



**Feasibility Study and
Preliminary Design of
Chumphon - Ranong Railway Project**

Executive Summary Report



Submitted by : **AEC** **IPC**

- Asian Engineering Consultants Corp., Ltd.
- Infra Plus Consulting Co.,Ltd.
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Office of Transport and Traffic Policy and Planning

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February 2018

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Chapter 1

Introduction

Chapter 1

Introduction

1.1 Project Background

The cabinet meeting on 11 October, 2016 acknowledged the outcome of the meeting on 16 September, 2016 between the Prime Minister and Joint Committee between Public and Private Sectors to Solve Economic Problems of Central Region and Southern Andaman Provincial Cluster that the Ministry of Transport was appointed to follow the recommendation of the Joint Committee on developing and extending the southern railway network from Chumphon to Ranong Provinces, totaling 125 km long, by developing another railway from the Gulf of Thailand to the Andaman Sea for transportation and tourism purposes including linking to Ranong Deep Sea Port to function as a gateway to BIMSTEC in the future.

The development and extension of new railway network from Chumphon to Ranong linking the Gulf of Thailand to the Andaman Sea is consistent with Article 6 of the government policies on enhancing the economic potential of the country in terms of transportation development to be more convenient, faster and safer to upgrade the people's quality of life. It is also consistent with Strategy 7: Strategy for Advancing Infrastructure and Logistics as stated in the 12th National Economic and Social Development Plan in terms of railway network development that feasibility studies should be conducted for routes that could act as feeder lines from economic and industrial areas in different provinces to the main railway network. Thus, the Ministry of Transport has included the project in the main mission of the Ministry of Transport under the draft of the 20-year Transport Development Strategy (2017-2036).

Southern provincial cluster has a potential for economic and tourism development due to the advantage of the geographical location that transportation linkages between the Gulf of Thailand and the Andaman Sea could be developed to be a world class marine tourism center and an economic gateway to South Asia. The government has focused on transportation development linking the 2 coasts to enhance the competitive potential to southern provincial cluster.

The Office of Transport and Traffic Policy and Planning (OTP) deems it is necessary to conduct the feasibility study on economy, engineering and environment for railway Chumphon-Ranong to develop a new railway linking the Gulf of Thailand and the Andaman Sea to enhance transportation and tourism of the country.

1.2 Project Objectives

The objectives of the Feasibility Study for Railway from Chumphon-Ranong Deep Sea Port are as follows:

- 1) To study the development and extension of new railway network from Chumphon-Ranong Deep Sea Port to develop transportation system.
- 2) To design and prepare an initial environmental examination (IEE) report.
- 3) To conduct the feasibility study on economy, finance and investment option.
- 4) To create people's awareness processes and people's participation in area development along the railway from Chumphon-Ranong Deep Sea Port.

1.3 Scope Of Consultant Services

1.3.1 Task 1: Study, Survey, Collect and Analyze Data for the Development and Extension of New Railway Network from Chumphon-Ranong Deep Sea Port include

- 1) To review an investment strategic policy on infrastructure and transportation development.
- 2) To collect basic data.
- 3) To survey and collect transportation data and problems in the project area.

1.3.2 Task 2: Design and Prepare an Initial Environmental Examination (IEE) Report include

- 1) To study the feasibility of route.
- 2) To conduct a conceptual design.
- 3) To analyze and recommend station locations, container yard and inland container depot.
- 4) To conduct an initial environmental examination (IEE).
- 5) To conduct an initial cost estimation.
- 6) To analyze/evaluate/select the most appropriate route.
- 7) To prepare the right-of-way plan and land acquisition data.
- 8) To conduct a preliminary design.
- 9) To conduct a preliminary design for infrastructure.
- 10) To conduct a preliminary cost estimation.

1.3.3 Task 3: Feasibility Study on Economy, Finance and Investment Option include

- 1) To conduct the economic and financial analysis.
- 2) To prepare guidelines for public-private partnerships.
- 3) To prepare the project feasibility report for private investment, analyze financial and economic returns.

1.3.4 Task 4: Create People's Awareness Processes and People's Participation in Area Development along the Railway from Chumphon-Ranong Deep Sea Port include

- 1) To assign key personnel.
- 2) To arrange public participation activities.
- 3) To prepare public relations work plans.

Chapter 2

***Study, Survey, Collect and Analyze Data
in Various Fields for Network Development and
Expand the New Railway Line
from Chumphon Province – Ranong Province***

Chapter 2

Study, Survey, Collect and Analyze Data in Various Fields for Network Development and Expand the New Railway Line from Chumphon Province – Ranong Province

2.1 The Review of Policy and Investment Strategy for Developing of Infrastructure and Transport System Services

2.1.1 The Consistency with Policy and Strategy for Developing of Country's Infrastructure and Transport System

Based on a review of the policy and strategy for developing of country's infrastructure and transport system services, the focus will be on promoting the development of rail transport in both passenger and freight transport, as rail transport is a form of transportation that uses energy efficiently and is environmentally friendly because it produces less air pollution and environmental problems than road transport and also reduces traffic problems, as can be summarized policy and strategy of transport system infrastructure development related to the project as follows.

- The 20-year National Strategy and the 12th National Economic and Social Development Plan require a plan for the development of infrastructure and logistics systems by promoting rail transport systems and logistics centers in various ways linking the industrial production bases to the country's trade gateway. It also offers a regional and urban development strategy, which is an important strategy that is relevant to the tourism industry and services by promoting links the southern's tourist attractions between Andaman Sea and Thai Gulf, along with development of potential tourist cities to add value to the region by upgrading Ranong to a health and spa tourism town and Chumphon is an agricultural tourism town.
- The 3rd Strategic Plan for Logistics Development in Thailand requires a strategy for the development of transport infrastructure and logistic networks along the strategic route to link the sub-region and being trade gateways by supporting the shift to a more efficient transport model, promoting the modification to transport modes (Shift Mode) and multimodal transport by developing and improving railway network as the main network for freight transport in the country including the development of facilities and logistics activities.
- Strategy for Development of Thailand's Transportation System for 20 years and the Strategy for Development of Transport Infrastructure of Thailand in 2015-2022 require a plan to develop a transport network with a focus on rail infrastructure as the main transport model, by developing an inter-city rail network to reduce the transportation costs including the integration of existing infrastructure management to maximize utilization.

- The 2nd National Tourism Development Plan and the Development Strategy for the Southern Provinces, as well as the Chumphon and Ranong Development Strategies, have planned to develop infrastructure and facilities to support the expansion of tourism and to improve the quality of tourism, products and services for balancing and sustainable tourism, as well as supporting Ranong Port as a gateway to the Andaman Sea.

As a considering the consistency of the Chumphon - Ranong Railway Project with the country's development policies and strategies, it can be concluded that **Chumphon - Ranong Railway Project will create a link between the two coasts (the Andaman and the Gulf of Thailand), which will promote tourism between the two coasts, as well as linking the freight transport between the production base to the Ranong port, which is the Andaman side's trade gateway, linking with BIMSTEC countries in the form of travel and rail transport, which is a form of transport used the energy efficiently and environmentally friendly.**

2.1.2 The Review of Various Projects Plans Related to the Development of Transport Networks

The consultants have reviewed various project plans related to the development of transport networks concerned with the study area are as follows.

- The Development Plan of the Double Track Railway on the southern route starts from Nakhon Pathom - Hua Hin - Prachuap Khiri Khan - Chumphon - Surat Thani, which is expected to be completed in 2021 and Surat Thani – Padang Besar, which is expected to be completed in 2022, as well as the development of the new railway line Surat Thani - Phang Nga - Phuket as shown in **Figure 2.1.2-1**, which is in charge of the State Railway of Thailand (SRT).



