network is categorized into 6 letters, from level A to level F, as a qualitative measure, ranked from best to worst as shown in **Table 3.7-9.**

Table 3.7-9 Classification of service levels of the road network

Level of service provided	Description	V/C Ratio	Traffic conditions
A.	Independent flow that can be selected at any level of speed and will be overtaken. At this level, drivers and passengers can travel quickly without any impacts from other cars.	0.00 < A ≤ 0.60	Extremely smooth
B	Fixed flow, but the car user can see other cars clearly and choose the speed they want, but there is no flexibility in overtaking cars in the same route.	0.60 < B ≤ 0.70	Smooth.
C	Fixed flow, but drivers are affected by other cars. When choosing car speed and overtaking, drivers must take care in the journey. Comfort and flow will be reduced.	0.70 < C ≤ 0.80	Fair smooth.
D	The flow is dense and unstable. The speed and maneuverability of overtaking will be limited. Convenience and flow are reduced. And a slight increase in traffic volume will cause traffic problems. On a certain level	0.80 < D ≤ 0.90	Very stuck
E	Flow levels near or in critical conditions means the speed of all vehicles will decrease but still running at a consistent speed. Overtaking is difficult and asking for directions to increase the convenience of traveling but the ease of flow is reduced. This makes the driver unable to drive as he wants. Therefore, this level of maneuverability will not be stable due to the increased traffic or confusion from drivers in the traffic route which will cause a jam	0.90 < E ≤ 1.00	Stuck Severely
F	This level is a condition that occurs when the traffic in a group (Platoon) exceeds the amount that can flow due to exceeding the capacity of the traffic lane where the cars are arranged in the form of rows and moving intermittently similar to the Shock Wave, which is very congested, the traffic is almost at a standstill.	F > 1.00	almost unable to move

Source: Analysis report calculates traffic congestion index and traffic congestion. Office of Safety Director, Department of Highways, Year 2019

(2) Air transportation

- statistical data on the number of flights in U-Tapao International Airport during 2015-2019
- Statistical data on the number of domestic and international passengers during 2015-2019

3.7.3.3 Results of the Study

(1) Ground transportation

1) Road Transport Network

Main road network surrounding the project area consists of the main road and secondary road that canaccess the project area, namely the Highway No.7(Bangkok-Ban Chang in phase of Pattaya-Map Ta Phut), Highway No.3 (Sukhumvit road), Highway No.331, Highway No. 332 and Highway No. 3126, the network shown in **Figure 3.7-**12 and can be summarized as follows:

- **Highway No. 7 (Bangkok - Ban Chang, in the phase of Pattaya - Map Ta Phut):** This is a new road construction. There is a starting point connecting to Highway No. 7 at the Mabprachan Intersection passing Bang Lamung District, Sattahip District, Chonburi Province and converge with Highway No. 3, Ban Chang District, Rayong Province, a total distance of 32 kilometers.
- **The National Highway No.3 (Sukhumvit Road)** is a very important route for transporting goods and raw materials from various regions to Rayong area. It is an important economic route in the East. It originates from Bangkok via Samutprakan, Chonburi, Rayong, and Chanthaburi, and ends at Trat Province. It is a 6-lane road, some of which passes through the community areas, which have been found to be very heavy traffic during the community, as well as being transportation channel to the various parts of the eastern region.
- **Highway No. 331 (Sattahip-Khao Hin Son) :** Mainly known as Strategic Road, construction route and open in 1974 to support military mission. The route starts from Sukhumvit Road at Phlu Ta Luang subdistrict, Sattahip District, Chonburi, ending at Khao Hin Son Subdistrict, Phanom Sarakam District, Chacheongsao, a total distance of 156.397 kilometers, and it is the 4 Lane in 2017.
- **Highway No. 332 (Sattahip-Samnak Thon Route) :** Mainly known as Sattahip Bypass Road, starting from Highway No. 3 at Hat Sare Subdistrict, Sattahip District, Chonburi ending at Highway No.3 at Phala Subdistrict, Ban Chang District, Rayong, a total distance of 14.487 kilometers. It is 2 lane road.
- **Highway number 3126 (Phlu Ta Luang-Samaesarn) :** It is the main route between Chonburi and Chachoengsao provinces. The Highway Department has expanded the Highway No. 3126, junction route number 3 in the Phlu Ta Luang Subdistrict, Sattahip District, Chonburi Province, a total distance of 3.4 kilometers to support the journey into U-Tapao International Airport. It is 4 lane road.

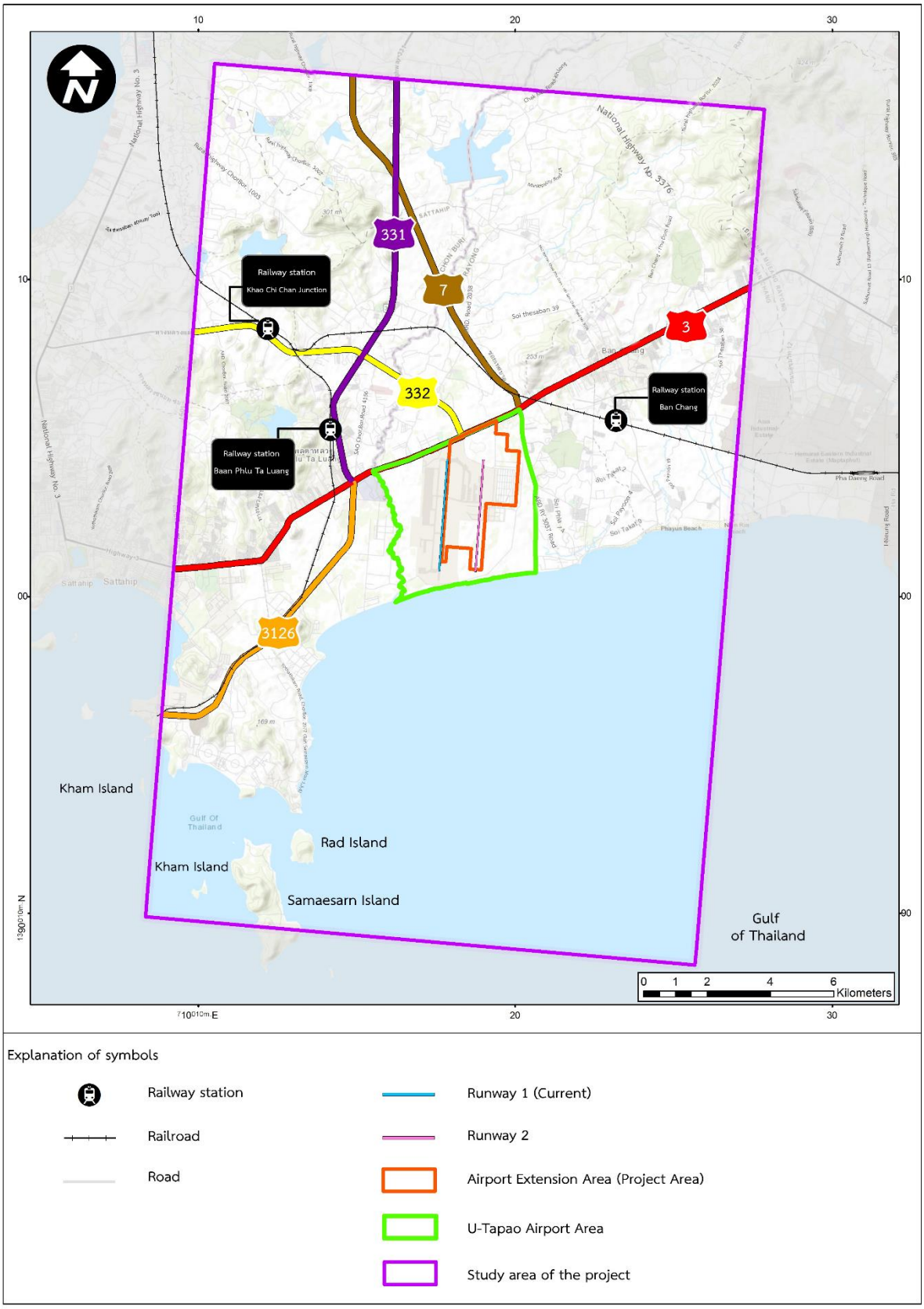
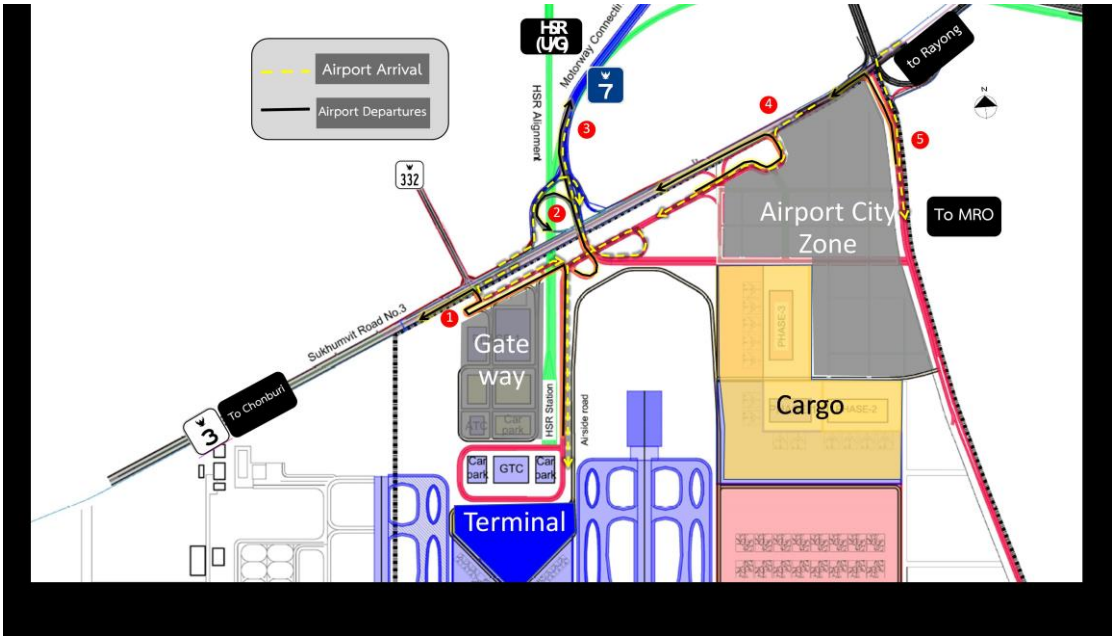


Figure 3.7 12 Transportation routes in the study area of the project

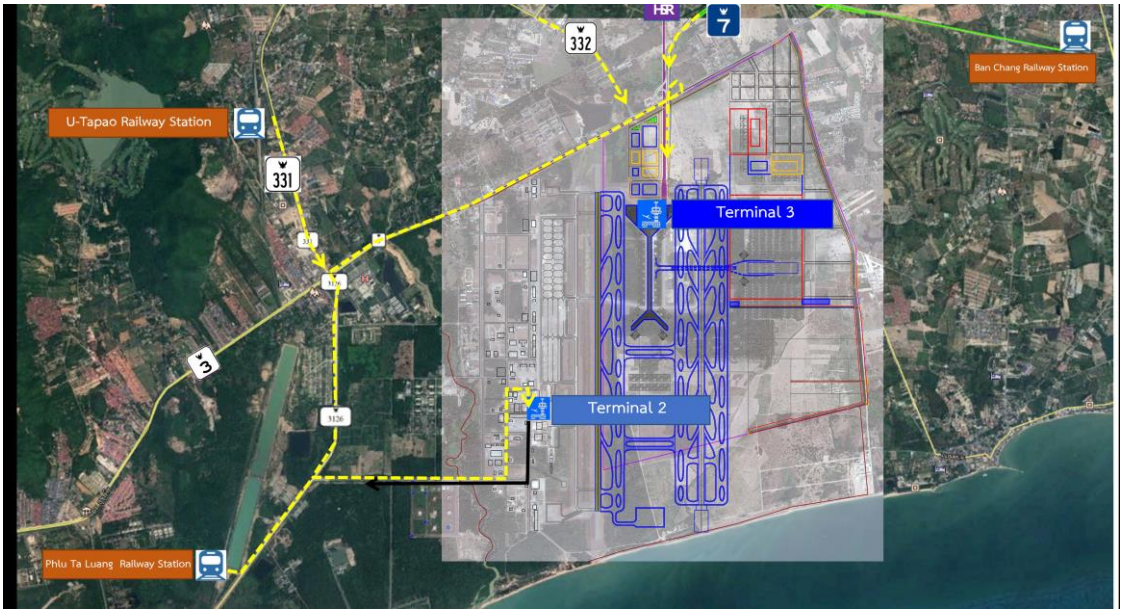
The road network has details and concepts of traffic connections between project areas and the road transportation network, divided into 2 directions as follows:

- The link to the project from the north is a journey that originates mainly from the area of Pattaya, Chonburi, or from other regions. The concept of developing a network connection to support traffic in this part will plan to link to and from the project by using Highway no. 3 (Sukhumvit road), and Intercity Highway no. 7 mainly. When the airport is open, passengers can take the route to the new terminal (the Terminal 3) directly. Therefore, there is no traffic congestion between the local traffic and the passenger traffic. In addition, the traffic of local people can do by connecting to the project by Highway No.332, connecting to Sukhumvit Road and enter the airport by using elevated road to airport to the front of Terminal 3, details as shown in Error! Reference source not found..
- Connecting to the project from the south side is traveling from the south, namely Sattahip area and Chuk Samet Pier. There is a plan to connect to the project via Highway No. 3126, currently there is a main road to support traveling to the current terminal. But in the future, when the third passenger terminal is opened, traveling to the project via Highway No. 3 (Sukhumvit Road) will use an elevated road directly to the terminal. The details are shown as follows **Figure 3.7-**13



Source: Project to hire consultants to support the Eastern Economic Corridor Policy Office to manage and supervise contracts U-Tapao Airport Development Project and Eastern Aviation City for fiscal year, 2021

Figure 3.7-13 Concept of connecting travel to the project from the north.



Source: Project to hire consultants to support the Eastern Economic Corridor Policy Office to manage and supervise contracts U-Tapao Airport Development Project and Eastern Aviation City for fiscal year, 2021

Figure 3.7-13 Concept of connecting travel to the project from the south

2) Traffic volume

From the data collection of the average annual traffic volume on the related road network, consisting of Highway No. 7 (Bangkok - Ban Chang, in the phase of Pattaya - Map Ta Phut), Highway No. 3 (175+000), Highway No. 331, Highway No. 332 and Highway No. 3126 during the year 2014 - 2019 (Details as shown in **Table 3.7-10** to **Table 3.7-14**) as follows:

- **Highway No. 7 (KM. 149+855)** currently open for testing on 22 May 2020 to August 2020.
- **Highway No. 3 (KM. 175+000).** The average daily traffic volume during 2014-2021 was 19,924, 21,548, 23,231, 25,403 and 31,164 cars per day, respectively. The most common cars were passenger cars not more than 7 people, followed by passenger cars more than 7 people and small trucks (4 wheels), respectively.
- **Highway no. 331 (KM. 5+663)** The average daily traffic volume during 2014-2019 was 13,157, 15,286, 16,511, 17,013 and 20,375 cars per day, respectively. The most common cars were passenger cars not more than 7 people, followed by passenger cars more than 7 people and small trucks (4 wheels), respectively.
- **Highway no. 332 (KM. 14+000)** Theaverage daily traffic volume during 2014-2019 was 10,556, 11,432, 12,891, 13,839 and 16,235 cars per day, respectively. The most common cars were passenger cars not more than 7 passengers, followed by passenger cars more than 7 passengers and small trucks (4 wheels), respectively.
- **Highway No. 3126 (KM. 0+600)** from the annual average traffic volume data found that the average daily traffic volume from 2014-2019 was equal to

10,376, 12,715, 14,362, 15,846 and 17,256 cars per day, respectively. Passenger cars not more than 7 people, followed by passenger cars more than 7 people and light trucks (4 wheels), respectively.