Source: The Study on Master Plan for the Development of Rail System and High Speed Trains (2010)

Figure 2.1.2-1 Overview of Network Development of the Double Track Railway on the Southern Route

- For a road network development plan consists of a 4-lane road improvement plan and a new road construction plan in the study area. Nowadays, Petchkasem Road, which is the main route linking Chumphon and Ranong, the construction has been completed in some ranges, some are under construction and some have not budgeted yet, which is expected that in the future this road will be a 4-lane throughout the route, as shown the road development plan in **Figure 2.1.2-2**, which is under the supervision of the Department of Highways and the Department of Rural Roads.



Figure 2.1.2-2 Highway Network Development in the Study Area

2.2 Compilation and Analysis of Basic Socio-Economic Data

In studying and forecasting of passenger volume of railway project, the consultants have collected, analyzed and forecasted the economic and social factors, which is the basis factor for the transport demand as following guidelines.

2.2.1 Compilation of Basic Socio-Economic Data

The consultants collected the socio-economic data in the past from various related sources composed of Gross Domestic Product (GDP), number of population, average income per capita, employment, tourism. The basic socio-economic data in the study area can be summarized as follows.

- In 2017, Chumphon Province had a population of 509,590 and Ranong Province had a population of 190,399, with the rate of increase in population in Chumphon and Ranong was 0.56% and 2.16% per year, respectively.
- In 2015, Chumphon province had a gross product value of 40,055 million baht and Ranong had a gross product value of 17,297 million baht, with the rate of increase in gross product value in Chumphon and Ranong was 2.86% and 1.39% per year, respectively.
- In 2015, Chumphon Province had the average income per capita of 151,835 baht and Ranong Province had the average income per capita was 91,452 baht / year, with the rate of increase in average income per capita in Chumphon and Ranong was 1.62% and 0.65% per year, respectively.
- In 2016, Chumphon Province had 279,529 employed persons and Ranong Province had 140,167 employed persons, with the rate of increase in number of employed persons in Chumphon and Ranong was -2.63% and 5.74% per year, respectively.
- In 2016, Chumphon Province had 1,357,428 visitors (persons-times) and Ranong had 923,243 visitors (persons-times), with the rate of increase in number of visitors in Chumphon and Ranong was 8.01% and 7.25% per year, respectively.

2.2.2 Study and Analysis of Future Change Trends for Socio-Economic Conditions

The consultants have analyzed and forecasted the trend of economic and social change. The major variables of future change are number of population, gross product, per capita average income, employment and tourism, which affect the change in travel volume in the future. The consultant divided the forecast into two parts as follows.

- **Estimates for a base year**

Since the latest year's data of each socio-economic variable will have both 2015 and 2016. Therefore, forecasting in future years, the data will be adjusted as 2017, which is the base year used in the study to be consistent with the traffic survey data of the project, which was conducted in 2017.

- **Target Year Forecast**

Forecasting the socio-economic variables in the future for the target year 2025, 2034, 2044 and 2054, respectively, to analyze the increasing rate of the volume travel in target year.

Results of population projections, gross product value, average income per capita, employment and future tourist numbers in the study area are shown in **Table 2.2.2-1**, which summarizes the guideline and expected results as follows.

- **Population Projections**

Population Projections using the population growth rate data from the NESDB's Thailand Population Estimates data by first estimating the national population and then using it as a baseline for population projections at regional and provincial levels. By the years 2017-2054, Chumphon and Ranong provinces have the population projections in the range 509,590 - 576,889 persons and 190,399 - 204,215 persons, respectively, with the rate of increase in population was 0.34% and 0.19%, respectively.

- **Gross Product Value Forecasts**

Gross Product Value Forecast using Gross Product Value growth rate data for the past 10 years to forecast and use the results of the Gross Domestic Product (GDP) forecast as a baseline for forecasting Gross Regional Product (GRP) and Gross Provincial Product (GPP). By the years 2017-2054, Chumphon and Ranong provinces have the results of the Gross Product Value forecasts in the range of 40,739 - 59,098 million baht and 17,498 - 22,351 million baht, respectively, with the rate of increase in Gross Product Value was 1.01% and 0.66%, respectively.

- **Forecasting on Average Income Per Capita**

Forecasting on average income per capita using the results of the Gross Product Value forecasts divided by the expected population in the future. By the years 2017-2054, Chumphon and Ranong Province have the results of the average income per capita in the range of 79,626 - 102,443 baht and 91,990 -109,448 baht, respectively, with the rate of increase in average income per capita was 0.68% and 0.47%, respectively.

- **Employment Forecasts**

Employment Forecasts using the average of the proportion between employment and number of population, by the year 2017-2054, Chumphon and Ranong Province have the results of employment forecast in the range of 304,372 - 344,568 persons and 122,060 - 130,917 persons, respectively, with the rate of increase in employment was 0.34% and 0.19%, respectively.

- **Visitors Forecasting**

The forecasts of number of visitors using the average increase rate in the number of visitors from the forecasting data and determine the target of the direction of the expansion of tourism according to the National Tourism Development Plan No. 2, by the years 2017-2054, Chumphon and Ranong provinces have the results of number of visitors forecasts in the range of 1,402,179 - 3,603,242 and 952,881 - 2,362,508, respectively, with the rate of increase in visitors was 2.58% and 2.48%, respectively.

Table 2.2.2-1 Forecasting of Socio-Economic Data in the Study Area

Province	Base Year 2017	Year				Average annual increase rate (%)
		2025	2034	2044	2054	
Population projections (person)						
Chumphon	509,590	536,746	550,087	559,974	576,889	0.336
Ranong	190,399	196,485	198,612	200,678	204,215	0.190
Gross product value forecast (million baht)						
Chumphon	40,739	45,812	51,044	55,821	59,098	1.011
Ranong	17,498	18,950	20,378	21,599	22,351	0.664
Average income forecasts per capita (baht)						
Chumphon	79,626	85,351	92,793	99,685	102,443	0.683
Ranong	91,990	96,445	102,602	107,630	109,448	0.471
Employment forecasts (person)						
Chumphon	304,372	320,591	328,560	334,465	344,568	0.336
Ranong	122,060	125,962	127,325	128,650	130,917	0.190
Visitors forecasting (person)						
Chumphon	1,402,179	1,824,238	2,475,408	3,005,399	3,603,242	2.584
Ranong	952,881	1,230,208	1,651,008	1,987,804	2,362,508	2.484

Source: Analysis by consultants

2.3 Trade Condition between Thailand and BIMSTEC Countries

2.3.1 Trade Overview between Thailand and BIMSTEC Countries

In the study and forecast the rail freight volumes on project line, it will be transported through Ranong Deep Sea Port to neighboring countries Andaman coast. Nowadays, it is transported through several private ports in Ranong province for export and import with Myanmar, which is a result of border trade. While the Ranong Deep Sea Port, which is under the supervision of the Port Authority of Thailand, has not yet been transported to Andaman coast's countries, especially BIMSTEC countries, which currently there is no freight through the Ranong Deep Sea Port.

Thailand - Myanmar border trade statistics in Ranong province for the year 2016 had a total trade value of 25,578 million baht, import value of 8,285.21 million baht and export value of 17,292.72 million baht. Considering the import and export value, it was found that products with the most import value are aquatic animals (chilled fish), followed by seamless pipe for drilling and fish meal, and the most exported value products were fuel, lubricant, followed by cement and seamless pipe for drilling.

There is also a need to study trade conditions with BIMSTEC countries, which currently there is no freight through the Ranong Deep Sea Port. Most of the goods are produced and consumed in the upper area and transported through Bangkok Port and Laem Chabang Port. Therefore, the study of trade will give us an insight into the type of

products and the volume of products that are important and will be analyzed to identify potential products, which have a chance to be transported through Ranong Port in the case of the construction of the railway route project Chumphon - Ranong Deep Sea Port. In 2016, Thailand's trade with BIMSTEC countries has export value 378,498 million baht, accounted for 5% of total Thai exports. India is the Thailand's export market with the most export value, accounted for 48% of the value of exports to BIMSTEC countries followed by Myanmar and Bangladesh, accounted for 39% and 9%, respectively, and has import value 178,356 million baht, accounted for 2.6% of total Thai imports. India is the source of imported product with the most import value, accounted for 51% of the import value from BIMSTEC countries followed by Myanmar and Bangladesh, accounted for 47% and 1%, respectively, as shown in **Figure 2.3.1-1**.

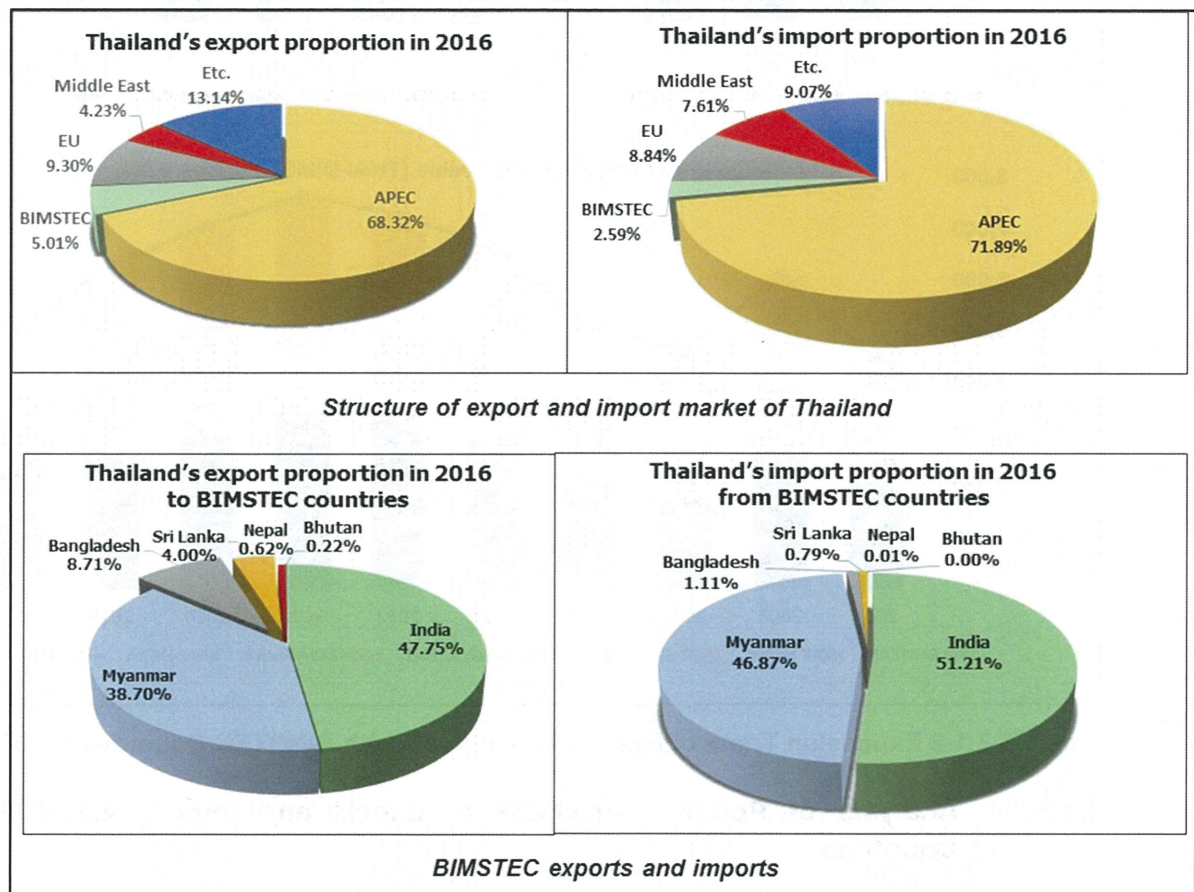


Figure 2.3.1-1 Export and Import Proportion of Thai and BIMSTEC Countries in 2016

Considering the expansion trend of export and import with BIMSTEC countries in 2007-2016, it was found that the average growth rate was 13.3% and 4.0%, respectively, as shown in **Figure 2.3.1-2**.

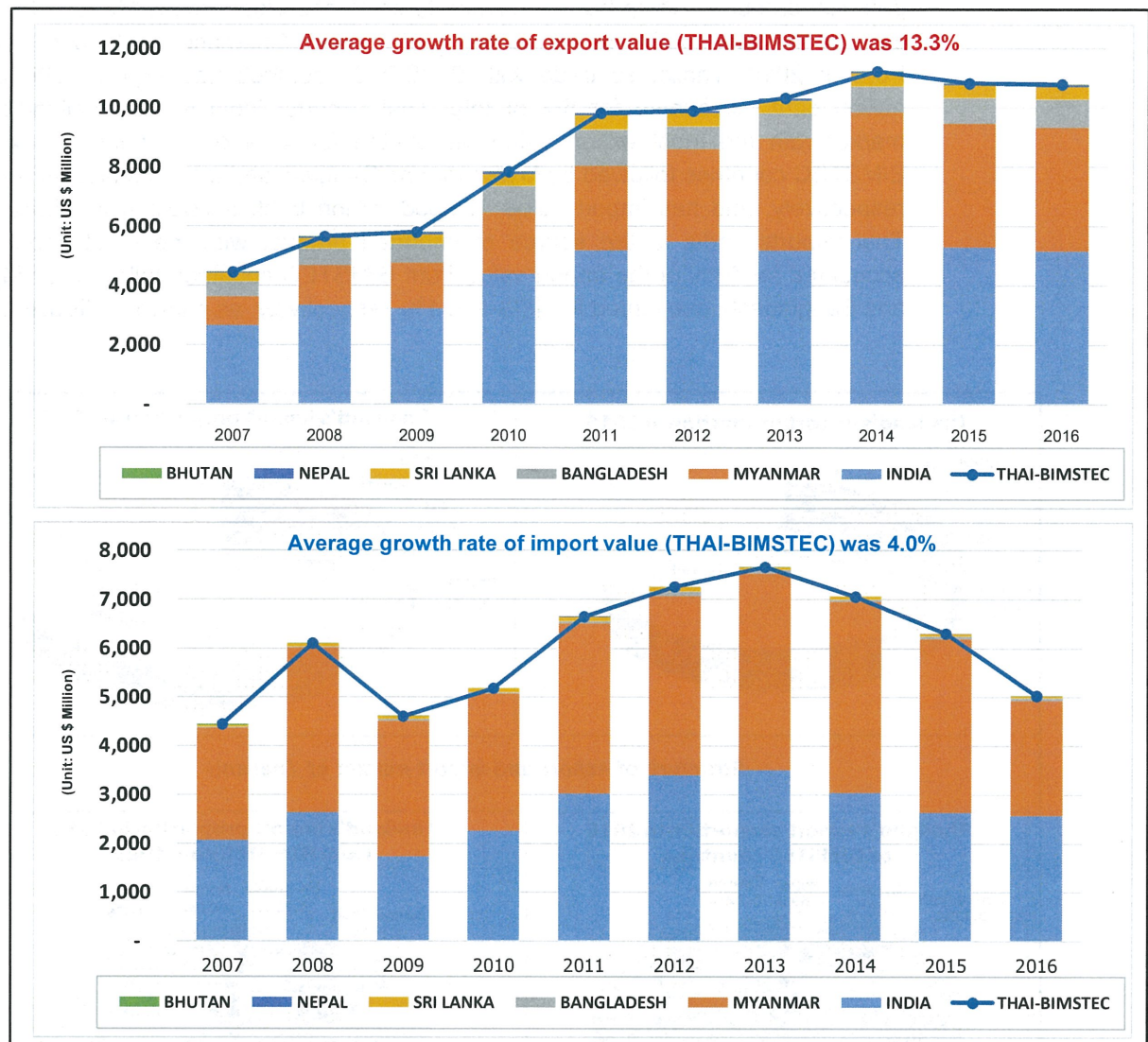


Figure 2.3.1-2 Expansion Trend of Exports and Imports with BIMSTEC Countries in 2007-2016

2.3.2 Analysis of Potential Products to Export and Import with BIMSTEC Countries

Based on the consideration of export and import data with BIMSTEC countries in terms of volume and value from Information Center of Information and Communication Technology, Office of the Permanent Secretary, Ministry of Commerce by cooperating with the Customs Department found that:

- Major products with export potential include cement (HS 2523), liquor and vinegar (HS 22), sugar (HS 1701), Petroleum products (HS 2710) Gypsum (HS 2520), Dolomite (HS 2518), resins (HS 3901 3907), iron and steel (HS 7204), rubber (HS 4001 4011) and automobile components and accessories (HS 8708).
- Major products with imported potential include fresh fish chilled / frozen fish (HS 0302 / HS 0303), iron and steel (HS 7201 / HS7202), wood charcoal (HS 4402), Petroleum products (HS 2710) and automobile components and accessories (HS 8708).