Table 3.7□10 Average annual traffic volume on project-related highways, year 2014-2019

Car type	Unit of	Highway No. 3 (KM.175+000)						Highway No.331 (KM. 5+663)						Highway No.332 (KM.14+000)						Highway No.3126 (KM. 0+600)					
		Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019
Passenger car up to 7 persons	cars per day	7,860	8,724	9,203	9,751	10,410	11,493	5,601	6,795	7,296	7,694	8,220	8,962	4,534	5,272	5,788	6,341	6,943	7,429	4,347	5,422	5,865	6,338	6,807	7,032
Passenger car more than 7 people	cars per day	7,243	8,293	8,970	9,664	10,007	11,036	4,452	5,346	5,889	6,185	6,460	6,925	2,581	4,738	5,236	5,604	6,387	6,226	2,973	3,452	4,052	4,498	4,339	4,682
Mini bus	cars per day	990	881	851	1,028	1,132	1,494	330	374	286	230	239	329	28	71	75	51	23	34	424	438	385	458	506	646
Mid-sized buses	cars per day	65	113	124	192	257	290	130	102	81	62	71	162	10	36	32	38	17	49	300	321	394	535	509	629
Big bus	cars per day	289	236	236	250	274	306	352	351	288	186	217	231	73	106	113	87	25	80	437	388	415	353	241	348
Small truck (4 wheels)	cars per day	2,635	2,727	3,173	3,606	4,447	4,969	1,226	1,485	2,073	2,241	2,567	3,052	2,876	776	1,206	1,359	860	1,806	631	1,368	1.973	2,355	2,362	2,646
Mid-sized truck (6 wheels)	cars per day	460	430	545	829	1,122	1,422	397	274	203	167	149	257	158	186	208	153	259	261	517	676	804	962	820	997
Big Truck (10 Wheels)	cars per day	366	190	103	72	96	139	354	318	242	153	188	268	219	164	177	114	184	249	636	510	406	310	280	268
Big Truck (Trailer)	cars per day	5	14	13	4	6	8	259	207	128	76	74	167	63	48	40	80	9	97	77	94	38	28	20	8
Big Truck (Semi trailer)	cars per day	11	10	13	7	6	7	56	34	25	19	5	22	24	35	16	12	0	4	34	46	30	9	4	0
Total	**cars per day**	**19,924**	**21,548**	**23,231**	**25,403**	**27,757**	**31,164**	**13,157**	**15,286**	**16,511**	**17,013**	**18,190**	**20,375**	**10,556**	**11,432**	**12,891**	**13,839**	**14,707**	**16,235**	**10,376**	**12,715**	**14,362**	**15,846**	**15,888**	**17,256**
Bicycles and tricycles	cars per day	18	10	10	3	3	0	17	14	10	4	0	4	32	29	18	9	8	0	17	25	17	2	4	4
Motorcycle	cars per day	4,267	5,098	5,556	6,123	6,523	6,758	1,215	2,092	2,445	2,897	3,179	3,280	1,376	1,933	2,298	2,838	3,019	3,468	2,393	2,792	3,200	3,668	3,805	4,057

Source: Office of Safety Director, Department of Highways, 2014-2019

Table 3.7□11 Highway No.3 Traffic Volume, year 2012-2019

Car type	PCU Factor	Highway No. 3 (KM. 175+000)											
		Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019	
		Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day
Passenger car up to 7 persons	1	7,860	7,860.0	8,724	8,724.0	9,203	9,203.0	9,751	9,751.0	10,410	10,410.0	11,493	11,493
Passenger car more than 7 people	1	7,243	7,243.0	8,293	8,293.0	8,970	8,970.0	9,664	9,664.0	10,007	10,007.0	11,036	11,036
Mini bus	1.5	990	1,485.0	881	1,321.5	851	1,276.5	1,028	1,542.0	1,132	1,698.0	1,494	2,241
Mid-sized buses	1.5	65	97.5	113	169.5	124	186.0	192	288.0	257	385.5	290	435
Big bus	2.1	289	606.9	236	495.6	236	495.6	250	525.0	274	575.4	306	642.6
Small truck (4 wheels)	1	2,635	2,635.0	2,727	2,727.0	3,173	3,173.0	3,606	3,606.0	4,447	4,447.0	4,969	4969
Mid-sized truck (6 wheels)	2.1	460	966.0	430	903.0	545	1,144.5	829	1,740.9	1,122	2,356.2	1,422	2,986.2
Big Truck (10 Wheels)	2.5	366	915.0	190	475.0	103	257.5	72	180.0	96	240.0	139	347.5
Big Truck (Trailer)	2.5	5	12.5	14	35.0	13	32.5	4	10.0	6	15.0	8	20
Big Truck (Semi trailer)	2.5	11	27.5	10	25.0	13	32.5	7	17.5	6	15.0	7	17.5
Total		**19,924**	**21,848.4**	**21,548**	**23,168.6**	**23,231**	**24,771.1**	**25,403**	**27,324.4**	**27,757**	**30,149.1**	**31,164**	**36,418**
Traffic volume per hour (PCU per hour) *		1,820.7		1,930.7		2,064.3		2,277.0		2,512.4		2,944	
Number of Lanes		6		6		6		6		6		6	
V/C Ratio **		**0.15**		**0.16**		**0.17**		**0.19**		**0.21**		**0.25**	
Traffic conditions 2/		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.	

Note : The symbol (*) means using the equation to adjust the average daily traffic volume to the average traffic volume per hour of the Office of Safety Administration, Department of Highways V = 334.3760 + 0.0802 (AADT) – 0.000000113 ($AADT^2$) PCU/hour.
Symbol (**) means V/C Ratio = (Total PCU/hr / traffic channel capacity x number of lanes)

Source: 1/ Average Annual Daily Traffic(AADT), Bureau of Safety Administration, Department of Highways, 2014-2019

Table 3.7□12 Highway No.331 Traffic Volume, year 2014-2019

Car type	PCU Factor	Highway No.331 (KM. 5+663)											
		Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019	
		Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day
Passenger car up to 7 persons	1	5,601	5,601.0	6,795	6,795.0	7,296	7,296.0	7,694	7,694	8,220	8,220.0	8,962	8,962.00
Passenger car more than 7 people	1	4,452	4,452.0	5,346	5,346.0	5,889	5,889.0	6,185	6,185.0	6,460	6,460.0	6,925	6,925.00
Mini bus	1.5	330	495.0	374	561.0	286	429.0	230	345.0	239	358.5	329	493.50
Mid-sized buses	1.5	130	195.0	102	153.0	81	121.5	62	93.0	71	106.5	162	243.00
Big bus	2.1	352	739.2	351	737.1	288	604.8	186	390.6	217	455.7	231	485.10
Small truck (4 wheels)	1	1,226	1,226.0	1,485	1,485.0	2,073	2,073.0	2,241	2,241.0	2,567	2,567.0	3,052	3,052.00
Mid-sized truck (6 wheels)	2.1	397	833.7	274	575.4	203	426.3	167	350.7	149	312.9	257	539.70
Big Truck (10 Wheels)	2.5	354	885.0	318	795.0	242	605.0	153	382.5	188	470.0	268	670.00
Big Truck (Trailer)	2.5	259	647.5	207	517.5	128	320.0	76	190.0	74	185.0	167	417.50
Big Truck (Semi trailer)	2.5	56	140.0	34	85.0	25	62.5	19	47.5	5	12.5	22	55.00
Total		**13,157**	**15,214.4**	**15,286**	**17,050.0**	**16,511**	**17,8227.1**	**17,013**	**17,919.3**	**18,190**	**19,148.1**	**20,375**	**21,842.80**
Traffic volume per hour (PCU per hour) *		1,267.9		1,420.8		1,485.6		1,493.2		1,595.7		2,032	
Number of Lanes		4		4		4		4		4		4	
V/C Ratio **		**0.16**		**0.18**		**0.19**		**0.19**		**0.20**		**0.25**	
Traffic conditions 2/		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.	

Note : The symbol (*) means using the equation to adjust the average daily traffic volume to the average traffic volume per hour of the Office of Safety Administration, Department of Highways V = 334.3760 + 0.0802 (AADT) – 0.000000113 ($AADT^2$) PCU/hour.
Symbol (**) means V/C Ratio = (Total PCU/hr / traffic channel capacity x number of lanes)

Source: 1/ Average Annual Daily Traffic(AADT), Bureau of Safety Administration, Department of Highways, 2014-2019

Table 3.7 13 Highway No.332 Traffic Volume, year 2014-2019

Car type	PCU Factor	Highway No.332 (KM. 14+000)											
		Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019	
		Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day
Passenger car up to 7 persons	1	4,534	4,524.0	5,272	5,272.0	5,788	5,788.0	6,341	6,341.0	6,943	6,943.0	7,429	7,429.00
Passenger cars with more than 7 people	1	2,581	2,581.0	4,738	4,738.0	5,236	5,236.0	5,604	5.604.0	6,387	6,387.0	6,226	6,226.00
Mini bus	1.5	28	42.0	71	106.5	75	112.5	51	76.5	23	34.5	34	51.00
Mid-sized buses	1.5	10	15.0	36	54.0	32	48.0	38	57.0	17	25.5	49	73.50
Big bus	2.1	73	153.3	106	222.6	113	237.3	87	182.7	25	52.5	80	168.00
Small truck (4 wheels)	1	2,876	2,876.0	776	776.0	1,206	1,206.0	1,359	1,359.0	860	860.0	1,806	1,806.00
Mid-sized truck (6 wheels)	2.1	158	331.8	186	390.6	208	436.8	153	321.3	259	543.9	261	548.10
Big Truck (10 Wheels)	2.5	219	547.5	164	410.0	177	442.5	114	285.0	184	460.0	249	622.50
Big Truck (Trailer)	2.5	63	157.5	48	120.0	40	100.0	80	200.0	9	22.5	97	242.50
Big Truck (Semi trailer)	2.5	24	60.0	35	87.5	16	40.0	12	30.0	0	0	4	10.00
Total		**10,566**	**11,298.1**	**11,432**	**12,177.2**	**12,891**	**13,647.1**	**13,839**	**14,456.5**	**14,707**	**15,328.9**	**16,235**	**17,176.60**
Traffic volume per hour (PCU per hour) *		941.5		1,014.8		1,137.3		1,204.7		1,277.41		1,679	
Number of Lanes		4		4		4		4		4		4	
V/C Ratio **		**0.12**		**0.13**		**0.14**		**0.15**		**0.16**		**0.21**	
Traffic conditions 2/		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.	

Note : The symbol (*) means using the equation to adjust the average daily traffic volume to the average traffic volume per hour of the Office of Safety Administration, Department of Highways V = 334.3760 + 0.0802 (AADT) – 0.000000113 ($AADT^2$) PCU/hour.

Symbol (**) means V/C Ratio = (Total PCU/hr / traffic channel capacity x number of lanes)

Source: 1/ Average Annual Daily Traffic(AADT), Bureau of Safety Administration, Department of Highways, 2014-2019

Table 3.7 14 Highway No.3126 Traffic Volume, year 2014-2019

Car type	PCU Factor	Highway No. 3126 (KM. 0+600)											
		Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019	
		Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day	Number of vehicles (vehicles per day) 1/	PCU per day
Passenger car up to 7 persons	1	4,347	4,347.0	5,422	5,422.0	5,865	5,865.0	6,338	6,338.0	6,807	6,807.0	7,032	7,032.00
Passenger cars with more than 7 people	1	2,973	2,973.0	3,452	3,452.0	4,052	4,052.0	4,498	4,498.0	4,339	4,339.0	4,682	4,682.00
Mini bus	1.5	424	636.0	438	657.0	385	577.5	458	687.0	506	759.0	646	969.00
Mid-sized buses	1.5	300	450.0	321	481.5	394	591.0	535	802.5	509	763.5	629	943.50
Big bus	2.1	437	917.7	388	814.8	415	871.5	353	741.3	241	506.1	348	730.80
Small truck (4 wheels)	1	631	631.0	1,368	1,368.0	1,973	1,973.0	2,355	2,355.0	2,362	2,362.0	2,646	2,646.00
Mid-sized truck (6 wheels)	2.1	517	1,085.7	676	1,419.6	804	1,688.4	962	2,020.2	820	1,722.0	997	2,093.70
Big Truck (10 Wheels)	2.5	636	1,590.0	510	1,275.0	406	1,015.0	310	775.0	280	700.0	268	670.00
Big Truck (Trailer)	2.5	77	192.5	94	235.0	38	95.0	28	70.0	20	50.0	8	20.00
Big Truck (Semi trailer)	2.5	34	85.0	46	115.0	30	75.0	9	22.5	4	10.0	0	0.00
Total		**10,376**	**12,907.9**	**12,715**	**15,239.9**	**14,362**	**16,803.4**	**15,846**	**18,309.5**	**15,888**	**18,018.6**	**17,256**	**19,787**
Traffic volume per hour (PCU per hour) *		1,075.7		1,269.9		1,400.3		1,525.8		1,501.6		1,877	
Number of Lanes		6		6		6		6		6		6	
V/C Ratio **		**0.09**		**0.11**		**0.12**		**0.13**		**0.13**		**0.16**	
Traffic conditions[2/]		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.		Traffic flow is very good.	

Note : The symbol (*) means using the equation to adjust the average daily traffic volume to the average traffic volume per hour of the Office of Safety Administration, Department of Highways V = 334.3760 + 0.0802 (AADT) – 0.000000113 ($AADT^2$) PCU/hour.
Symbol (**) means V/C Ratio = (Total PCU/hr / traffic channel capacity x number of lanes)

Source: 1/ Average Annual Daily Traffic(AADT), Bureau of Safety Administration, Department of Highways, 2014-2019

3) Parking lot in U-Tapao International Airport

The management system for the parking lot of U-Tapao International Airport is shown in **Figure 3.7-14** as follows:

- Parking Lot 1 is located opposite Terminal 1which is a non-roof parking lot, with an area of approximately 10,000 square meters, approximately 248 cars can be parked (open to the public).
- Parking Lot 2 is a roofed-parking with an area of approximately 9,000 square meters. About 230 cars can be parked. It is parking lot for all employees, operators and airlines (not open to the public).
- Parking lot 3, opposite the parking lot 2, has an area of approximately 22,000 square meters,and can park approximately 288 cars (open to the public).

In this regard, car parking service at U-Tapao International Airport is subject to following car and motorcycle service charges :

- Car: 1 hour parking fee 20 baht and 7 hours parking fee counted as 24 hours, parking fee 140 baht.
- Motorcycle: 1 hour parking fee 10 baht per hour, over 5 hours, counted as daily rate, parking fee 50 baht per day (More than 20 minutes counted as 1 hour, fractions of an hour charged an additional 1 hour).

Source: https://www.rayonghip.com/utp-2/

Figure 3.7-14 Parking lot of U-Tapao International Airport

(2) Rail transportation

In the study area, there are 3 railway routes and 3 railway stations, namely Ban Chang railway station, Phlu Ta Luang railway station, and Khao Chi Chan railway station. Details are as follows:

- Ban Chang railway station is located at Ban Chang Subdistrict, Ban Chang District, Rayong, 192.25 kilometres away from Bangkok. There are 3 railway lines and 1 platform.
- Phlu Ta Luang Railway Station is located at, Phlu Ta Luang Subdistrict, Sattahip District, Chonburi, 184.03 kilometres away from Bangkok. There are 8 railway lines and 1 platform.
- Khao Chi Chan Railway Station (ChorJor.) Located at Sera Subdistrict, Sattahip District, Chonburi, 180 kilometres away from Bangkok. There are 4 railway lines and 1 platform.

(3) Air transportation

U-Tapao Airport International Airport is located in the area of Phala Subdistrict, Ban Chang District, Rayong, about 11 kilometres away from the Phala Subdistrict Municipality, and about 160 kilometres away from Bangkok. Currently, it is located at Naval Aviation Battalion, Naval Air Squadron, and the U-Tapao Airport which serves both domestic and international airlines and is developing to become a commercial airport.

1) Statistics on the number of domestic and international flights at U-Tapao International Airport during the year 2015-2019

Statistics on the number of commercial aircraft that take off and land at U-Tapao International Airport during 2015-2019 has an increasing trend, found that in 2015, there were 4,611 flights. flying and in 2016-2018 increased to 8,374, 12,484 and 15,096 flights, while in 2019 decreased to 13,690 flights, respectively, as detailed in **Table 3.7-15**

2) Statistics on the number of arrivals and departures within and between the countries of U-Tapao International Airport during the year 2015-2019

Statistics on the number of passengers at U-Tapao International Airport during the year 2015-2019 has a tendency to increase continuously, found that in 2015, there were 241,384 passengers in total. 2016-2018 increased to 783,846 1,448,675 and 1,856,997 people, and in 2019 decreased to 1,715,949 people, respectively. Details are shown in **Table 3.7-**16

Table 3.7-15 Statistics on the number of domestic and international flights during the year 2015-2019

Unit : Visiting (round-trip)

Month	Year 2015			Year 2016			Year 2017			Year 2018			Year 2019		
	Domestic Country	International Country	Total	Domestic Country	International Country	Total	Domestic Country	International Country	Total	Domestic Country	International Country	Total	Domestic Country	International Country	Total
January	266	128	394	429	260	689	519	246	765	818	743	1,561	698	551	1,249
February	256	112	368	410	375	785	473	223	696	675	853	1,528	613	582	1,195
March	260	55	315	437	341	778	509	454	963	721	840	1,561	645	567	1,212
April	366	68	434	416	252	668	616	452	1,068	659	595	1,254	736	375	1,111
May	342	35	377	429	283	712	622	315	937	624	520	1,144	710	345	1,055
June	224	44	268	402	279	681	628	264	892	616	501	1,117	692	314	1,006
July	216	67	283	396	283	679	757	267	1,024	650	537	1,187	681	396	1,077
August	218	94	312	392	298	690	778	291	1,069	683	541	1,224	728	431	1,159
September	206	106	312	412	246	658	695	272	967	620	459	1,079	651	367	1,018
October	207	123	330	461	214	675	721	507	1,228	674	478	1,152	717	373	1,090
November	282	111	393	448	201	649	697	660	1,357	624	473	1,097	725	522	1,247
December	559	266	825	489	221	710	788	730	1,518	685	507	1,192	721	550	1,271
Total	**3,402**	**1,209**	**4,611**	**5,121**	**3,253**	**8,374**	**7,803**	**4,681**	**12,484**	**8,049**	**7,047**	**15,096**	**8,317**	**5,373**	**13,690**

Source: U-Tapao Airport, 2020.

Table 3.7-16 Statistics on the number of domestic and international passengers during the year 2015-2019

Unit : subject

Month	Year 2015			Year 2016			Year 2017			Year 2018			Year 2019		
	Domestic Country	International Country	Total	Domestic Country	International Country	Total	Domestic Country	International Country	Total	Domestic Country	International Country	Total	Domestic Country	International Country	Total
January	7,032	16,029	23,061	33,272	26,609	59,881	45,305	20,298	65,603	80,985	134,825	215,810	72,200	102,240	174,440
February	8,192	11,773	19,965	31,145	45,164	76,309	39,720	26,303	66,023	73,239	150,792	224,031	64,974	105,808	170,782
March	6,830	7,156	13,986	31,503	48,170	79,673	43,221	83,468	126,689	73,874	143,646	217,520	70,088	106,642	176,730
April	8,384	8,366	16,750	29,835	36,456	66,291	62,945	70,584	133,529	70,901	93,748	164,649	76,702	62,483	139,185
May	11,449	5,706	17,155	31,658	33,569	65,227	55,296	42,223	97,519	60,802	72,317	133,119	70,633	50,244	120,877
June	3,659	3,632	7,291	27,621	34,046	61,667	49,724	39,549	89,273	54,271	69,229	123,500	62,958	48,004	110,962
July	5,008	10,452	15,460	31,537	43,740	75,277	67,126	41,316	108,442	58,495	71,351	129,846	64,537	57,200	121,737
August	6,612	12,092	18,704	30,222	49,786	80,008	67,165	43,174	110,339	58,801	69,483	128,284	63,037	64,533	127,570
September	4,328	11,188	15,516	27,401	27,836	55,237	59,926	38,364	98,290	52,979	52,830	105,809	54,382	53,752	108,134
October	4,689	11,090	15,779	35,796	19,983	55,779	79,462	74,099	153,561	63,168	54,825	117,993	69,756	58,505	128,261
November	9,159	12,667	21,826	32,966	15,828	48,794	66,814	122,309	189,123	57,564	78,944	136,508	63,672	97,283	160,955

December	31,556	24,335	55,891	40,149	19,554	59,703	77,455	132,829	210,284	71,270	88,658	159,928	69,269	107,047	176,316
Total	**106,898**	**134,486**	**241,384**	**383,105**	**400,741**	**783,846**	**714,159**	**734,516**	**1,448,675**	**776,349**	**1,080,648**	**1,856,997**	**802,208**	**913,741**	**1,715,949**

Source: U-Tapao Airport, 2020.