Details of export and import volume of products with BIMSTEC countries in 2016 are shown in **Table 2.3.2-1**.

Table 2.3.2-1 Volume of Export and Import Potential Products with BIMSTEC Countries in 2016

Category	India	Myanmar	Bangladesh	Sri Lanka	Nepal	Bhutan	Total
Export							
Cement (KG)	18,026,902	2,748,845,899	3,825,967,762	360,706,163	550	-	6,953,546,726
Liquor and vinegar (LT)	7,228,139	1,114,411,445	1,912,032	136,852	8,679,718	119,857	1,132,488,043
Sugar (KG)	1,865,017	679,770,373	2,525,750	50,391,066	1,000	-	734,553,206
Petroleum product (LT)	31,947,303	630,508,271	8,969,182	7,876,802	-	-	679,301,558
Dolomite (KG)	488,507,150	-	56,213	-	-	-	488,563,363
Gypsum (KG)	111,773,270	3,131,275	192,488,210	151,047,054	-	-	458,439,809
Plastic Pellets (KG)	254,262,778	31,647,060	36,556,346	7,787,799	487,678	280,500	331,022,161
Iron and steel (KG)	178,824,597	124,387	32,922,930	21,345	-	-	211,893,259
Timber (KG)	95,124,033	11,351,524	2,352,616	14,348,224	4,570	1,434	123,182,401
Automotive Components & Equipment (KG)	33,327,476	6,449,289	1,793,072	821,186	32,222	14,026	42,437,271
Import							
Fresh and chilled fish (KG)	61,060,366	146,571,988	26,460	450	-	-	207,658,814
Iron and steel (KG)	114,491,411	-	-	-	-	-	114,491,411
Petroleum (LT)	107,923,129	-	-	-	-	-	107,923,129
Charcoal (KG)	4,368,111	73,746,045	-	-	-	-	78,114,156
Automotive Components & Equipment (KG)	26,578,137	4,142	97	4,173	-	-	26,586,549

Source: Information and Communication Technology Center Office of the Permanent Secretary by the cooperation of the Customs Department.

Chapter 3

Analysis/Evaluation/Selection of Appropriate Route Alignment

Chapter 3

Analysis/Evaluation/Selection of Appropriate Route Alignment

3.1 Preparation of Basemap

The Consultant has used a set of L7018 maps of the Royal Thai Survey Department on the scale of 1:50,000 covering the areas of the 4 alternative route alignments. The maps have been scanned into digital file format. The Consultant has also used satellite images in digital file format with the minimum resolution of 1 meter per pixel covering the project area. Both maps and satellite images have been rectified into UTM (Universal Transverse Mercator) based on WGS84 for preparing a basemap.

3.2 Consideration of the Feasibility of Route Alignment

3.2.1 Origin-Destination

The Consultant has studied the southern railway from Chumphon-Ranong Provinces in order to develop the new railway from the Gulf of Thailand to the Andaman Sea for transportation and tourism purposes including linking to Ranong Deep Sea Port. The route shall be able to link the origin-destination of potential freights/passengers to use the rail system. The Consultant has surveyed the origin-destination linkages of freights/passengers which may influence the determination and design of alternative route alignments, e.g.

- Location of the station and use of the surrounding area.
- The existing location of container yard and inland container depot and as planned for the future.
- The current development projects or future projects concerning transportation demand.
- General environmental impacts.
- The survey enabled the Consultant to know the potential and feasibility of railway system development that shall be able to fulfill more transportation demands in the future.

The Consultant has the idea that the starting point of the project shall be on the existing southern railway in Chumphon Province and the ending point shall be at Ranong Deep Sea Port. The next section described the starting point and ending point of alternative route alignments.

3.2.2 Criteria for Selection of Alternative Route Alignments

The determination has considered thoroughly the areas where the alignment has to pass both the areas to be avoided and the appropriate areas. The criteria for consideration were as follows:

- 1) Areas to be avoided
 - Areas to be avoided according to promulgation as they are sensitive to environmental impacts. These areas include: main watershed classification area, conservative forest area according to promulgation and the cabinet resolution, the area where natural resources should be preserved, Archaeological sites and artifacts. These areas should be the first priority to be avoided.
 - Areas to be avoided due to environmental impacts at regional level. These areas include a dense village or community, land use area, area with complete natural, flooded area, mountainous area etc.
 - Areas to be avoided due to topography and community. These areas include a dense village or community, land use area, area with complete natural, flooded area, mountainous area etc.
- 2) These areas include plain, wasteland, public area without structures, blank land, area without dense perennial plant and forbidden plant, plateau etc.
- 3) Areas of other agencies which coordination with the responsible agency is needed. These areas include areas of other agencies, e.g. the Royal Irrigation Department, the State Railway of Thailand, the Rural Roads Department and other public areas etc. The route alignment can pass these areas but coordination with the responsible agency is needed and the scope of work should suit the utilization of that agency and not obstruct the land use of other agencies.

3.2.3 Alternative Route Alignments

The project area covers 2 provinces, i.e. 6 districts of Chumphon Province consisting of Muang Chumphon District, Sawi District, Lang Suan District, Tha Sae District, Thung Tako District and Phato District and 3 districts of Ranong Provinces consisting of Muang Ranong District, La-un District and Kra Buri District. The Consultant has determined the alternative route alignments which can extend from the existing southern railway to Ranong Deep Sea Port and Muang Ranong as show in **Figure 3.2.3-1**.

- Alternative Route Alignment 1

This alternative route alignment shall start at the south of Chumphon Station, about 3.20 km from Chumphon Station and about 0.80 km from the north of Saeng Dad Station. The alignment shall curve off the existing southern railway, head to the west to pass Highway Route No. 2009 and 41, run westerly to parallel Highway Route No. 4 (Phetkasem Road) with a distance of about 1.0 km from the highway, pass Khun Krating Sub-district, Ban Na Sub-district and Wang Mai Sub-district of Muang District, Chumphon Province, Choporo Sub-district and Pak Chan Sub-district of Kra Buri District, Ranong Province. The area is flat alternating with rolling terrain and at Chumphon and Ranong border is mountain terrain where the alignment shall need specific construction. The communities are located along Highway Route No. 4 (Phetkasem Road) and nearby. After that the alignment shall run southerly, parallel to the east of Highway

Route No. 4 (Phetkasem Road) with a distance of about 1-2 km from the highway, pass Mamu Sub-district, Namchuet Noi Sub-district and Namchuet Sub-district of Kra Buri District, Ranong Province. Then, the alignment shall be elevated across Highway Route No. 4 (Phetkasem Road) near Namchuet and Lam Liang Border, head to the south parallel to Highway Route No. 4 (Phetkasem Road) but switch to the west, pass Lam Liang Sub-district and Bang Yai Sub-district of Kra Buri District, Bang Kaeo Sub-district and Bang Phra Tai Sub-district of La-un District, Sai Daeng Sub-district and Pak Nam Sub-district of Muang District, Ranong Province. The area is mangrove forest alternating with rolling terrain. The alignment shall pass main canals, e.g. Lam Liang Canal and La-un Canal. Most of the communities are located along Highway Route No. 4 (Phetkasem Road) and the distributor road. With the said conditions, it is inevitable that the alignment shall need specific construction to avoid environmental impacts. The alignment shall end at Ranong Deep Sea Port, having a total length of 102.50 km.