(4) Transportation system within U-Tapao International Airport

The transportation system within U-Tapao International Airport consists of public buses that the Department of Land Transport has open to facilitate passengers. Details are as follows:

1) Buses

There are 3 buses that connect U-Tapao International Airport with the Eastern tourist province. Take a minimum of 4 trips per day as follows:

- Route 398: Trat-Tapao International Airport (08.30 a.m -4.30 p.m.) Routes and stops are located at Trat, Chanthaburi, 1st Rayong Passenger Transportation Station, U-Tapao International Airport, total of 220 kilometers. The journey time is 3 hours and 15 minutes.
- Route 399 Rayong-U-Tapao International Airport (04.30 a.m. - 5.00 p.m.). Routes and stops are located at, 2nd Rayong Passenger Transportation Station, Ban Chang District, U-Tapao International Airport, 35 kilometers. The journey time is 33 minutes.
- 400 Chonburi - U-Tapao International Airport (9.00 a.m.-5.00 p.m.) Routes and stops for passenger pick-up and drop-off which are located at Chonburi, Sriracha District, Pattaya, Sattahip District, U-Tapao International Airport, total of 100 kilometers. The journey time is 1 hour and take 1 hour and 34 minutes.

2) Car rental

Car rental can be contacted at service point in front of Terminal 2, Domestic Arrival, i.e.

- National Car Rental, contact 081-931-4713
- Bizcar Rental, contact 089-982-7667
- Avis Car Rental, contact 062-603-2938
- Chic Car Rent, contact: 02-286-6779, 092-274-0440, 092-274-0110
- Hertz Car Rental contact 02-266-4666, 063-204-0082
- Asap Car Rental, contact 093-457-4433
- Thai Rent A Car, contact: 1647, 098-247-0909
- SUS CARRENT UTAPAO; contact 095-568-0999, 086-353-1228
- Europcar contact 063-218-2666

3) Taxis and vans

Within U-Tapao International Airport, taxis and chartered vans are available by concession companies. There are routes from U-Tapao International Airport to Rayong, which are Rayong, Ban Chang, Ban Pae (Koh Samet), Chonburi, which is Pattaya, Chonburi, Sriracha, Sattahip, Bang Saray, Trat, Koh Chang, and Bangkok, which is Suvarnabhumi Airport, Don Mueang Airport and others as agreed, however, the service fee depends on the company (Source: U-Tapao Airport Authority)

(5) Eastern Economic Corridor (EC) infrastructure

From the review of the performance report of the infrastructure development plan in Eastern Economic Corridor (EC) as of March 2020 (Source: Ministry of Transport, Bureau of Transport Policy and Plan), it was found that the Eastern Special Development Area had a guideline for the development of infrastructure to seamlessly link the Multi Modal Transport (Seamless) in both rail, waterway and airway routes with the concept in Chonburi, Rayong and Chacheongsao as follows:

- Air includes U-Tapao International Airport.
- Ships consist of Sattahip commercial port, Laem Chabang pier and Map Ta Phut industrial port.
- Road, including intercity highways Bangkok-Chonburi Pattaya - Map Ta Phut and Laem Chabang - Nakhon Ratchasima
- The track is a double-track railway, Chachoengsao-Khlong Sip Kao-Kaeng Khoi. and Bangkok-Rayong

There is an action plan for infrastructure development in the Eastern Special Development Zone for 3 phases, details are shown as in **Table 3.7-17** Eastern Economic Corridor (EC) Infrastructure Development

Table 3.7-17 Eastern Economic Corridor (EC) Infrastructure DevelopmentAction Plan

Urgent Phase (2017-2019)	Mid Phase (2019-2021)	Next Phase (2022 onwards)
- PPP MRO U-Tapao Phase 1 - PPP High-speed rail links 3 airports - U-Tapao Railway Station - PPP in Terminal 3 U-Tapao International Airport - PPP Laem Chabang Port Phase 3 - PPP Map Ta Phut Port Phase 3 - Motorway (Pattaya-Map Ta Phut) - Terminal: Chuk Samet Pier - Improve the secondary road network	- Construction of double railroads (Laem Cha Bang - Map Ta Phut-Rayong-Chantonburi-Trat) - Construction of Runway 2 International Airport U-Tapao - PPP Air Cargo U-Tapao International Airport, - PPP Free Trade Zone U-Tapao International Airport - Motorway (Laem Chabang - Prachinburi) - Improve the secondary road network - Add a city bypass network	- EEC train linking Dawei-Cambodia - ICD Chacheongsao - PPP Air Cargo U-Tapao International Airport, Phase 2 - Motorway (Chonburi-Klaeng) - Add Road network to support the new city
99 projects	**62 Projects**	**7 Projects**
Total of 168 projects		

Source: Report on the results of operations under the Infrastructure Development Action Plan in the Eastern Economic Corridor (EEC) as of March 2020, Ministry of Transport. Office of Transport and Traffic Policy and Planning

In this regard, from the results of operations according to the Infrastructure Development Action Plan in the Eastern Special Development Zone from relevant agencies It was found that there were projects for the development of road, rail and water communication network around U-Tapao International Airport. Details are shown in **Table 3.7-18**

Table 3.7 18 The project to develop a communication network around U-Tapao International Airport

Project	Responsible Agencies	Plan duration
1. Transport network in progress/Construction completed		
1.1 Road transport network		
- The project schedules a bus route to support U-Tapao International Airport.	Department of Land Transport	-
- Research Project: Highway No.3126–Airport Entrance to U-Tapao International Airport	Department of Highways	Year 2016-2018
- Project: Highway No.3126, Entrance to U-Tapao International Airport-Chuk Samet Port	Department of Highways	Year 2018-2020
- Intercity Highway project Bangkok (Motorway) Chonburi-Pattaya-Map Ta Phut	Department of Highways	Year 2016-2020
1.2 Waterway transportation network		
- Building projects of the Ferry Terminal with facilities	Royal Thai Navy (Sattahip Commercial Port)	Year 2561-2563
- Ferry Terminal Construction Project with facilities	Royal Thai Navy (Sattahip Commercial Port)	Year 2017-2020
- Coastal Port Development Project (Port A)	Port Authority of Thailand	Year 2018-2020
Transport network in progress / construction		
1. Road transport network		
-Project Tor Lor. 332, Tor Lor 3 intersection (J intersection), Tor Lor 3 intersection (U-Tapao intersection)	Department of Highways	2019-2021
2. Railroad transport network		
- Project on construction of U-Tapao railway station	State Railway of Thailand	Year 2018-2020
- Bangkok-Rayong High Speed Rail Project (Seamlessly Link 3 Airports)	State Railway of Thailand	Year 2018-2023
3. Waterway transport network		
- Map Ta Phut Port Development Project (Phase 3)	Industrial Estate Authority of Thailand	Year 2017-2024
- Development project of Laem Chabang Port, Phase 3	Port Authority of Thailand	Year 2017-2025

Source: Report on the results of operations according to the Infrastructure Development Action Plan in the Eastern Special Development Zone as of March 2020, Ministry of Transport Office of Transport and Traffic Policy and Planning
Overall diagram for the development of the Eastern Special Development Zone (2017-2022), Office of the Eastern Special Development Zone Policy Office

1) **Transport network in progress/Construction completed**

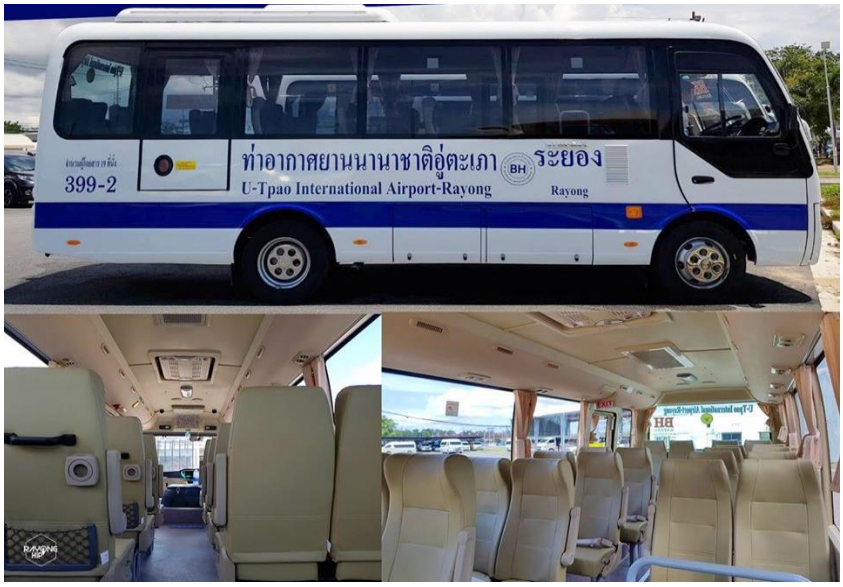
1.1) Projects for the development of a road transportation network

The project to schedule a bus route to support U-Tapao International Airport.

The Department of Land Transport (DLT) has opened 3 bus routes on May 4, 2018 to connect U-Tapao International Airport with Eastern Tourism Provinces. with a minimum of 4 trips per day as follows:

- Route 398: Trat-U-Tapao International Airport
- Route 399: Rayong - U-Tapao International Airport
- Route 400: Chonburi - U-Tapao International Airport

The new standard air-conditioned buses (**Figure 3.7-**15) have a comprehensive safety system installed, GPS Tracking, and speed monitor. There are ABS braking system according to standards established by the Department of Land Transport and various equipment such as fire extinguishers, hammers to break glass, in compliance with safety standards, certified by the Department of Land Transport, using 2-4 vehicles in each route to comply with the number of daily flights and tourist seasons (Sources :https://www.dlt.go.th/th/public-news/view.php?_did=2035 (Department of Land Transport)



Source: https://www.rayonghip.com/dlt-utp/?fbclid=IwAR0-kYNS0Y1VnNedryFucEGzi83gYe4OcnvfK0aZzHskkL74jeHT6OE9jgU

Figure 3.7-15 Bus connections at U-Tapao International Airport

Project TL. 3126, Intersection Tor Lor. 3 – the entrance to U-Tapao Airport

Department of Highway (DOH) has conducted a project to expand highway number 3126, intersection of TL.3 – entrance to U-Tapao International Airport from km. 0 – km. 3+400, with 3.4 kilometres of total distance, expanded from 2 Lanes to 4 Lanes (**Figure 3.7-**16) to support the entrance to U-Tapao International Airport, equipped with electricity to illuminate along the way, construction of 3 U-turn points and improvement of traffic lights at the intersection of 1 place, the construction was completed at the end of 2018

Source: https://www.google.com/maps

Figure 3.7 16 Research Project TL.3126, Separated Lor.3 – U-Tapao Airport Entrance

Project TL.3126, Entrance of U-Tapao International Airport - Chuk Samet Port

Extension of Highway No. 3126, entrance to U-Tapao International Airport – Chuk Samet Port from 3+400 – km. 11+163, total of 7.763 kilometers from 2 Lanes to 4 Lanes (**Figure 3.7-17**8). The project is currently open for operation.

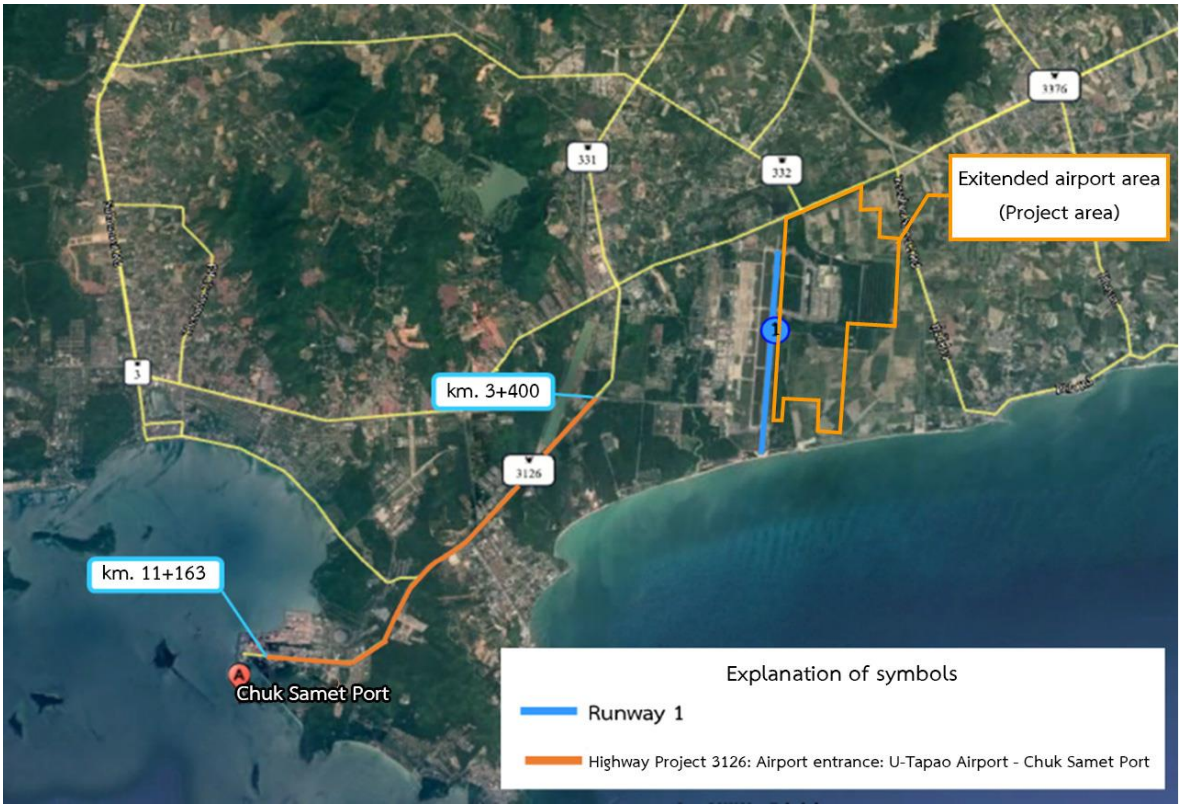
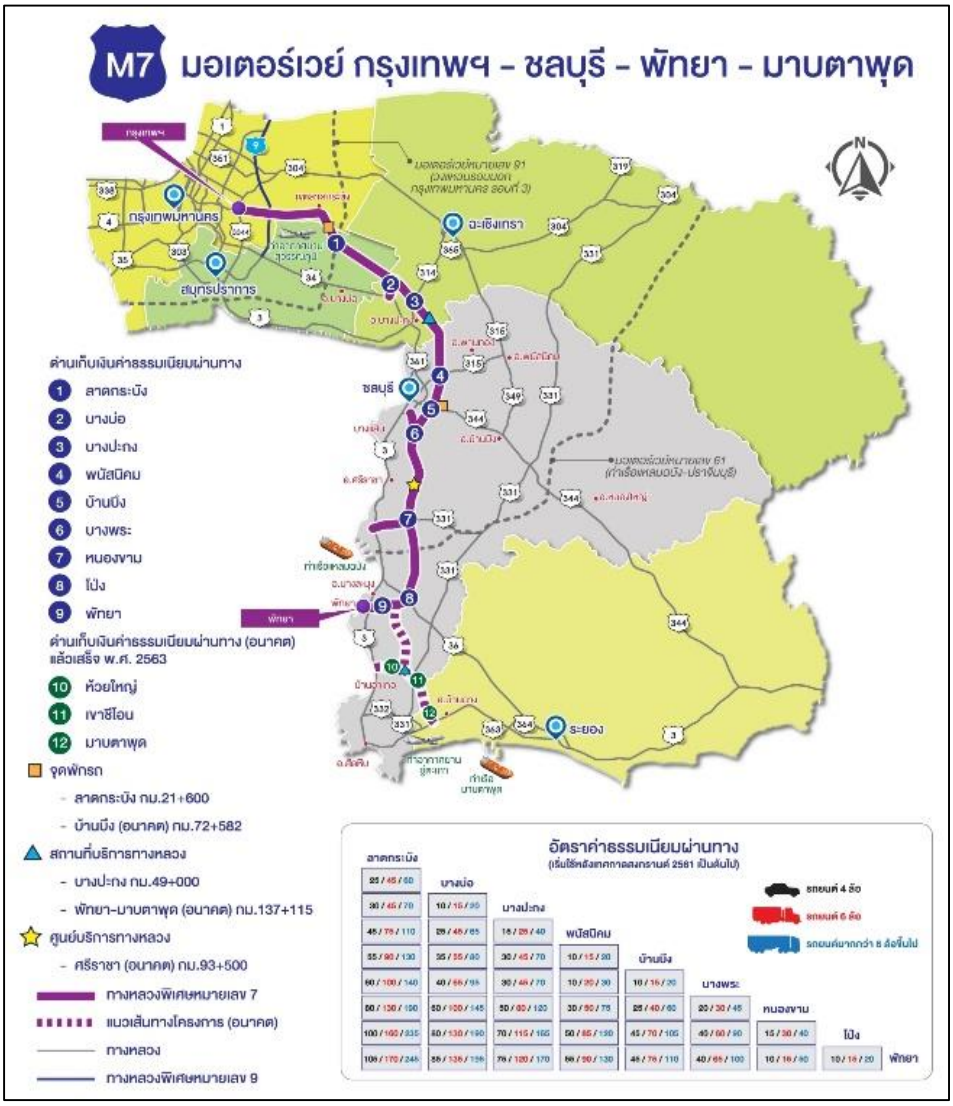


Figure 3.7 17 Project: TL.3126, entrance to U-Tapao International Airport-Chuk Samet Port

Intercity Motorway Project,Bangkok-Chonburi-Pattaya-Map Ta Phut

Intercity Motorway Project Bangkok-Chonburi-Pattaya-Map Ta Phut in which the construction is divided into 2 phases: Bangkok - Chonburi - Pattaya, a total distance of 132.9 kilometers, with 6-8 traffic lanes. At present, the construction has been completed and is open for service. and the Pattaya-Map Ta Phut section from km 2+300 – km 35+381.335 through Bang Lamung District, Sattahip District, Chonburi Province and converge at Highway No. 3, Ban Chang District, Rayong, totaling a distance of 32 kilometers, with 6 traffic lanes. Opened for trial on May 22, 2020 (**Figure 3.7-**18).



Source: https://www.motorway.go.th/m-map-7-th/

Figure 3.7 18 Intercity Motorway Prpject, Bangkok-Chonburi-Pattaya-Map Ta Phut

1.2) Water transport network

Ferry Terminal Construction Project with Facilities

Royal Thai Navy (RTN) (Sattahip Port) has undertaken the construction of a passenger terminal for the ferry with facilities, 1 building (**Figure 3.7-19**), with a project area of approximately 20,000 square meters, consisting of a passenger terminal with a usable area of approximately 6,000 square meters, which has various components in accommodating travelers and transportation of cars or other types of wheels. The passenger terminal consists of Souvenir Shops, Food Court, Ticket Counters, Restrooms, Boarding Area and Waiting Area, and additional improvements for passengers and cars in front of the ferry terminal. (This is a continuation of Port Renovation Project No. 6) comprising Parking Lots, Internet Zone and Accommodations.

Ferry Terminal Construction Project with Facilities

Royal Thai Navy (RTN) (Sattahip Port) has carried out the construction of a passenger and car ferry terminal at the ferry terminal with facilities to prepare to support sailing across the Gulf of Thailand and sailing between ports in the Eastern Sea, including

- Chuk Samet Port, Sattahip District, Chonburi - Bang Bao Port, Koh Chang District, Trat
- Chuk Samet Port, Sattahip - Khao Takiab Port, Hua Hin, Prachuap Khiri Khan
- Chuk Samet Port, Sattahip - Pranburi Phetchaburi

By constructing a berth in the area of 150 x 150 meters, at the current berth No. 6, adjacent to the Chuk Samet port. It is a wharf bridge 13 meters wide, 75 meters long, 2 bridges, each of which can dock ships on both sides, resulting in a total of 4 berths (designated as berths No. 61, 62, 63 and 64), each of which accommodates ships of The hull width is 15 meters, the length is 80 meters, the displacement is not more than 2500 tons, the bridge can support the weight of not more than 5 tons per square meter. Each pose has a depth in front of the pose as follows:

- Port No. 61 has a water depth of about 10 meters in front of the pier.
- Port No. 62 has a water depth of about 9 meters in front of the pier.
- Port No. 63 has a water depth of about 7 meters in front of the pier.
- Port No. 64 has a water depth of about 5 meters in front of the pier.

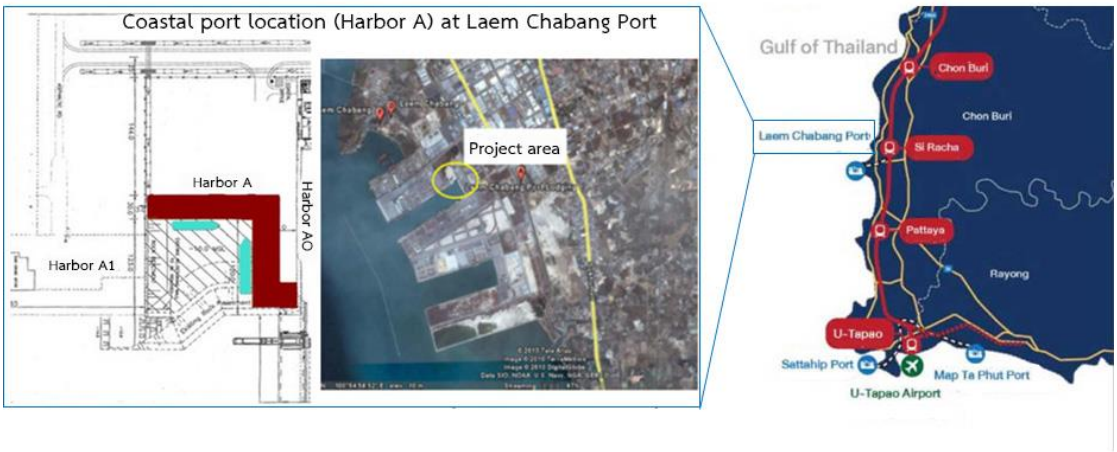
The Royal Thai Navy held a foundation stone laying ceremony for the Ferry Terminal construction project with facilities and the ferry terminal construction project with facilities. (**Figure 3.7-19**) on 18 September 2017, and operates on 17 February 2020 (Source: https://www.facebook.com/prthainavy/posts/1660075350710481/ (Public Service Division, Secretary Office, Royal Thai Navy)) and https://www.facebook.com/Thailand.Infra/posts/870213496750464/ Thailand Infrastructure.

Source: https://th-th.facebook.com/Thailand.Infra/photos/pcb.870213496750464/870209503417530/?type=3&theater Searched on 11 October 2021

Figure 3.7-19 ConstructionProject of Ferry Pier, Ferry Terminal with Facilities

Coastal port development project(Port A)

The coastal port development project (Port A) is the development of a route linking the transport network with Laem Chabang Port in response to the government's policy in developing water transportation and maritime affairs. The port style is L-shaped, has a port length of 125 meters and 120 meters, a port depth of 10 meters, is capable of supporting coastal ships with a capacity of 3,000 DWT, a capacity of 200 DWT at a time, and a tonnage of 1,000. DWT can transport 100 DWT containers at the same time. It is convenient and safe as well as being able to utilize the area in front of the posture and back of the posture effectively In which there has been construction and installation of labor-saving tools such as a Rail Mounted Gantry Crane: RMG and a container gantry crane in the yard (Mobile Harbor Crane), 1 each, along with a mobile girder truck with rubber wheels. (Rubber Tyred Gantry Crane : RTG) 2 units (**Figure 3.7-**20) to increase the capacity to support containers of 300,000 TEU per year, an increase from 5% to 10%. Laem Chabang tends to grow continuously. At present, the project has been completed and opened for operation on March 13. 2020.



Source: http://www.marinerthai.net/forum/index.php?topic=6310.0 Searched on 11 October 2021

Figure 3.7-20 Coastal port development project (Port A)

2) Transport network in progress / construction

2.1) Projects for the development of a road transportation network

Project Tor Lor. 332 Intersection Tor Lor. 3 (J. Intersection) - Tor Lor. 3 Intersection (U-Tapao Intersection)

Project to expand the Highway 332 Intersection Tor Lor 3 (J Intersection) - Tor Lor 3 Intersection (U-Tapao Intersection) from km. 0+000 to km. 14+487, a total distance of 14.487 km, from 2 traffic lanes to 4 lanes. traffic.

2.2) Railway network system development project

Project of construction of U-Tapao railway station

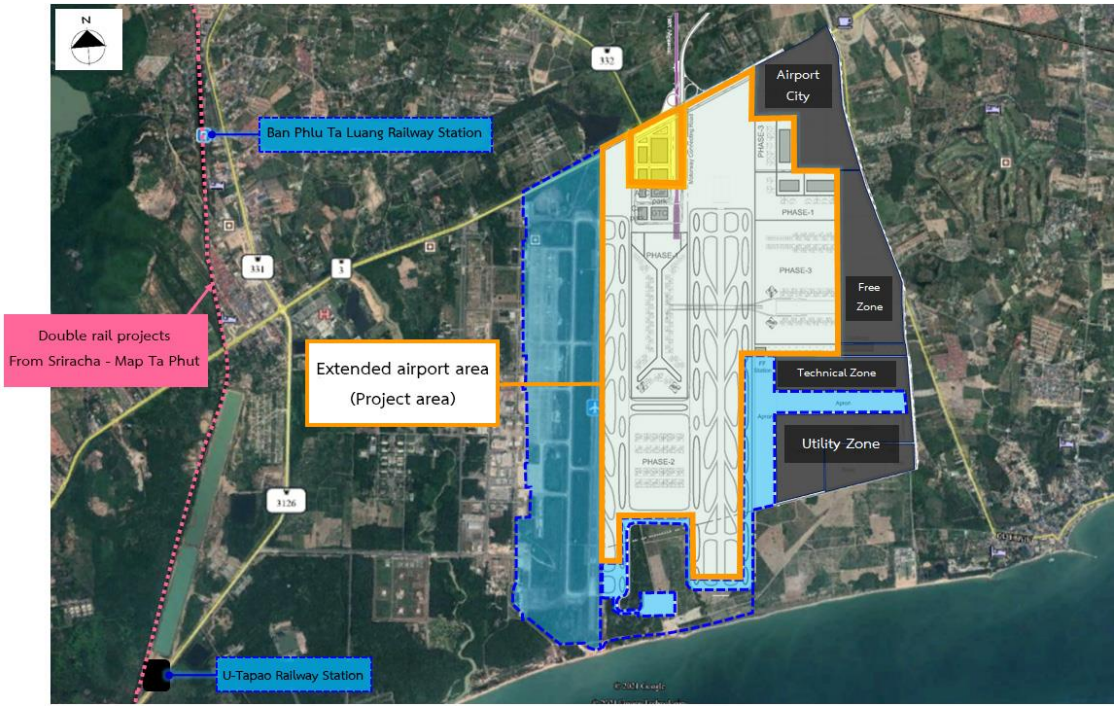
U-Tapao Railway Station Construction Project is part of the project to increase efficiency and increase the capacity of the Hua Mak - Chachoengsao - Sriracha railway and the Si Racha - Map Ta Phut double-track railway project operated by the State Railway of Thailand (SRT). At km. 188+523 to km. 189+173, currently, the aforementioned trains are single-track, therefore, in order to increase efficiency in supporting travel by rail system, SRT has a development plan to expand into a double track. Route map of the project to optimize and increase the capacity of the Hua Mak - Chachoengsao - Sriracha railway and the Si Racha - Map Ta Phut dual-track railway project, with U-Tapao Railway Station being part of the Si Racha - Map Ta Phut dual-track railway project, which is one of the infrastructure projects. An important basis in the development of the EEC area by the route of the project linking 3 ports, namely Chuk Samet Port, Laem Chabang Port and Map Ta Phut Port. It is considered a transportation network system around U-Tapao International Airport. As shown in **Figure 3.7-**21, there is a construction of a train station building, platform, a bus stop building, a passenger building, a residence building, etc., as shown in the Figure 3.7***-22*** **Construction** with construction completed in 2020. The project is not directly linked to U-Tapao International Airport. Details are shown in Figure 3.7**-**23**.**

Source: feasibility study project Detailed design and environmental impact studies Railway Efficiency and Capacity Improvement Project Huamark - Chachoengsao - Sriracha and the double-track railway project Sriracha - Map Ta Phut 2020.

Figure 3.7□21 Route map of the project to increase efficiency and increase the capacity of the Hua Mak - Chachoengsao - Sriracha railway and the Si Racha - Map Ta Phut railway project.

Source: Project to hire consultants to support the Eastern Economic Corridor Policy Office to manage and supervise contracts Project to Development of U-Tapao Airport and Eastern Aviation City in the Budget Year 2020.

Figure 3.7 22 Construction of U-Tapao Railway Station



Source: Project to hire consultants to support the Eastern Economic Corridor Policy Office to manage and supervise contracts U-Tapao Airport Development Project and Eastern Aviation City Fiscal Year B.E. 2020.

Figure 3.7 23 Map showing the position of U-Tapao railway station, which is part of the double rail project in the phase of Sriracha - Map Ta Phut

Bangkok-Rayong High Speed Railway Project (Seamlessly Connecting 3 Airports)

The Bangkok-Rayong high-speed train project (seamlessly connecting 3 airports) was the Eastern High-Speed Rail Project. The route is shown in Figure**Figure** 3.7-24, divided into 2 phases: Phase 1 is the high-speed rail project connecting 3 airports (Don Mueang - Suvarnabhumi - U-Tapao) and the second phase is the high-speed rail project from U-Tapao Airport. Rayong, Chanthaburi and Trat**.**

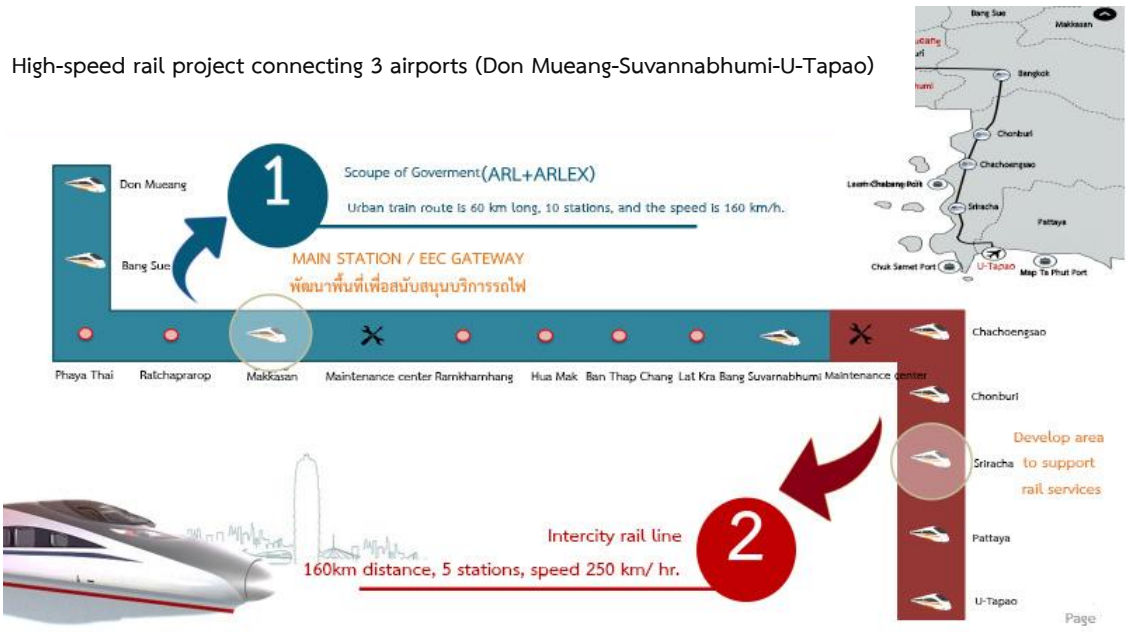
Source: Analysis and feasibility study for the construction of a high-speed rail linking 3 airports, phase 2, the extension of Rayong-Chanthaburi-Trad Province, 2020.

Figure 3.7-24 Bangkok-Rayong High Speed Railway Line (Seamlessly Connecting 3 Airports)

The Eastern Economic Corridor Development Committee in the meeting no. 3/2560 on 22 November 2017 reported progress and considered the plan to schedule significant infrastructure development in the EEC area and had resolution to adjust the implementation plan of the high-speed rail project. The TOR announced that it invited and signed the private company to invest in the 3 Airport Connecting High-Speed Rail Project, Phase 1 from Don Mueang International Airport ends at U-Tapao Airport and to conduct an appropriate route study and design of the second phase of the high-speed train from U-Tapao Airport, Rayong, Chanthaburi and Trat.

1) Phase 1: High-speed rail project connecting 3 airports (Don Mueang - Suvarnabhumi - U-Tapao) with a total distance of about 220 kilometers, comprising a 60-kilometer urban rail line with 10 stations, capable of serving at a speed of 160 kilometers per hour and the intercity railway, a distance of 160 kilometers, with 5 stations, can serve at a speed of 250 kilometers per hour The route map of the high-speed rail project connecting 3 airports (Don Mueang-Suvarnabhumi-U-Tapao) is shown in **Figure 3.7-**25, whereby the State Railway of Thailand has signed a joint venture agreement with the Company of Eastern high-speed rail linking three airports limited on October 24, 2019. This project will have a direct positive impact on travel into U-Tapao International Airport. In the year of service, the project will have a passenger capacity of 147,200 people per day, and there will be a total of 2,780 passengers per day at U-Tapao high-speed train station, and in the next 50 years (2073), there will be a total of 307,810 passengers. per day and there will be a total of 19,860 passengers per day at U-Tapao High Speed Rail Station.