- Alternative Route Alignment 2

This alternative route alignment shall start at the south of Wisai Station, about 1.50 km from the station. The alignment shall separate from the existing southern railway, head to the southwest to pass Highway Route No. 41, head to the west to pass Wisai Tai Sub-district, Khron Sub-district, Sawi Sub-district and Thung Raya Sub-district of Sawi District, Chumphon Province. Then, the alignment shall be curved to avoid the north of Kao Thalu Mountain Range, head to the south to pass Kao Thalu Sub-district of Sawi District, Chumphon Province. The alignment shall head to the west to pass Chumphon and Ranong Border where locates Thung Raya-Na Sak Wildlife Sanctuary and Ngao Waterfall National Park and the area is mountain terrain where the alignment shall need specific construction. Most of the communities are located scattering lightly along the rural road and the local road. Upon entering Ranong Province, the alignment shall head to the west and southwest to parallel and pass Rural Road No. Ror Nor. 5011 intermittently. The alignment shall pass La-un Canal, run along the canal, pass Highway Route No. 4139 and 4 (Phetkasem Road), pass Bang Kaeo Sub-district of La-un District and Sai Daeng Sub-district of Muang District, Ranong Province where most of the areas are mountain terrain and the areas at La-un canal are lowland alternating with rolling terrain with light community. After passing Highway Route No. 4 (Phetkasem Road), the alignment shall head to the south, parallel to the west of Highway Route No. 4 (Phetkasem Road), pass Sai Daeng Sub-district and Pak Nam Sub-district of Muang District, Ranong Province. The area is mangrove forest alternating with rolling terrain. Most of the communities are located along Highway Route No. 4 (Phetkasem Road) and the distributor road. With the said conditions, it is inevitable that the alignment shall need specific construction to avoid environmental impacts. The alignment shall end at Ranong Deep Sea Port, having a total length of 74.15 km.

- Alternative Route Alignment 3

The alignment shall start at the south of Khao Suan Thurian Station, about 400 m from the station. The alignment shall separate from the existing southern railway, curve to the southwest to pass Highway Route No. 41, head to the west to parallel the north of Highway Route No. 4139 with a distance of about 1.50 km from the highway. The alignment shall pass the south of Highway Route No. 4139 for a distance of about 4 km, pass and parallel the north of Highway Route No. 4139 again with a distance of about 0.5 km from the highway, pass Na Sak

Sub-district of Sawi District and Thung Takhrui Sub-district of Thung Tako District, Chumphon Province. The alignment shall curve to the south to pass Highway Route No. 4139 again, divert to the southwest to pass Khao Khai Sub-district of Sawi District, Chumphon Province. The alignment shall head to the west to pass Highway Route No. 4139 and pass Chumphon and Ranong Border where locates Ngao Waterfall National Park and the area is mountain terrain where the alignment shall need specific construction. Most of the communities are located scattering lightly along the rural road and the local road. Upon entering Ranong Province, the alignment shall overlie Alternative Route Alignment 3 until the ending point of the project at Ranong Deep Sea Port, having a total length of 74.70 km.

- Alternative Route Alignment 4

This alternative route alignment shall start from Khuan Hin Mui Station, curve to the west to pass Highway Route No. 4097 and 41, head to the north of Highway Route No. 4006 with a distance of about 1-3 km from the highway. Then, the alignment shall run parallel to the south of Highway Route No. 4006 for a distance of about 26 km, pass and parallel the north of Highway Route No. 4006 again with a distance of about 1.0 km from the highway. The alignment shall head to the south to pass Highway Route No. 4006, divert to the west and parallel Highway Route No. 4006 with a distance of about 2-3 km from the highway. The alignment shall be near and parallel to the south of Highway Route No. 4006 again prior to arriving at Chumphon and Ranong Border, pass Na Kha Sub-district, Wang Tako Sub-district, Had Yai Sub-district of Lang Suan District and Pang Wan Sub-district, Phra Rak Sub-district, Phato Sub-district, Phra Song Sub-district of Phato District, Chumphon Province. Most of the areas are plain alternating with mountain terrain intermittently where the alignment shall need specific construction. The communities are located scattering along Highway Route No. 4006. After that, the alignment shall head to the west to overlie Highway Route No. 4006 for a distance of about 1.0 km, parallel to the south and pass Chumphon and Ranong Border where locates Ngao Waterfall National Park and the area is mountain terrain where the alignment shall need specific construction. Upon entering Ranong Province, the alignment shall head to the northwest to pass Highway Route No. 4 (Phetkasem Road), make a detour to the north to avoid Ranong Airport. The alignment shall head to the east to pass and parallel the east of Highway Route No. 4 (Phetkasem Road) with a distance of about 1.0 km from the highway. At this section, the alignment shall run between Phetkasem Road (left side) and mountain terrain (right side) with a dense community and main government offices along Phetkasem Road. After passing the community areas, the alignment shall be elevated across Highway Route No. 4 (Phetkasem Road) in Bang Non Sub-district, head to the northwest to pass through the mountain terrain in Kra Buri National Park. The alignment shall pass Ratchakrud Sub-district, Ngao Sub-district, Bang Rin Sub-district, Khao Niwet Sub-district, Bang Non Sub-district and Pak Nam Sub-district of Muang District, Ranong Province. With the said conditions, it is inevitable that the alignment shall need specific construction in many locations to avoid environmental impacts. The alignment shall end at Ranong Deep Sea Port, having a total length of 108.20 km.