High-speed rail project connecting 3 airports (Don Mueang-Suvannabhumi-U-Tapao)

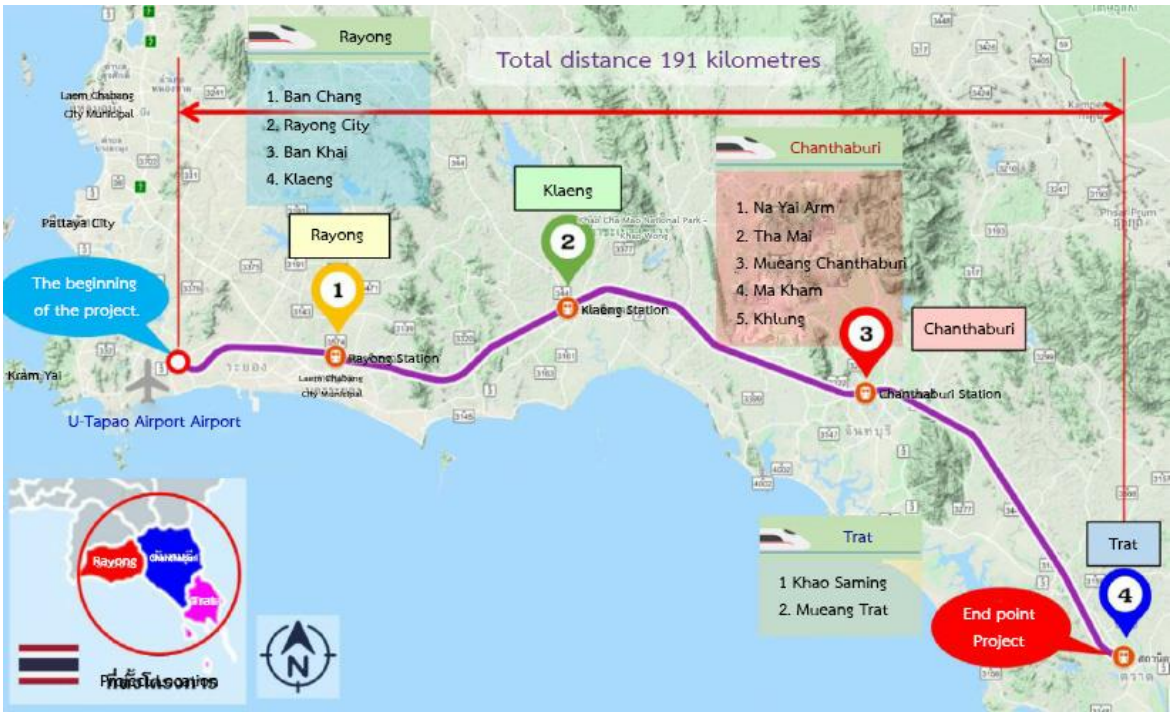


Source: Project to study, review and analyze the appropriateness of the Environmental Impact Assessment Report Project. Prepare tender documents and the implementation of the Act on the private sector to participate in the event 2013 of the high-speed rail project connecting 3 airports (Don Mueang – Suvarnabhumi – Ut-Tapao), 2018

Figure 3.7 25 Project Map of High-Speed Rail Connecting 3Airports (Don Mueang – Suvarnabhumi - U-Tapao)

2) Phase 2 : The 3-Airport high-speed rail project, Phase 2, extension of Rayong-Nonthaburi-Trat is shown in **Figure 3.7-26** extension of the high-speed rail project connects 3

airports at U-Tapao high-speed railway station to Rayong, Chanburi and end at Trat, total of 191 kilometers, with a total of 4 stations. The State Railway of Thailand has studied the suitability, investment guidelines and preliminary design have been completed. Currently, it is in the process of preparing for construction investment. With plans to open for service in 2028, it is expected that in the year of service there will be about 4,500 passengers per day It will help support the travel needs of people in the eastern provinces in Rayong, Chanthaburi and Trat provinces to be able to enter U-Tapao International Airport faster. to promote U-Tapao International Airport to be the hub of air transportation in the EEC area.



Source: Analysis and feasibility study for the construction of a high-speed rail linking 3 airports, phase 2, the extension of Rayong-Chanthaburi-Trad Province, 2020.

Figure 3.7 26 Routes of high-speed rail project connecting 3 airports, Phase 2, Rayong – Chantburi – Badge extension

High-speed rail project connecting 3 airports with 9 stations, namely Don Mueang Station, Bang Sue Station, Makkasan Station Suvarnabhumi Station Chachoengsao Station, Chonburi Station, Sriracha Station, Pattaya Station and U-Tapao Station by U-Tapao high-speed train station It is the terminal station of the high-speed rail project connecting 3 airports (Don Mueang-Suvarnabhumi-U-Tapao), the route line is shown in **Figure 3.7-28** which change from the mode of rail transport through the high-speed train into the air transport mode at U-Tapao International Airport in the future. The area of the U-Tapao high-speed train station will be linked to the regional transportation hub in the basement of the airport which are equipped with moving walkways, escalators, and elevators to facilitate passengers to enter the terminal quickly.

Source: Environmental Impact Assessment Report of a High-Speed Rail Project Connecting Three Airports Seamlessly (Don Mueang - Suvarnabhumi Section - U-Tapao) 2020.

Figure 3.7 27 Bangkok-Rayong High Speed Rail Project (Seamlessly Connecting 3 Airports)

2.3) Projects for development of a water transport network system

Map Ta Phut Port Development Project (Phase 3)

Industrial Estate Authority of Thailand (IEAT) is responsible for the development of industrial estate and new communities in Map Ta Phut. The first phase was completed in 1992 and the second phase in 1999. The Map Ta Phut industrial port has been developed in two phases due to the economic situation of Thailand continually expanding. Therefore, it is necessary to develop the Map Ta Phut Industrial Port Phase 3 to support the growth of economic activities. The project is

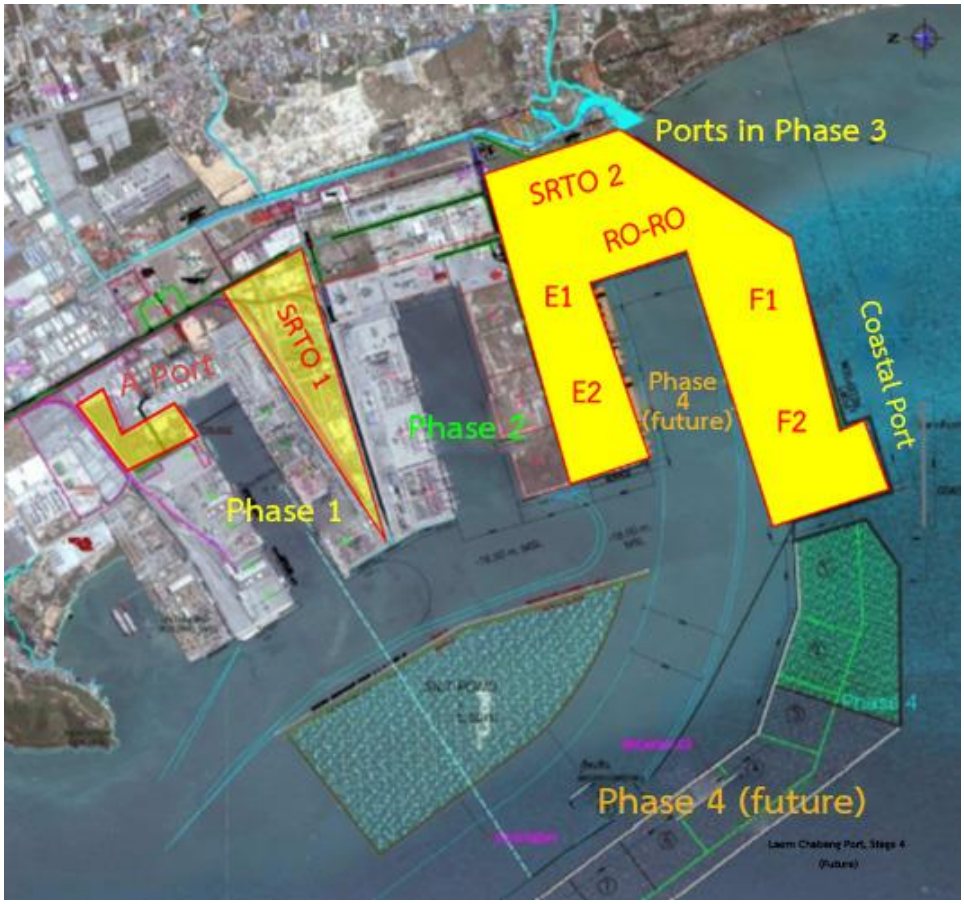
located in Map Ta Phut Industrial Estate, Map Ta Phut Subdistrict, Mueang District, Rayong Province, covering an area of 1,000 rai, divided into 550 rai in front of the port, with a length of 2,200 meters in front of the port (**Figure 3.7-**28), consisting of a liquid port, a gas port, a service port. Energy Industry Development Area, soil sediment pond and breakwater which will be ready to open for operation in 2024 (Source: Integrated diagram for the development of the Eastern Special Development Zone (2017-2022), the Office of the Eastern Special Development Zone Policy Office). The Industrial Estate Authority of Thailand (IEAT) signed a joint investment contract for Map Ta Phut Industrial Port Development Project Phase 3 (Phase 1) with Gulf MTP LNG Terminal Company Limited on the 1 October 2019, with a plan to start the detailed design and construction of sea reclamation in the year 2021-2024, port construction 2024-2026 (Source: Report on the results of the action plan Develop infrastructure in the Eastern Special Development Zone as of March 2020, Ministry of Transport Office of Transport and Traffic Policy and Planning).

Source: https://www.eeco.or.th Searched on 21 February, 2019

Figure 3.7-28 Map Ta Phut Port Development Project (Phase 3)

Development Project of Laem Chabang Port, Phase 3

Laem Chabang Port by The Port Authority of Thailand (PAT) has a volume of containers through the port of 6.77 million TEU / year (Phase 1 of 4,375 million containers and Phase 2 of 2,404 million containers), with a maximum carrying capacity of 11.1 million. TEU/year It is expected that if Laem Chabang Port has an annual growth rate of 5%, there will be container volumes resulting in the port capacity in 2025 because the development of large deep-sea ports will require a period of time from planning episode study construction design Until it has been in service for more than 10 years, it is necessary to accelerate the development of Laem Chabang Port Phase 3, Laem Chabang Port Phase 3, located at Thung Sukla Subdistrict, Sriracha District, Chonburi Province (**Figure 3.7-**29. has a total area of 1,600 rai, the depth of the basin -18 meters from the water level. Able to support ships with a displacement of not less than 100,000 DWT, consisting of 1) 1 car (Ro/Ro) port 2) 1 general cargo and container berth 3) at least 7 million container berths TEU per year and can support 1 million cars per year, which will be opened in the year 2025 East) is divided into 5 years of infrastructure construction (2018 - 2023) and 3 years of berth construction and loading and unloading equipment installation (2022 - 2025). Work under the Infrastructure Development Action Plan in the Eastern Special Development Zone as of March 2020, Ministry of Transport Office of Transport and Traffic Policy and Planning.



Source: https://www.eeco.or.th/ Searched on 21 February 2019

Figure 3.7-29 Location of Phase 3 Laem Cha Bang Port Development Project

3.7.4 Public utilities and public facilities

3.7.4.1 Scope of Study

Study and collect information on public utility systems in the project area and surrounding areas of U-Tapao International Airport. To be used as a basis for forecasting the usage of public utilities that will occur.

3.7.4.2 Research Method

Collect secondary data as follows:

- Electricity consumption data from the Rayong and Chonburi Statistics Report, 2014-2017 from Rayong and Chonburi Statistics Office.
- Four-year local development plan, Phala Subdistrict Municipality, 2018-2021
- Public utility systems of U-Tapao International Airport, from U-Tapao International Airport master plan (December 2018).
- Water usage information of Rayong and Chonburi, 2014-2018 from Provincial Waterwork Authority.

3.7.4.3 Results of the Study

(1) Electrical consumption

1) Rayong

Overview of electricity consumption in Rayong Province during 2013-2017 found that the number of electricity users tends to increase. In 2017, Rayong had a total of 377,086 electricity users. Electricity 10,822.901 million kWh The details are shown as **Table 3.7-**19

Table 3.7-19 Number of electricity users and electricity distribution of Rayong by user type during 2013-2017

District	Number Electrical users (subjects)	Power distribution (million kilowatts per hour)				
		Residential Address	Business facilities and industry	Government and public offices	Other	Total
Year 2013						
Mueang Rayong	144,843	304.02	664.80	1.50	10.73	981.05
Ban Chang	27,336	66.56	129.58	2.82	3.64	202.60
Klaeng	46,330	124.82	485.69	-	1.86	612.38
Wang Chan	8,288	22.41	12.79	-	1.90	37.10
Ban Khai	22,442	4.45	95.58	0.25	-	100.27
Pluak Daeng	34,876	62.67	3,416.67	0.02	55.36	3,534.73
Khao Cha Mao	6,027	12.93	0.60	-	0.09	13.62
Nikom Pattana	15,582	31.33	539.66	0.20	4.18	575.36

Table 3.7-19 Number of electricity users and electricity distribution of Rayong by user type during 2013-2017

District	Number Electrical users (subjects)	Power distribution (million kilowatts per hour)				
		Residential Address	Business facilities and industry	Government and public offices	Other	Total
Total	305,724	629.19	5,345.37	1.79	77.76	6,057.10

Table 3.7 19 Number of electricity users and electricity distribution of Rayong by user type during 2013-2017

District	Number Electrical users (subjects)	Power distribution (million kilowatts per hour)				
		Residential Address	Business facilities and industry	Government and public offices	Other	Total
Year 2014						
Mueang Rayong	149,375	435.14	842.40	8.24	13.52	1,291.30
Ban Chang	28,311	70.98	133.58	4.17	4.84	215.57
Klaeng	52,585	145.40	511.08	4.38	10.65	671.51
Wang Chan	8,580	22.79	13.45	0.72	9.90	46.86
Ban Khai	24,900	50.58	862.13	9.70	-	922.41
Pluak Daeng	37,758	69.71	3,781.72	6.70	20.91	3,879.03
Khao Cha Mao	6,108	12.88	0.65	0.15	0.42	14.09
Nikom Pattana	17,296	33.73	512.34	0.41	2.16	548.63
Total	**324,913**	**841.21**	**6,657.35**	**34.47**	**62.40**	**7,589.39**
Year 2558						
Mueang Rayong	100,810	276.55	334.51	-	11.29	622.35
Ban Chang	30,032	0.01	0.00	0.00	0.00	0.01
Klaeng	56,610	117.29	540.60	9.83	2.75	670.47
Wang Chan	9,003	19.64	22.79	0.79	27.04	70.27
Ban Khai	25,998	4.69	66.04	1.00	0.00	71.73
Pluak Daeng	37,758	69.71	3,781.72	6.70	20.91	3,879.04
Khao Cha Mao	6,198	10.88	3.18	0.82	0.19	15.06
Nikom Pattana	19,002	37.54	578.08	0.40	27.54	643.56
Total	**285,411.00**	**542.79**	**5,431.93**	**21.04**	**389.71**	**5,972.49**
Year 2016						
Mueang Rayong	106,476	0.10	0.01	0.00	-	0.11
Ban Chang	31,410	82.28	156.62	632.64	3.59	243.13
Klaeng	58,347	124.60	543.78	10.14	3.31	681.83
Wang Chan	9,358	20.71	30.79	1.01	41.93	94.44
Ban Khai	26,855	58.55	1,043.46	4.29	0.06	1,106.36

Table 3.7-19 Number of electricity users and electricity distribution of Rayong by user type during 2013-2017

District	Number Electrical users (subjects)	Power distribution (million kilowatts per hour)				
		Residential Address	Business facilities and industry	Government and public offices	Other	Total
Pluak Daeng	49,468	0.52	0.04	0.00	0.01	0.57
Khao Cha Mao	6,358	11.01	3.29	1.13	0.24	15.66
Nikom Pattana	20,299	0.00	0.00	0.00	0.00	0.00
Total	**308,571**	**297.78**	**1,777.99**	**17.19**	**49.15**	**2,142.10**

Table 3.7-19 Number of electricity users and electricity distribution of Rayong by user type during 2013-2017

District	Number Electrical users (subjects)	Power distribution (million kilowatts per hour)				
		Residential Address	Business facilities and industry	Government and public offices	Other	Total
Year 2560						
Mueang Rayong	168,484	433.74	2,946.35	4.57	41.64	3,426.30
Ban Chang*	32,607	83.31	157.99	0.52	0.22	242.04
Klaeng	58,016	157.49	607.57	0.22	25.39	790.68
Wang Chan	9,302	1.72	4.82	3.89	-	10.42
Ban Khai	27,410	60.59	1,189.73	1.24	0.39	1,251.96
Pluak Daeng	53,347	99.53	4,208.49	0.54	8.74	4,317.30
Khao Cha Mao	6,289	0.93	0.29	0.03	-	1.24
Nikom Pattana	21,631	43.83	738.59	0.38	0.16	782.96
Total	**377,086**	**881.13**	**9,853.83**	**11.40**	**76.54**	**10,822.90**

Note : (*) means the project area.
(-) means no data has been saved in the database.
Source: Rayong Provincial Statistics Report 2017, Rayong Provincial Statistics Office

The project location is in Phala Subdistrict Municipality which expanding the electric field. At present, there is electricity for every household, accounted for 95 percent. The problem is that the road lighting or public places are still unable to cover the entire area because the budget for the operation is not enough. The solution is sort priorities and take action as needed and has informed the public about the reasons for the community to help solve problems.

2) Chonburi

Overview of electricity consumption in Chonburi Province during 2013-2017, it was found that the number of electricity users tends to increase. In 2017, Chonburi Province had a total of 709,666 electricity users. Electricity 21,957.15 million kWh, detail as shown in **Table 3.7-20**

Table 3.7 20 Number of electricity consumers and electricity distribution of Chonburi Province Classified by type of users per district during the year 2013-2017

District	Number of Electrical Users (Individuals)	Power distribution (million kilowatts per hour)				
		Residential Address	Business facilities and industry	Government and public offices	Other	Total
Year 2013						
Mueang Chonburi	157,067	439.21	1,960.45	0.002	23.42	2,423.08
Baan Bueng	35,918	78.21	842.44	-	5.94	926.59
Nong Yai	5,849	13.13	183.44	-	0.31	196.87
Bang La Mung	164,678	549.10	1,443.37	0.32	47.41	2,040.20
Pan Thong	25,343	62.48	703.35	-	9.38	775.21
Panus Nikom	31,636	68.58	138.85	-	3.04	210.47
Sriracha	127,087	333.34	2,989.64	0.001	46.42	3,369.40
Koh Sichang	1,463	3.40	3.76	-	0.06	7.22
Sattahip	-	-	-	-	-	-
Bo Thong	10,881	22.90	83.84	0.00001	0.77	107.52
Koh Chan	13,915	26.79	120.14		1.25	148.18
Total	**573,837**	**1,597.14**	**8,469.28**	**0.32**	**138.00**	**10,204.74**
Year 2557						
Mueang Chonburi	168,651	459.04	1923.76	-	21.93	2404.73
Baan Bueng	37,783	81.71	925.50	-	7.14	1014.35
Nong Yai	6,060	13.33	196.34	-	0.77	210.43
Bang La Mung	175,696	573.49	1453.64	0.35	56.01	2083.48
Pan Thong	27,926	68.05	764.38	-	10.40	842.83
Panus Nikom	32,703	71.91	145.82	-	2.80	220.53
Sriracha	136,255	354.96	3098.06	0.01	49.06	3502.09
Koh Sichang	1,485	3.42	3.49	-	0.02	6.94
Sattahip	-	-	-	-	-	-
Bo Thong	11,488	24.60	87.82	-	2.29	114.70
Koh Chan	14,210	27.71	119.06	0.00	1.79	148.56
Total	**612,257**	**1,678.219**	**8,717.86**	**0.36**	**152.20**	**10,548.63**
Year 2015						
Mueang Chonburi	178,911	501.01	1,937.40	-	20.84	2,459.25

Table 3.7 20 Number of electricity consumers and electricity distribution of Chonburi Province Classified by type of users per district during the year 2013-2017

District	Number of Electrical Users (Individuals)	Power distribution (million kilowatts per hour)				
		Residential Address	Business facilities and industry	Government and public offices	Other	Total
Baan Bueng	39,421	89.65	954.55	-	6.45	1,050.64
Nong Yai	6,211	14.07	215.46	-	0.45	229.99
Bang La Mung	185,802	614.65	1,545.61	0.42	56.47	2,217.15
Pan Thong	30,435	76.19	831.98	-	12.69	920.86
Panus Nikom	33,743	77.82	165.98	-	2.61	246.40
Sriracha	146,164	390.48	3,135.67	0.02	51.45	3,577.62
Koh Sichang	1,489	3.67	3.45	-	0.02	7.13
Sattahip	-	-	-	-	-	-
Bo Thong	11,689	25.70	94.55	-	2.78	123.03
Koh Chan	14,702	25.70	124.80	0.00	1.37	151.87
Total	**648,567**	**1,818.94**	**9,009.45**	**0.44**	**155.13**	**10,983.94**
Year 2559						
Mueang Chonburi	107,110	539.17	2,003.31	-	19.88	2,562.35
Baan Bueng	40,89	98.20	1,006.05	0.00	6.09	1,110.34
Nong Yai	6,443	14.89	231.62	-	0.38	246.89
Bang La Mung	195,986	664.11	1,630.30	0.36	54.54	2,349.31
Pan Thong	32,857	85.23	912.90	-	9.84	1,007.97
Panus Nikom	34,645	84.58	182.49	-	3.78	270.85
Sriracha	156,087	427.80	3,366.35	0.02	51.52	3,845.69
Koh Sichang	1,521	4.03	3.86	-	0.02	7.91
Sattahip	-	-	-	-	-	-
Bo Thong	12,121	27.75	98.53	-	2.92	129.20
Koh Chan	15,175	32.81	131.35	0.00	1.35	165.51
Total	**602,839**	**1,978.57**	**9,566.76**	**0.38**	**150.32**	**11,696.02**
Year 2017						
Mueang Chonburi	189,550	262.02	2,062.31	0	17.84	4,700.39
Baan Bueng	42,071	117.87	1,072.40	0.001	6.19	2,257.30
Nong Yai	6,603	26.28	246.66	0	0.57	510.02

Table 3.7-20 Number of electricity consumers and electricity distribution of Chonburi Province Classified by type of users per district during the year 2013-2017

District	Number of Electrical Users (Individuals)	Power distribution (million kilowatts per hour)				
		Residential Address	Business facilities and industry	Government and public offices	Other	Total
Bang La Mung	205,484	2,393.28	1,667.44	0.35	53.54	4,114.62
Pan Thong	35,202	104.38	945.72	0	8.47	1,997.98
Panus Nikom	35,860	28.96	194.34	0	8.69	492.58
Sriracha	165,321	388.28	3,385.75	0.0001	60.18	7,328.80
Koh Sichang	1,534	7.85	3.62	0.002	0.03	11.50
Sattahip	-	-	-	-	-	-
Bo Thong	12,477	131.73	99.77	0.10	3.40	235.0
Koh Chan	15,564	17.12	136.19	0.01	1.56	308.96
Total	**709,666**	**3,477.72**	**9814.20**	**0.46**	**160.47**	**21,957.15**

Note : symbol (*) means the project area.
Symbol (-) means that there is no record in the database.
Source: Chonburi Provincial statistics Report 2017, Chonburi Provincial Statistics Office

3) Electricity use in the area of U-Tapao International Airport

Electricity Business, Royal Thai Navy Concession Welfare Located in Sattahip Subdistrict which received a concession to provide electricity services from the Ministry of Energy and purchase electricity from the Provincial Electricity Authority (PEA) about 115 kilovolts for electricity generation and distribution in the Sattahip district Chonburi Province consists of 5 sub-districts, 41 villages, covering an area of 348.122 square kilometers, namely Sattahip Subdistrict, Phlu Ta Luang Subdistrict, Samaesarn Subdistrict, Bang Sare Subdistrict and Na Jomtien Subdistrict. There are 52,489 service recipients (Source: Electricity Business, Navy Concession Welfare) and supply power to agencies in the area of U-Tapao International Airport and the Naval Aviation Division (RAC). of the electricity business as follows:

- electricity business sends electricity to Sattahip Power Station 2 (Km.6) and sends to the sub-station of the Navy Aviation Division (NAD). It is located within the Navy Aviation area of approximately 22 kilovolts.
- electricity business that sends electricity directly (Peal line) to a sub-power station of the Navy Aviation Division (NAD) Approximately 22 kilovolts

For electricity sent to a sub-station of the NAD (**Figure 3.7-30**) will be converted to 220 volts before distributing to the office building of U-Tapao International Airport and NAD where the power sub-station of NAD has a total of 5 Feeder power distribution, which separated into Feeder

No. 1 2 3 4 to the Naval Aviation Division, and the 5th Feeder distributed electricity to U-Tapao International Airport. In addition, NAD has a back-up power plant in the event of a malfunction which can back up electricity for about 20-30 minutes.

Naval Aviation Division Sub-Power Plant

Backup power plant

Figure 3.7 30 Sub power plant within the area of the Navy Aviation Division

From the statistics of electricity usage in the airport, consisting of the Naval Aviation Division and U-Tapao International Airport (Table **Table** 3.7-21), it was found that the amount of electricity used in each month was different and increased. But there is still no problem of insufficiency in the use of electricity in such areas.

Table 3.7-21 Statistics on Electricity Consumption within U-Tapao International Airport during the year of 2014-2018

Agency	Electricity consumption (units)											
	Jan	Feb	Mar	Apr	May	Jun.	Jul	Aug	Sep	Oct	Nov	Dec
Total electricity in the year 2014	503,640.00	634,800.00	575,640.00	590,760.00	691,200.00	579,960.00	532,200.00	577,200.00	633,600.00	555,000.00	557,040.00	356,760.00
The amount of electricity used by Naval Aviation Division	37,589.24	52,872.96	58,407.42	57,476.00	86,209.96	66,743.42	72,256.00	50,820.00	75,055.00	54,852.51	70,411.69	36,457.34
Electricity consumption at U-Tapao International Airport	130,046.00	151,917.00	124,130.00	120,003.00	202,093.00	203,970.00	175,104.00	184,895.00	157,680.00	157,042.00	155,124.00	156,221.00
Total	**167,635.24**	**204,789.96**	**182,537.42**	**177,479.00**	**288,302.96**	**270,713.42**	**247,360.00**	**235,715.00**	**232,735.00**	**211,894.51**	**225,535.69**	**192,678.34**
Total electricity in the year 2015	714,840.00	537,240.00	468,261.76	604,395.59	528,480.00	489,840.00	611,160.00	501,960.00	553,320.00	494,160.00	588,480.00	649,320.00
The amount of electricity used by Naval Aviation Division	62,858.74	61,701.88	64,168.24	83,671.41	74,917.33	71,460.00	78,425.96	68,122.23	69,685.42	61,595.42	84,582.78	57,996.14
Electricity consumption at U-Tapao International Airport	162,839.00	165,911.00	163,187.00	186,696.00	174,786.00	221,840.00	194,535.00	199,405.00	204,874.00	186,982.00	182,077.00	219,907.00
Total	**225,697.74**	**227,612.88**	**227,355.24**	**270,367.41**	**249,703.33**	**293,300.00**	**272,960.96**	**267,527.23**	**274,559.42**	**248,577.42**	**266,659.78**	**277,903.14**
Total electricity in the year 2016	428,880.00	541,200.00	509,940.00	616,320.00	534,720.00	551,640.00	575,400.00	576,480.00	521,160.00	561,720.00	585,960.00	624,960.00
The amount of electricity used by Naval Aviation Division	69,113.00	65,899.00	62,715.00	67,899.00	63,283.00	88,171.00	76,751.00	80,047.81	69,079.00	64,698.00	72,558.00	54,455.00
Electricity consumption at U-Tapao International Airport	243,936.00	206,148.00	192,912.00	249,276.00	272,698.00	219,757.00	244,380.00	238,896.00	234,234.00	209,409.00	231,368.00	171,470.00
Total	313,049.00	272,047.00	255,627.00	317,175.00	335,981.00	307,928.00	321,131.00	318,943.81	303,313.00	274,107.00	303,926.00	225,925.00
Total electricity in the year 2017	1,053,840.00	1,090,880.00	1,544,160.00	1,377,760.00	1,459,680.00	1,417,280.00	1,418,240.00	1,139,520.00	1,362,820.00	1,025,760.00	1,446,000.00	1,185,600.00
The amount of electricity used by Naval Aviation Division	44,569.00	59,407.00	63,224.00	72,215.00	70,086.00	71,156.00	56,667.00	54,592.00	56,633.00	41,353.00	56,888.00	38,940.00
Electricity consumption at U-Tapao International Airport	187,639.00	191,505.00	260,550.00	227,462.00	196,496.00	231,337.00	195,469.00	195,883.00	241,122.00	241,086.00	230,826.00	239,347.00
Total	**232,208.00**	**250,912.00**	**323,774.00**	**299,677.00**	**266,582.00**	**302,493.00**	**252,136.00**	**250,475.00**	**297,755.00**	**282,439.00**	**287,714.00**	**278,287.00**
Total electricity in the year 2018	1,809,840.00	1,777,920.00	1,656,720.00	1,782,000.00	134,000.00	1,277,520.00	1,423,680.00	1,398,480.00	1,414,320.00	1,301,520.00	1,340,160.00	649,440.00
The amount of electricity used by Naval Aviation Division	36,500.00	49,230.00	40,669.00	43,643.00	45,306.00	47,149.00	57,395.00	53,421.00	38,910.00	43,799.00	54,098.00	40,251.00
Electricity consumption at U-Tapao International Airport	247,575.00	232,484.00	226,883.00	270,549.00	278,672.00	263,040.00	258,085.00	1,139,148.00	589,581.00	748,451.00	722,010.00	722,010.00
Total	**284,075.00**	**281,714.00**	**267,552.00**	**314,192.00**	**323,978.00**	**310,189.00**	**315,480.00**	**1,192,569.00**	**628,491.00**	**792,250.00**	**776,108.00**	**762,261.00**

Source: Navy Aviation Division (Information as of September 26, 2019)

(2) Water usage

1) Rayong

Rayong Waterworks Authority has 3 branches, namely Rayong Branch, Ban Chang Branch and Pak Nam Prasae Branch. Ban Chang Provincial Waterworks Authority has a scope of distribution to the study area of the project, namely, Phala Subdistrict Municipality, Ban Chang Municipality, Samnak Thon Subdistrict Municipality and Ban Chang Subdistrict Municipality has scope to buy raw water from East Water Public Company Limited, Rayong River (Ban Khai Weir Area), Raw Water Storage Pool, Khlong Bang Phai - Huai Yai Ra Ban Chang Raw Water Reserving Pool and Khlong Bang Phai Reservoir. During the past 5 years (2014-2018), the number of water users has increased. including production volume The amount of water produced and dispensed and the amount of water. Details are shown in **Table 3.7-22**.

Table 3.7-22 Water User Statistics Production and Sales Volume of the Provincial Waterworks Authority by branches of Rayong Province during the year 2014-2018

items	Year				
	2014	2015	2016	2017	2018
Provincial Waterwork Authority, Rayong branch					
Total number of water users (subjects)	72,490	16,858	80,117	82,492	76,453
Volume of water produced (cubic meters per month)	2,082,337	2,110,811	2,048,896	2,323,776	2,080,497
Volume of water to be distributed (cubic meters per month)	2,075,816	2,011,680	1,958,999	2,204,622	2,054,547
Volume of water sold (cubic meters per month)	1,615,613	1,645,619	1,647,405	1,652,557	1,504,223
Provincial Waterwork Authority, Ban Chang Branch					
Total number of water users (subjects)	33,829	36,709	39,819	41,815	49,826
Volume of water produced (cubic meters per month)	1,249,474	1,328,863	1,396,337	1,409,918	1,616,530
Volume of water to be distributed (cubic meters per month)	1,229,474	1,308,463	1,364,238	1,378,418	1,523,231
Volume of water sold (cubic meters per month)	920,587	979,775	1,020,541	1,036,795	1,194,424
Provincial Waterwork Authority, Pak Nam Prasae Branch					
Total number of water users (subjects)	6,208	6,277	6,447	6,663	13,657
Volume of water produced (cubic meters per month)	186,000	184,200	169,624	186,023	498,813
Volume of water to be distributed (cubic meters per month)	170,200	167,545	152,800	157,856	422,318
Volume of water sold (cubic meters per month)	124,582	124,709	113,464	119,984	330,706

Table 3.7-22 Water User Statistics Production and Sales Volume of the Provincial Waterworks Authority by branches of Rayong Province during the year 2014-2018

items	Year				
	2014	2015	2016	2017	2018

Note : December data report every year
Source: Provincial Waterwork Authority(11 July 2019)

2) Chonburi

The Provincial Waterworks Authority of Chonburi has 7 branches, namely, Provincial Waterworks Authority District 1, Chonburi Branch (Special Class), Ban Bueng Branch, Phanat Nikhom Branch, Sriracha Branch, Laem Chabang Branch and Pattaya Branch (Special Class). Ban Chang Provincial Waterworks Authority has a scope of distribution to the study area of the project, namely, the Provincial Waterworks Authority, Pattaya branch (Special Class) which has a scope of distribution to the study area, namely Na Jomtien Subdistrict Municipality and Huai Yai Subdistrict Municipality which uses raw water sources to produce tap water from the Mabprachan Reservoir, Nong Klang Dong Reservoir, Huai Sak Nok Reservoir, Huai Saphan Reservoir, and Huai Khun Chit Reservoir. There is a reserve of raw water from Nong Kho Reservoir. Which isin the responsibility of Eastern Water Resources Development and Management Company Limited (Public). During the past 5 years (2014-2018), the number of water users has increased. including production volume The amount of water produced and dispensed and the amount of water. Details are shown in **Table 3.7-23**.

Table 3.7-23 Regional Water User Statistics, Production and Distribution Volumes, Pattaya Branch (Special Class) during 2014-2018

items	Year				
	2014	2015	2016	2017	2018
Provincial Waterwork Authority, Pattaya branch (special class)					
Total number of water users (subjects)	76,785	82,174	87,240	91,506	96,192
Volume of water produced (cubic meters per month)	5,340,829	5,600,396	6,251,667	7,749,801	6,178,457
Volume of water to be distributed (cubic meters per month)	4,820,930	4,841,745	4,917,793	5,283,980	5,377,964
Volume of water sold (cubic meters per month)	3,712,533	3,690,379	3,763,492	4,276,166	4,150,169

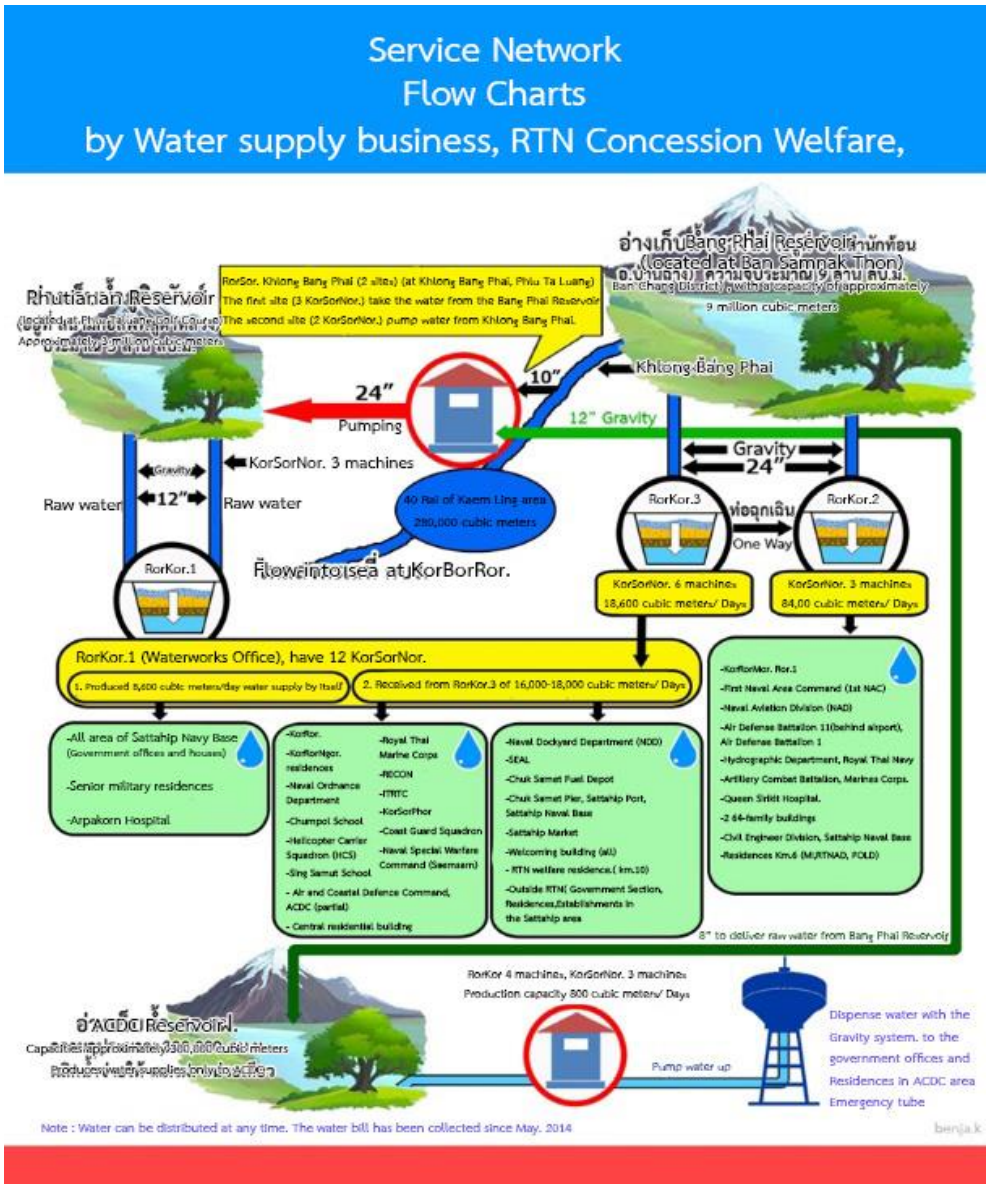
Note : December data report every year
Source: Provincial Waterwork Authority (11 July 2019)

3) Water usage in U-Tapao International Airport area

Royal Thai Navy originally produced tap water for military purposes. All of which are operated by the Civil Engineering Division, Sattahip Naval Base. There are 4 water purification plants in total, namely, Water Filtration Plant 1 (Battle Squadron Area), Water Filter Plant 2 (Naval Aviation Division Area), Water Filter Plant 3 (Naval Aviation Division Area), and Water Treatment Plant.