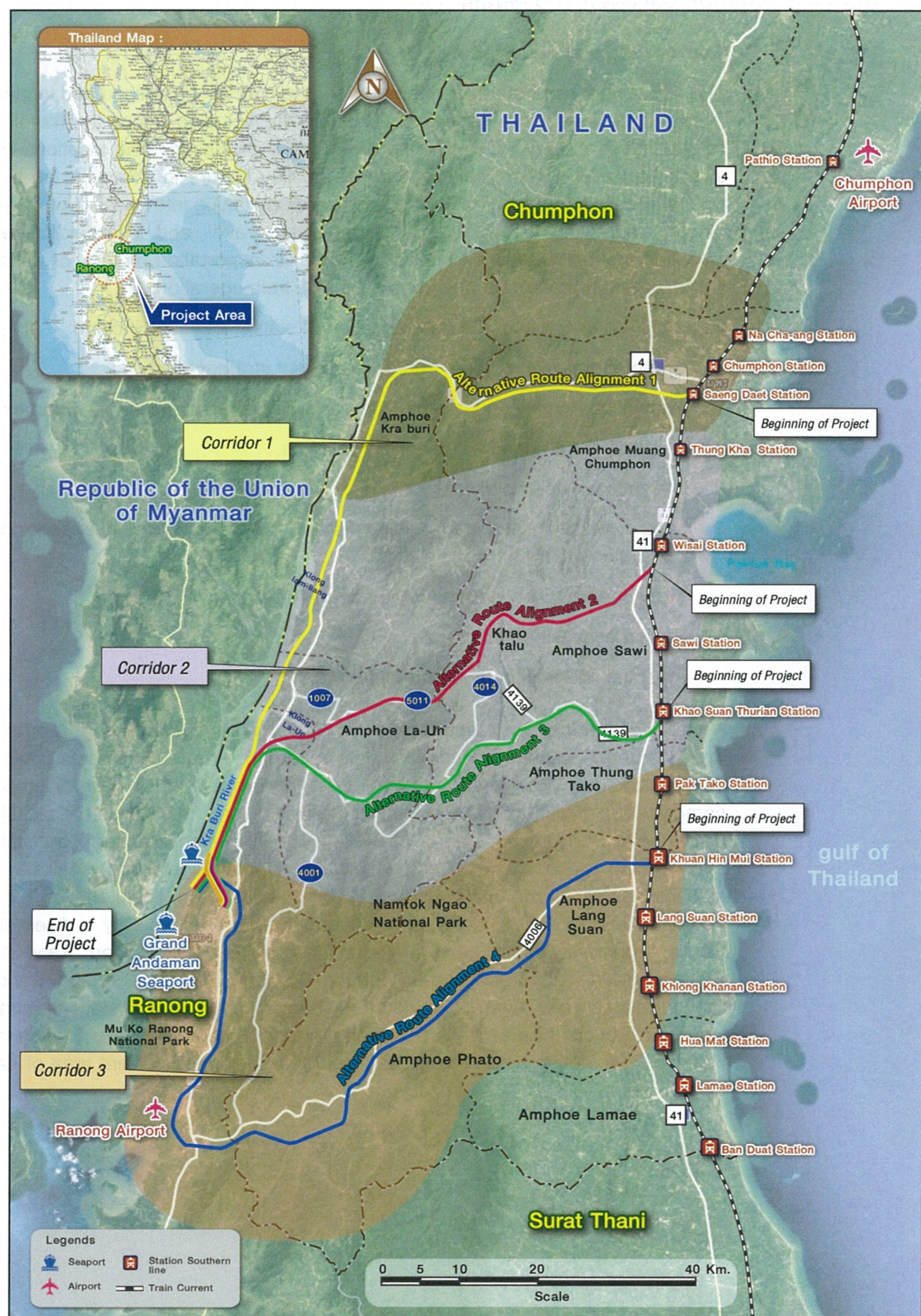


Figure 3.2.3-1 Alternative Route Alignment

3.3 Station Location and Model

1) Appropriate station location

The Consultant has determined the appropriate number of stations and locations in corresponding with the needs and topography including linking the travel and transportation nearby. Determining the number of stations and locations shall affect the travel system which is one of the key factors in choosing the travel mode. The determination has to be appropriate by taking into account population density, attracting travel, corresponding with travel and surrounding area including appropriateness in linking with other transportation modes for efficient traffic, urban development and consistent with train operation.

Factors used to consider the determination of station locations include:

- Comprehensive town plan and development strategy plan.
- Population density and community area which affects passenger volumes.
- Trend of socio-economic condition changes.
- Distance between stations.
- Land acquisition and surrounding utilities contributing to the expansion of the station.
- Transportation network and interchange station.
- Station accessibility of people
- Potential for local tourism promotion.

2) Number of stations and locations along the alternative route alignments

The number of stations and locations of 4 alternative route alignments could be summarized as follows: Alternative Route Alignment 1 shall have 9 stations namely Khun Krating Station, Ban Na Station, Wang Mai Station, Pak Chan Station, Kra Buri Station, Bang Yai Station, La-un Station, Ranong Port Station and Ranong Station respectively. Alternative Route Alignment 2 shall have 6 stations namely Khron Station, Thung Raya Station, Kao Thalu Station, La-un Station, Ranong Port Station and Ranong Station respectively. Alternative Route Alignment 3 shall have 6 stations namely Na Sak Station, Khao Khai Station, La-un Tai Station, La-un Station, Ranong Port Station and Ranong Station respectively. Alternative Route Alignment 4 shall have 5 stations namely Had Yai Station, Phato Station, Ranong Airport Station, Ranong Station and Ranong Port Station respectively. **Figure 3.3-1** shows the current area of each station.