Water Filter 4 (Aircraft Combat Command and Coast Guard Area) which has a network of water supply services as shown in **Figure 3.7-**31 by which raw water sources in Sattahip are

- **Phuti Anan Reservoir**, located at the Phlu Ta Luang Golf Course, with a capacity of approximately 3 million cubic meters. Raw water is pumped to the 1st water filter. A total of 12 pumps produces 8,600 cubic meters of water per day. There is a water supply office, Royal Thai Navy Concession Welfare who is responsible for supplying all tap water to the area of the Sattahip Naval Base (government and accommodation) accommodation of the senior soldier, Royal Thai Fleet and Arpakorn Hospital.
- **Khlong Bang Phai Reservoir**located at Ban Samnak Thon has approximately 9 million cubic meters capacity. Raw water is pumped into water filtration plant 2 and 3.
  - The water filtration plant 2 has 3 pumps, producing 8,400 cubic meters of water supply per day, supplying water to 11 agencies.
  - The water filtration plant 3 has 6 water pumps, producing 18,600 cubic meters of water supply per day, with the Waterworks Office Concession Welfare, Royal Thai Navy is in charge of supplying water to 22 units by receiving water from water filtration plant 3 about 16,000-18,000. cubic meter per day
- **Chuk Samet Reservoir (ACDC)** located in the area of Aircraft Combat Command and Coast Guard(ACDC) (near water filtration plant 4), with a capacity of 30,0000 cubic meters (producing water supply for only ACDC). Water transferred to water filtration plant 4, with 6 pumps, with capacity of 800 cubic meters per day, and pumping water to a rest tank at the radar location, distributing water with the Gravity system to the government and landhouse (ACDC).



Source: Waterworks, Concession Welfare, Royal Thai Navy (http://www.waterworks.navy.mi.th)

Figure 3.7 31 Service Network by Waterworks, Concession Welfare, RTN

In this regard, Waterworks, Concession Welfare, RTN has water economy measures in place, with cooperation with civil servant, employees and officers in Sattahip area. These measures are as follows:

1) Turn off water every time it is not used, such as washing hands, washing face, rubbing with soap, and washing others.
2) Keep taps and water equipment closed.
3) Change the tap to automatic on-off type.
4) Check water equipment and hose regularly and immediately notify repair if damage occurs.
5) Collect dishes, coffee cups, and glasses to rinse at the same time in large amount.

6) Use water support containers instead of directly opening water from the taps.

7) Choose sanitary ware that saves water, such as a toilet that uses 5-6 liters of water at a time.

At present, U-Tapao Airport and the Navy Aviation Division are receiving water from Waterwork, Concession Welfare, Royal Thai Navy, which is responsible for distributing water supply to government agencies and government residences in Sattahip and nearby areas. They are pumping raw water from Khlong Bang Phai to produce water supply at Water Filtration Plant 2 (Naval Aviation Division Area) and Water Filtration Plant 3 which provides water to U-Tapao International Airport and Naval Aviation Division as follows:

- **Water Filtration Plant 2** has a water production capacity of up to 12,000 cubic meters per day, but at present, it produces 7,000-8,000 cubic meters of water per day. Water can be supplied 24 hours a day, providing water to 11 agencies, namely:

  1) Royal Thai Naval Air Division,Royal Thai Fleet (RTNAD RTF)
  2) oAir Defense Artillery Battalion, Artillery Regiment, Marine Division Royal Thai Marine CorpsAir Defense Artillery Battalion, Regimen P,Marine Division
  3) Supply School, Naval Supply Department(SS.NSD.RTN)
  4) Assault Amphibious Vehicle Battalion, Patrolman, Marines (AV8)
  5) 1st Infantry Regiment, Marine Division, Royal Thai Marine Corps (Phra Maha Jetsada Camp) (Krom Rama 1 Pol. Gen. (Jetsada Camp))
  6) Civil Engineering Division Sattahip Naval Base (Civil Engineering Division, SNB)
  7) Meteorological Department
  8) Air and Coastal Defense Command 1(ACDC 1)
  9) 5th Military Police Company, Naval Military Police Regiment (5th NMPR)
  10) 6th kilometre residence
  11) The Queen Sirikit Hospital, Royal Thai Army Medical Department

- **Water Filtration Plant 3** has water capacity of up to 27,000 cubic meters per day, but at present it produces 16,000-17,000 cubic meters per day. Water can be supplied for 24 hours, distributing to 22 agencies, namely:

  1) Royal Thai Fleet(RTF)
  2) Sattahip Naval Base Workshop Department Residence (WD Accommodation)
  3) Naval Ordnance Department (NORDD.RTN)
  4) Naval Rating School (NRS)
  5) Helicopter Carrier Squadron, Royal Thai Fleet (HCS, RTF)
  6) Sing Samut School

7) Air and Coastal Defense Command (ACDC (partial))
8) Central residence building
9) Royal Thai Marine Corps (RTMC)
10) Reconnaissance Battalion, Marine Division (MD)
11) Recruit Training Center, Naval Education Department (RTC, NED, RTN)
12) Construction and Development Regiment (CDR, SNB)
13) Coast Guard Squadron, Royal Thai Fleet (CGS, RTF)
14) Samaesarn Naval Special Warfare Command (NSWC(Samaesarn))
15) Mahidol-Adulyadej Naval Dockyard (MND)
16) Chuk Samet Fuel Depot
17) Chuk Samet Port, Port Authority of Sattahip, Sattahip Naval Base(CSP, PAS, SNB)
18) Sattahip Market
19) Reserved building (whole)
20) Royal Thai Navy welfare house, RTN (Km.10)
21) Outside Royal Thai Navy (Government Section, Accommodation, Sattahip Area Site)
22) Naval Special Warfare Command (NSWC)

In addition, U-Tapao International Airport also has a water filtration system (RO) for producing good water and sending it to Terminal 2 for use and consumption (**Figure 3.7-32** and **Figure 3.7-33**).

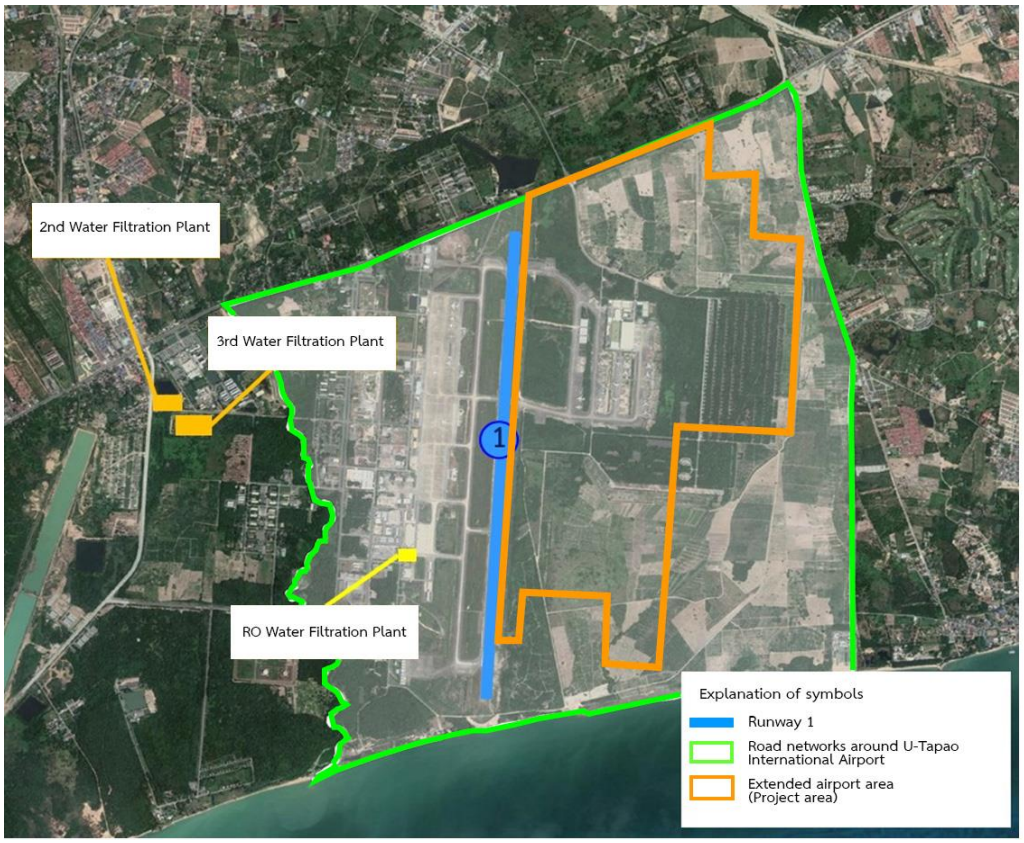


Figure 3.7-32 Location of water supply within the project area




Figure 3.7-33 RO water filtration system is located behind Terminal 2.

(3) Fire prevention system

1) Fire extinguishers

A fire water tank located at Water Plant 2 supplies water via pipes to 19 fire sprinklers on the current runway **Figure 3.7-** 34

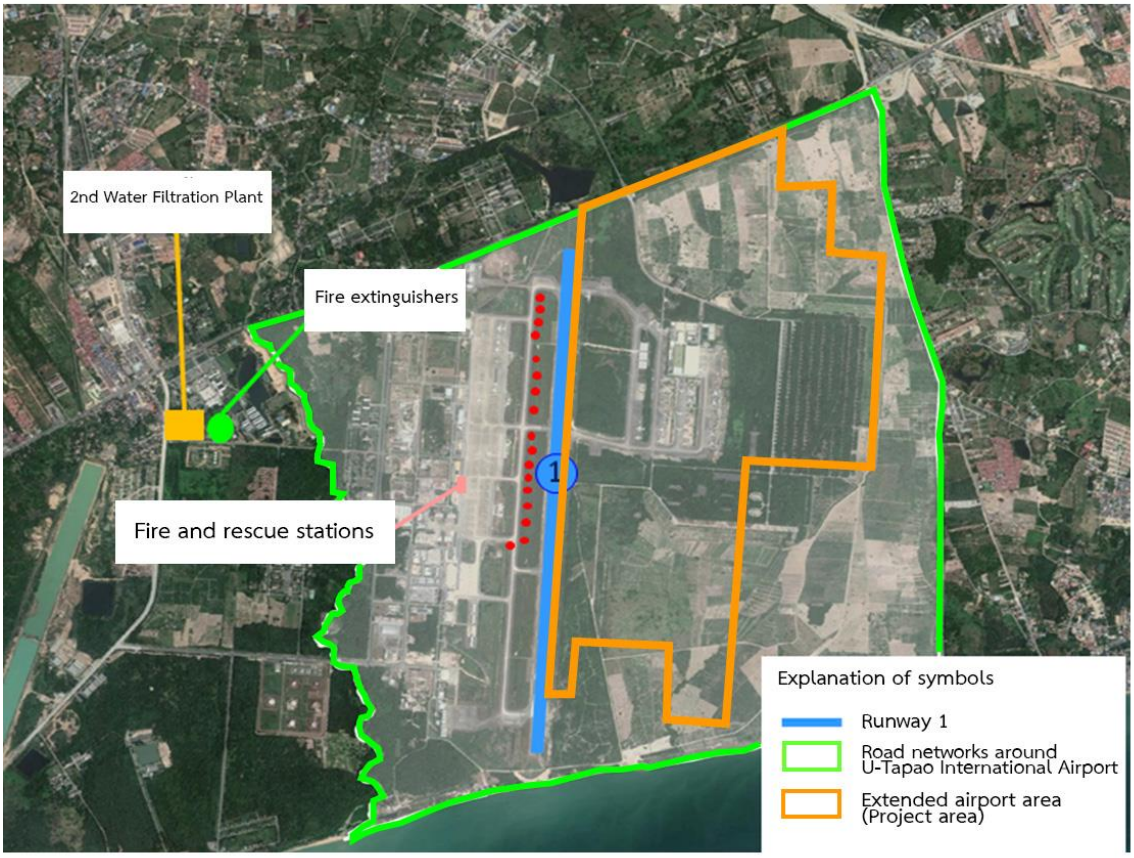


Figure 3.7 34Location of Fire and Rescue Stations, Fire Extinguishers and Fire Extinguishers at U-Tapao International Airport

2) Fire and rescue stations

Fire Station of U-Tapao International Airport Located on the west side of runway 1. (**Figure 3.7-** 34). It is responsible for fire fighting aircraft and buildings, consisting of 5 fire trucks, 3 water trucks, 1 emergency ladder, and 1 rescue car (**Figure 3.7-35**), as follows:

- 3 aircraft fire trucks as follows:
  - Fast moving fire truck with a capacity of 12,000 liters of water, 1,500 liters of foam, 250 liters of chemical powder, a pumping rate of 7,000 liters per minute, and a turret injection rate of 4,500 liters per minute, total of 2 vehicles.
  - 3,600 liters of water-filled fire truck with 400 liters of foam contained 250 liters of chemical powder with 3,400 liters/minute of pumping rate and turret injection rate of 2,400 liters per minute, 1 vehicle.
- 2 Fire Trucks for Building
  - 4,000 liters of water-filled fire truck with 500 liters of foam contained 250 liters of chemical powder with 3,000 liters/minute of pumping rate and turret injection rate of 3,800 liters per minute, 1 vehicle.

- 6,000 liters of water-filled fire truck. Turret injection rate is 2,400 liters per minute, total 1 vehicle.

- 3 water trucks
  - 2 water truck with a water load of 6,000 liters with terret injection rate of 1,000 liters per minute.
  - 7,000 liters of water truck with water Spray Rate : 800 liters/minute 1 unit.
- 1 rescue ladder
  - Rescue ladder truck with a capacity of 1,000 liters of water, 100 liters of foam, and a pumping rate of 3,000 liters per minute, 1 vehicle.

U-Tapao International Airport currently supports Code C aircraft, which currently has the capacity and number of aircraft fire and rescue equipment with Category 10 capability, which is sufficient to accommodate aircraft with a body width of not more than 8 meters and aircraft that with a length of 76 meters or more, but less than 90 meters, there is also one factor which is length of access to aircraft accident area from when the fire and rescue service has been notified until the first aircraft fire truck (the first group) arrives and is ready to spray foam at a rate of not less than 50 percent as specified by the ICAO within 2 minutes but not more than 3 minutes, with Response Time drills twice a month (1 time during the day and 1 at night) and every 3 months for building fire drills.

Fast moving aircraft fire truck

Fire Trucks

Water trucks

Rescue ladder

Figure 3.7-35 U-Tapao International Airport Aircraft Fire Truck

(4) Communication system

Communications systems within U-Tapao International Airport and the Naval Aviation Division are currently under the supervision of the Communications Division. Naval Aviation Division which telephone communication system is an Analogue PABX system with a Core Switch located at Terminal 1. The contact number consists of a central number (number of 9 digits) and an internal number (amount of 5 digits). For information system (Internet network), concessions to join the service are Advanced Info Service Public Company Limited, True Corporation Public Company Limited, Total Access Communication Public Company Limited, CAT Telecom Company Limited. Public Company Limited and TOT Public Company Limited.

(5) Fuel

The fuel sources used for airplanes are Jet A-1 type fuels. Most of the fuels were received from PTT Co. which purchased by the airline, some of the Company's cars will supply fuel to the aircraft's fuel tank, with the supply pipe sent to the airside pits, which currently has 37 pits (number 1-3), and 6 more pits have not operated (number 4).

For fuel tank located at the bottom of runway 1, 13 fuel storage tanks (6 small tanks and 7 large tanks) are currently used only small tanks to store fuel for military aircraft. For large tanks, there is no use due to the large size, as shown in **Figure 3.7-36**

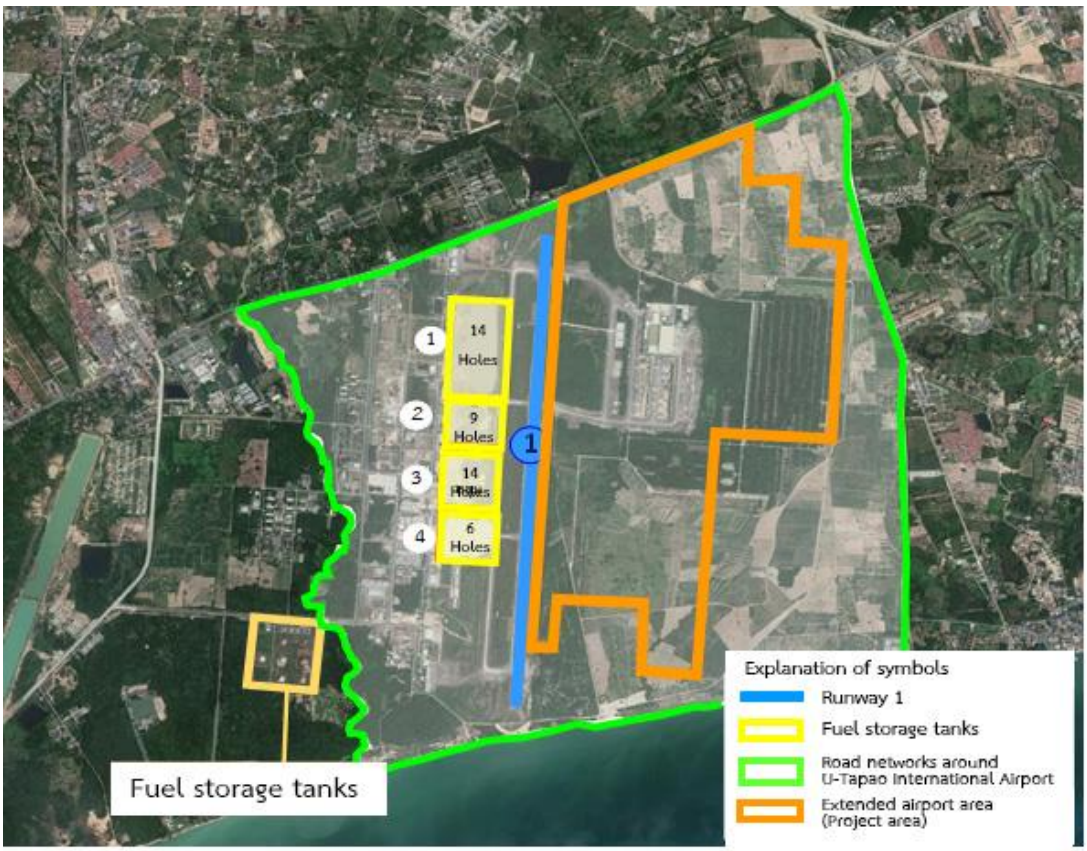


Figure 3.7-36 Fuel tank and fuel injector

3.7.5 Water drainage and flood prevention systems

3.7.5.1 Scope of Study

Collect secondary data of water drainage and flood prevention of U-Tapao International Airport and its past, present, and various obstacles to use as baseline data to predict the effectiveness of water drainage and flood prevention and the potential impact.