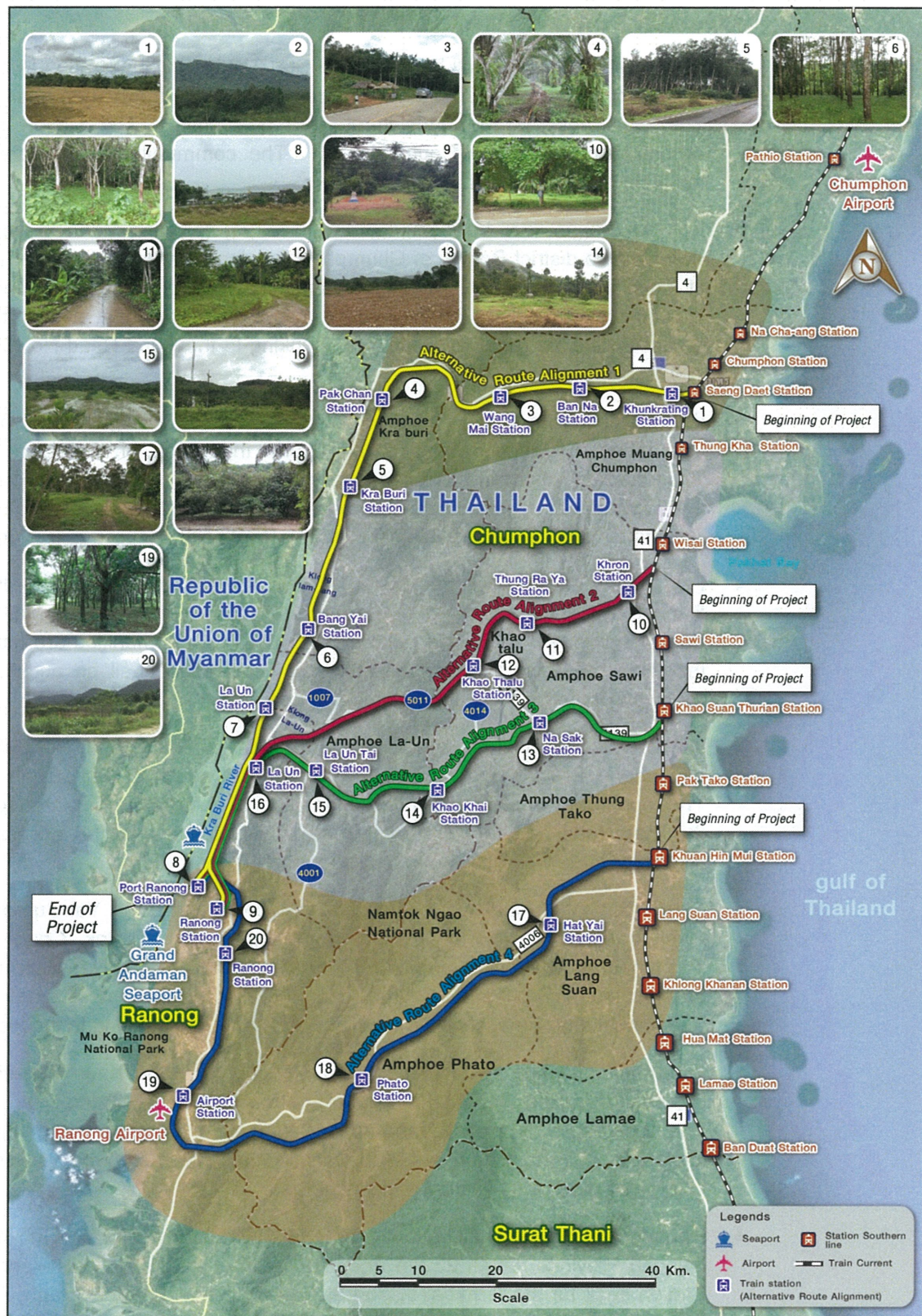


Figure 3.3-1 The Current Area of Each Station

Alternative Route Alignment 1

- Khun Krating Station shall be located at Sta. 3+750 in Khun Krating Sub-district, at the southwest of Chumphon Province, about 7 km from Chumphon Station. The topography is the agricultural area and plain. The station shall be accessible via Highway Route No. 41. The communities are located along the main road and the distributor road.
- Ban Na Station shall be located at Sta. 14+125, at Wang Mai Sub-district and Ban Na Sub-district Border of Chumphon Province, about 10 km from the west of Khun Krating Station. The topography is lowland. The communities are located scattering along the main road and the distributor road. The station shall be accessible via Highway Route No. 4 linking to the Rural Road No. Chor Por. 1005.
- Wang Mai Station shall be located at Sta. 21+700, at Wang Mai Sub-district of Chumphon Province, about 9 km from the west of Ban Na Station. The topography is rolling terrain and rubber plantation. As only few communities are located along the distributor road, the station shall be a small station. The station shall be accessible via Highway Route No. 4 linking to the local road.
- Pak Chan Station shall be located at Sta. 42+650, at Mamu Sub-district of Ranong Province, about 19 km from the southwest of Wang Mai Station. The topography is plain and palm plantation. The communities are located on the main road and the distributor road. The station shall be accessible via Highway Route No. 4 linking to the local road.
- Kra Buri Station shall be located at Sta. 52+600, at Nam Chuet Noi Sub-district of Ranong Province, about 10.5 km from the south of Pak Chan Station. The topography is plain and rubber plantation. The communities are located on the main road and the distributor road. The station shall be accessible via Highway Route No. 4 linking to the local road.
- Bang Yai Station shall be located at Sta. 70+570, at Bang Yai Sub-district of Ranong Province, about 18 km from the south of Pak Chan Station. The topography is rolling terrain and rubber plantation. As only few communities are located along the distributor road, the station shall be a small station. The station shall be accessible via Highway Route No. 4 linking to the local road.
- La-un Station shall be located at Sta. 78+600, at Bang Kaeo Sub-district of Ranong Province, about 9 km from the south of Bang Yai Station. The topography is plateau and rubber plantation. Dense communities are located on the main road at La-un Canal. The station shall be accessible via Highway Route No. 4 linking to the local road.
- Ranong Port Station shall be located at Sta. 102+200, at Pak Nam Sub-district of Ranong Province, about 23 km from the south of La-un Station. Ranong Port Station shall be the terminal station at Ranong Port. The topography is rolling terrain. Only few communities are located on the distributor road. The station shall be accessible via Highway Route No. 4004 and Rural Road No. 4010 linking to the local road of the port.

- Ranong Station shall be located on the spur line at Sta. 4+732, at Bang Non Sub-district of Ranong Province, about 3 km from the east of Ranong Port. The topography is plateau with dense communities especially at Ranong Town. The station shall be accessible via Highway Route Nos. 4 and 4004.

Alternative Route Alignment 2

- Khron Station shall be located at Sta. 5+170, at Khron Sub-district on the southwest of Chumphon Province, about 6.5 km from Wisai Station. The topography is plain and rubber plantation. The communities are located along the main road and the distributor road. The station shall be accessible via Highway Route No. 41 and the local road.
- Thung Raya Station shall be located at Sta. 17+350, at Thung Raya Sub-district of Chumphon Province, about 12.5 km from the southwest of Khron Station. The topography is lowland adjacent hill and rubber plantation. As only few communities are located along the distributor road, the station shall be a small station. The station shall be accessible via the local road.
- Kao Thalu Station shall be located at Sta. 28+250, at Kao Thalu Sub-district of Chumphon Province, about 10.7 km from the southwest of Thung Raya Station. The topography is lowland. As only few communities are located along the distributor road, the station shall be a small station. The station shall be accessible via the local road.
- La-un Station shall be located at Sta. 55+550, at Sai Daeng Sub-district of Ranong Province, about 27 km from the southwest of Kao Thalu Station. The topography is lowland adjacent hill. The communities are located along the main road. The station shall be accessible via Highway Route No. 4.
- Ranong Port Station shall be located on the same position as Alternative Route Alignment 1. The communities, accessibility to the station and topography are the same as Alternative Route Alignment 1 as well.

Alternative Route Alignment 3

- Na Sak Station shall be located at Sta. 16+550, at Na Sak Sub-district of Chumphon Province, about 16.5 km from the west of Khao Suan Thurian Station. The topography is lowland. The communities are located along the main road and the distributor road. The station shall be accessible via Highway Route No. 4139.
- Khao Khai Station shall be located at Sta. 29+500, at Khao Khai Sub-district of Chumphon Province, about 13 km from the southwest of Na Sak Station. The topography is plain. As only few communities are located along the distributor road, the station shall be a small station. The station shall be accessible via Highway Route No. 4139 linking to the local road.
- La-un Tai Station shall be located at Sta. 45+820, at La-un Tai Sub-district of Ranong Province, about 17 km from the west of Khao Khai Station. The topography is lowland. As only few communities are located along the distributor road, the station shall be a small station. The station shall be accessible via Highway Route No. 4139.

- La-un Station shall be located at Sta. 56+103, at Sai Daeng Sub-district of Ranong Province, about 9 km from the west of La-un Tai Station. The topography is lowland adjacent hill. The communities are located along the main road at La-un Canal. The station shall be accessible via Highway Route No. 4.
- Ranong Port Station shall be located on the same position as Alternative Route Alignments 1 and 2. The communities, accessibility to the station and topography are the same as Alternative Route Alignments 1 and 2 as well.

Alternative Route Alignment 4

- Had Yai Station shall be located on the agricultural area at Sta. 15+650, at Had Yai Sub-district of Chumphon Province, about 16.5 km from the southwest of Khuan Hin Mui Station. The topography is plain. The communities are located on the main road and the distributor road. The station shall be accessible via Highway Route No. 4006.
- Phato Station shall be located on the agricultural area at Sta. 45+250, at Phato Sub-district of Chumphon Province, about 28.8 km from the southwest of Had Yai Station. The topography is lowland surrounded by rolling terrain. As only few communities are located along the main road and the distributor road, the station shall be a small station. The station shall be accessible via Highway Route No. 4006 linking to the local road.
- Ranong Airport Station shall be located at Sta. 79+150, at Ratchakrud Sub-district of Ranong Province, about 32.2 km from the west of Phato Station. The topography is plain. The communities are located on the main road. The station shall be accessible via Highway Route No. 4.
- Ranong Station shall be located at Sta. 90+500, at Bang Rin Sub-district of Ranong Province, about 16.5 km from the north of Ranong Airport Station towards Ranong Town. The topography is plateau. The communities are located on the main road and Ranong Town. The station shall be accessible via Highway Route No. 4 linking to the local road.
- Ranong Port Station shall be located at Sta. 107+901, at Pak Nam Sub-district of Ranong Province, on the same position of Alternative Route alignments 1, 2 and 3, about 12 km from the west of Ranong Station. The topography is rugged terrain. Few communities are located on the distributor road. The station shall be accessible via Highway Route No. 4004 and Rural Road No. Ror Nor. 4010 linking to the local road of the port.

3.4 Selection of Appropriate Route Alignment

3.4.1 Criteria for Selection

The Consultant has determined the method and criteria for selection of appropriate route alignment based on the Multi-Attribute Utility Theory (MAUT). According to this method, 3 parameters have been considered, i.e. 1. engineering, 2. economic and 3. environment. Generally, the Multi-Attribute Utility Theory (MAUT) considers the feasibility of 3 parameters as follows:

- Engineering. The method considers the route length, geometric properties both horizontal and vertical, structural form, difficulty and ease in construction, capacity to accommodate traffic volumes, comfort and safety etc.
- Economic or cost. Many projects have considered only construction cost, property or land compensation cost. However, some projects have considered additionally on vehicle operating cost saving (VOC), Vehicle Operating Time Saving (VOT), maintenance cost or attracting development.
- Environment or Impact on the Public. Generally, the method considers 4 environmental parameters such as physical resources, biological resources, human use values and quality of life values by selecting only significant and distinguishable impacts.