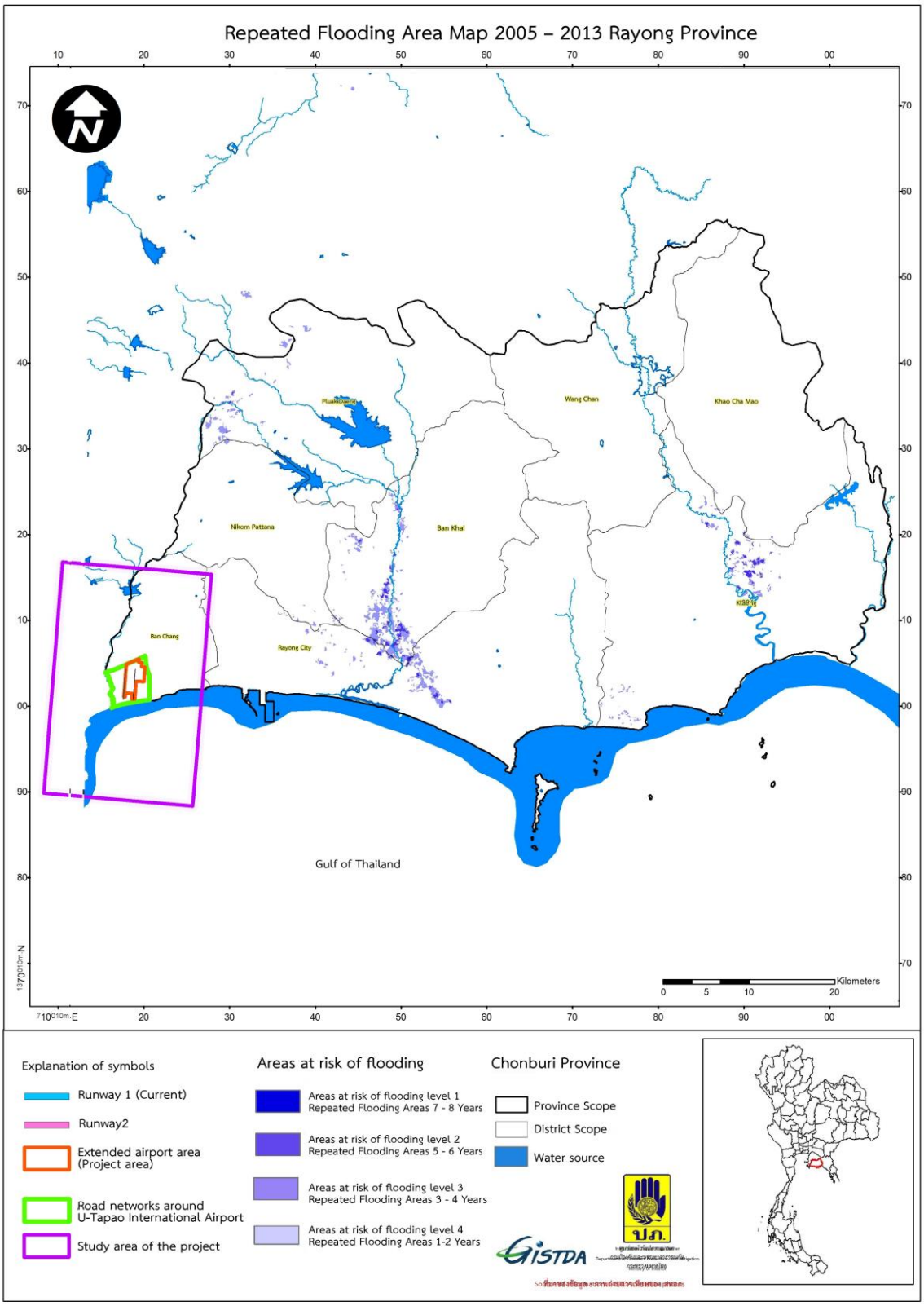
3.7.5.2 Research Method

Collect data on drainage, drainage problem and flooding issues, accident and damage records, as well as the condition and management of the current draining in the project area.

3.7.5.3 Results of the Study

(1) Flood area near the project area

According to the review of the repeated flooding area of Rayong province during 2005-2013, it was not found that there was any residual flood area within the study area, as shown in **Figure 3.7-37**



Source: Adapted from a satellite image of the Geo-Informatics and Space Technology Development Agency. (Public Organization)

Figure 3.7 37 Repeated flooding area in Rayong province, 2005-2013

(2) Flooding scenario occurred in Rayong province

From the report of the Rayong Provincial Flood Response Plan (**Table 3.7-**24), covering 8 districts, namely Nikhom Phatthana District, Khao Cha-Mao District, Wang Chan District, Ban Chang District, Pluak Daeng District, Ban Khai District, Klaeng District, and Mueang Rayong District found that the flood situation in Rayong province between 2015-2018 caused a total of 28 floods, 21,231 households were affected, 39,624 people were affected. One life and one injury were summarized as follows:

In 2015, the most severe flooded were 13 times, covering the area of 6 districts, namely Wang Chan District, Ban Chang, Pluakdaeng District, Ban Khai District, and Mueang Rayong District, and Rayong District. There were 1,137 households affected with 3,911 people in trouble.

followed by the year 2016 which flooding had been held for 7 times, covering the area of 8 districts, which were Nikom Pattana District, Kao Cha Mao District, Wang Chan District, Ban Chang District, Pluak Daeng District, Ban Khai District, Klaeng District, and Mueang Rayong District. The affected households were 12,012 households, with 25,834 people in trouble.

In 2017, there were 7 floods covering 6 districts, including Nikom Pattana District Ban Chang District, Pluak Daeng District, Ban Khai District, Klaeng District, and Mueang Rayong District. In this regard, 7,972 households affected with 9,247 people, were in trouble and 1 injured person found.

In 2018, there were 2 floods covering 2 districts, namely Ban Khai District and Mueang Rayong District. 110 households affected with 632 people in trouble.

Table 3.7□24 Flooding Scenarios in Rayong Province

Year	Number of disasters (times)	Risk area (districts)	Sub-district/Village (community)	The trouble.		Impact people (persons)	
				Household	People	Death	Injury
2015	13	6 Districts	14 Subdistricts, 48 Villages, 8 Communities	1,137	3,911	-	-
2016	7	8 Districts	28 Subdistricts, 160 Villages, 4 Communities	12,012	25,834	1	-
2017	7	6 Districts	31 Subdistricts, 144 Villages, 44 Communities	7,972	9,247	-	1
2018	2	2 Districts	5 subdistricts, 27 villages	110	632	-	-
Total	**28**	-	-	**21,231**	**39,624**	**1**	**1**

Source: Rayong Provincial Disasters Response Plan, Rayong Disasters Prevention and Mitigation Division, 2019

In this regard, the area affected by the flooding in the Rayong economic area found that the majority of the problem was low-level area which is water basins caused by the

occurrence of various waters to be uncontrollable and land reclamation caused the water to be shallow, overflowing, etc.

(3) The drainage system nearby the project area.

Phala Subdistrict

The drainage trough system of Phala Subdistrict Municipality consists of reinforced concrete pipes, drainage trough, reinforced concrete (Kor.Sor.Lor.) (U-shape) long stone drainage trough (V-trough), stone walls, and natural drainage trough which has a total length of 35,317 meters, as shown in **Table 3.7-25**

Table 3.7-25 Phala Subdistrict Municipality Drainage System

Type of drainage system	Amount (line/place)	Length (meters)
Reinforced concrete pipe	10	4,846
Drainage trough Kor.Sor.Lor. (U-shaped) Drain	32	14,182
Long Stone Drainage (V trough)	2	609
Stone walls	4	3,380
Natural drainage trough	2	12,300
Total	**50**	**35,317**

Source: 4-year local development plan (2018-2021) Phala Subdistrict Municipality

Drainage and flood prevention system at U-Tapao International Airport

There are two types of rainwater drainage systems at U-Tapao International Airport, which are concrete drainage trough and natural drainage systems. It is an open drainage trough (earth ditch) designed and excavated since the construction of the airport to drain rainwater in which rain drainage trough are dug 1-2 times a year during the dry season, in the area of U-Tapao International Airport. There has never been a flood report since the construction of U-Tapao International Airport.

Draining rainwater in the area of the building group, **current** (westside) runway and driveway areas has details as follows:

- Water from various building/office groups: There is drainage into the natural drainage trough in the airport area, which is connected to Khlong Bang Phai and flows to the sea, as shown in **Figure 3.7-38**

- The area for runways and driveways (in the aviation zone) currently drain water into the water drainage canals beside the runways and drive ways as shown in **Figure 3.7-39** and further release into the sea.

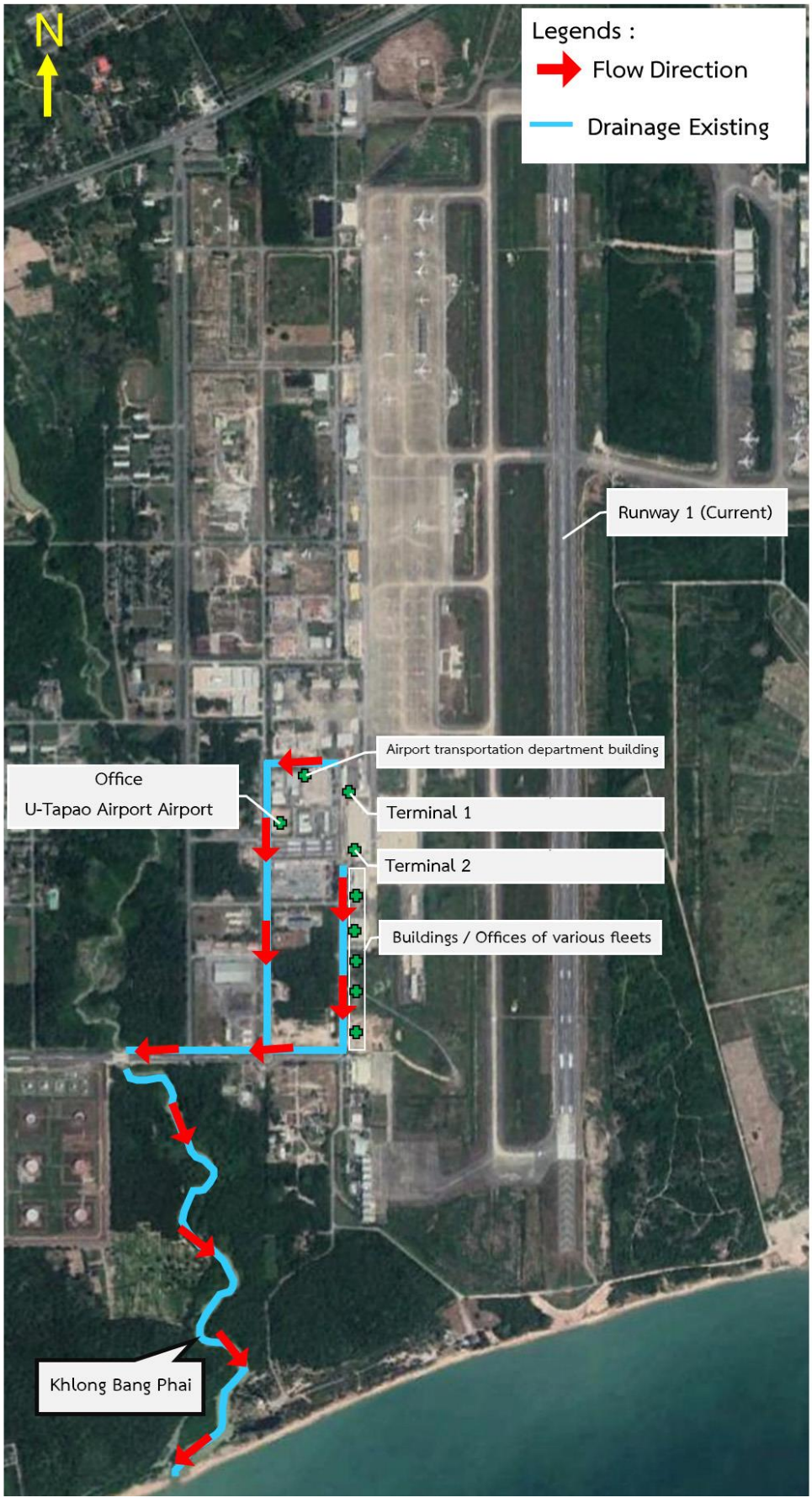

N
Legends :
Flow Direction
Drainage Existing
Runway 1 (Current)
Airport transportation department building
Office
U-Tapao Airport Airport
Terminal 1
Terminal 2
Buildings / Offices of various fleets
Khlong Bang Phai

Figure 3.7 38 Draining water from existing building/office groups

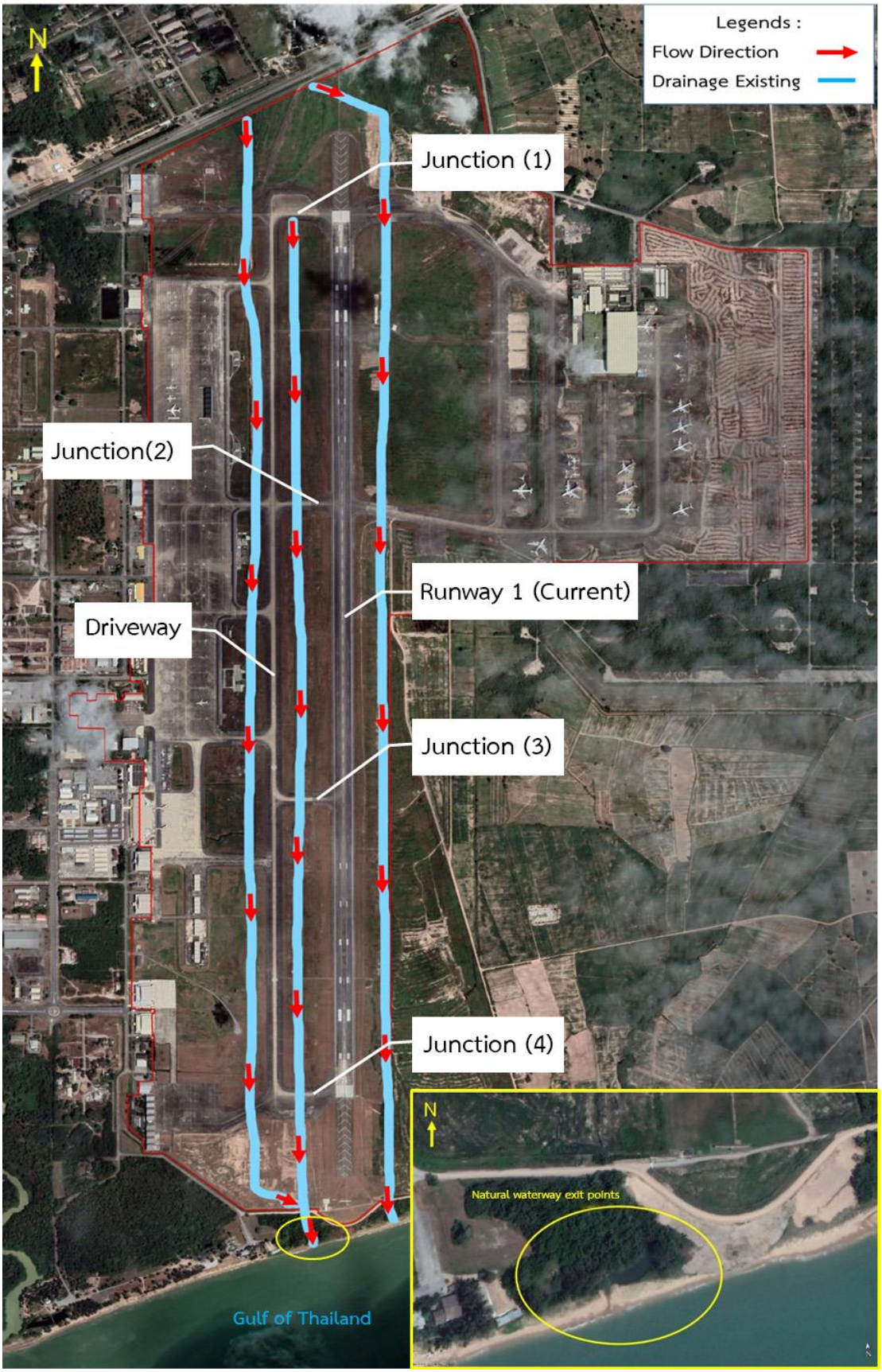


Figure 3.7 39 Draining water in the area of the current runway and driveway

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