Due to the complex topography of the project area which is mountain terrain between Chumphon and Ranong Provinces and most of the areas are national park and national reserved forest including fertile mangrove forest of the country, the construction of new railway may impact on resettlement/land and property expropriation especially the land which has to be expropriated for the construction of railway and stations. As the alignment has to pass the sensitive areas where air, noise and vibration shall be impacted as well, the Consultant has designated the weighting for environmental parameters higher than other parameters. Due to the complex topography as already mentioned above which requires specific construction, e.g. overpass, tunnel etc., these also result in higher investment cost. Upon consideration of 3 parameters which are important nearly equally, the Consultant has designated 30 weighting for engineering, 30 weighting for economic and investment and 40 weighting for environment and social respectively. Details of each parameter are shown on **Table 3.4.1-1**.

Table 3.4.1-1 Designated Weighting of Important Parameters

Important Parameters	Designated Weighting
• Engineering Parameters	(30)
1. Route Length	5
2. Horizontal Characteristic of Route Alignment	5
3. Vertical Characteristic of Route Alignment	5
4. Difficulty and Ease in Construction	6
5. Safety in Train Operation	5
6. Geological Conditions	4
• Economic and Investment Parameters	(30)
1. Investment	
1.1 Immovable Property Expropriation Cost	5
1.2 Construction Cost	15
2. Passenger Volumes along Alternative Route Alignments	
2.1 Potential Population for each Station along the Alternative Route Alignments	5
2.2 Distance to Access each Station along the Alternative Route Alignments	5
• Environmental and Social Parameters	(40)
1. Important reserved and conservation areas	10
2. Soil and soil erosion	7
3. Surface water hydrology	5
4. Resettlement and community separation	
4.1 Number of buildings/structures	6
4.2 Number of communities that the alternative alignments pass	5
5. Sensitive areas to environmental and social impacts	
5.1 Sensitive areas to air-noise-vibration within the radius of 500 m. from the center line	4
5.2 Main road and rural road intersections	3
Total	100

3.4.2 Result of Alternative Route Alignments Selection

From the comparison to select the most appropriate alignment of the project which the Consultant has considered the 3 major parameters of engineering parameter, economic and investment parameter and environmental and social parameter, Table 3.4.2-1 shows the total scores of each alternative route alignment.

Table 3.4.2-1 Total Scores of Alternative Route Alignments

Parameters	Designated Weighting	Total Scores of Alternative Route Alignments			
		Route No.1	Route No.2	Route No.3	Route No.4
Engineering	30	22.71	19.93	16.84	14.32
Economic and investment	30	28.30	24.95	23.70	16.65
Environmental and social	40	24.00	26.75	25.50	16.75
Total	100	75.01	71.63	66.04	47.72

From the above table, it could be noticed that **Alternative Route Alignment 1** gets the highest scores of 75.01. So, it is the most appropriate route alignment for future study and design. The details are as follows:

Engineering. Alternative Route Alignment 1 is ranked no. 1 for engineering from the geometric property of the alignment which has more advantage than other alternative route alignments. In addition, it saves time in travel and transportation as the alignment passes lower mountain terrain, has less curvature and is the most safe for train operation. The alignment structure is more stable and stronger as it passes the active fault time “Ranong Fault Line” less than other alignments.

Economic and investment. Alternative Route Alignment 1 is ranked no. 1 for economic and investment as an investment cost (construction cost and land expropriation/structures compensation cost) is less than Alternative Route Alignments 3 and 4 distinctly. Though the investment cost is higher than Alternative Route Alignment 2 but it is not significant. In addition, Alternative Route Alignment 1 can have more passenger volumes than other alternative route alignments as the alignment parallels Highway Route No. 4 (Phetkasem Road) where dense communities are located. It responds to the need of the local people better.

Environment and Social. Alternative Route Alignment 1 is ranked no. 2 whilst Alternative Route Alignment 2 is ranked no. 1 for this comparison but all alternative route alignments of the project have to pass mountain terrain where it is vulnerable to soil erosion. Some areas are forested watershed and mangrove forest and scattered communities are located on the existing road. Alternative Route Alignment 1 passes conservation area for the shortest distance and Alternative Route Alignment 2 passes the least sensitive areas to environment and social impacts.

Chapter 4

Study and Forecast of Traffic and Transportation

Chapter 4

Study and Forecast of Traffic and Transportation

4.1 Survey and Data Collection of Transport Network

4.1.1 Survey and Data Collection of Transport Network in the Current

The consultant has reviewed and collected information on current transport network conditions and plan/project information on network development in the study area summarized as follows.

- Currently, the route connecting Chumphon and Ranong Province has only road network. The main road is Highway 4 (Phetkasem) starting from Pathom Phon Intersection (Chumphon) along the route Highway 4 through Ranong and Phang Nga Province, which is a 2-4 lanes road, and some are under construction to expand into 4 lanes. In the future, Highway 4 will be a four-lane highway throughout the route. The route is steep and winding because it is a mountainous area, so traveling between each other is not very convenient, especially for freight trucks. In the year 2016, traffic volume on Phetkasem Road (Highway 4) from Chumphon (Pathom Phon Intersection) - Ranong is about 5,000 - 11,500 vehicles per day, as shown in **Figure 4.1.1-1**.

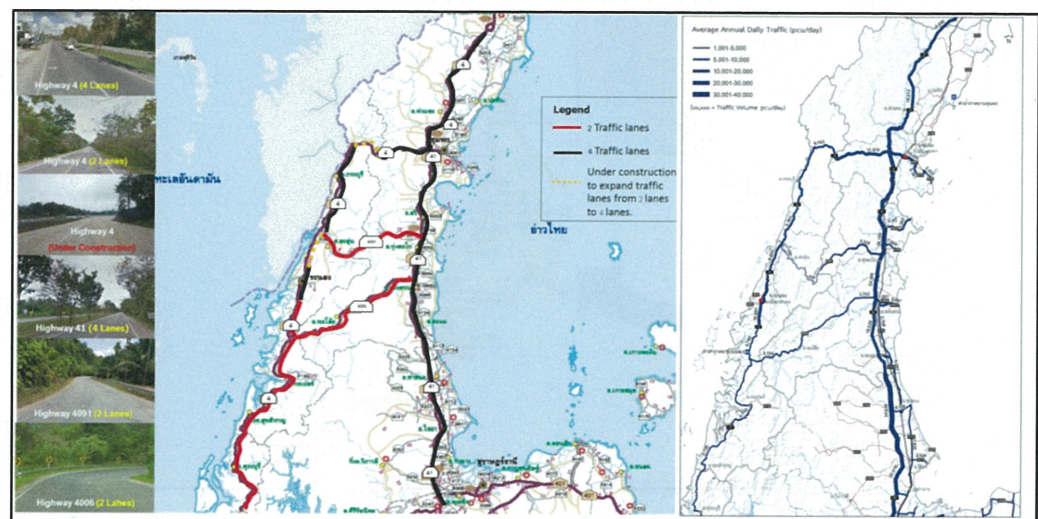


Figure 4.1.1-1 Road network and Annual Average Daily Traffic (AADT) in the Project Area in 2016

- At present, Chumphon has an airport located at Pathew District, about 38 kilometers from the city and Ranong has an airport located in Rajchagrude Sub-district, Mueang District, away from the city about 25 kilometers with small airlines flying from Bangkok (Don Mueang) 2 and 4 times a day, respectively and some time ago, the airline stopped flying and came back to serve again later. According to the statistics of air travel in the year 2016, the number of passengers traveling by air, including Chumphon and Ranong was 195,795 persons per year, up from the year 2011, which is 8,551 persons per year at the rate of 87% per year, since the airline

has increased its many more service, by the year 2017, Chumphon had a passenger volume of 87,689 persons and Ranong had a passenger volume of 121,484 persons.

- The southern railway line starts at Thonburi Station and has a junction from the Northern Railway at Bang Sue Junction across the Chao Phraya River at Rama VI Bridge and converges to the Southern Railway at Taling Chan Junction. The southern railway line through Nakhon Pathom, Ratchaburi, Phetchaburi, Prachuap Khiri Khan, Chumphon, Surat Thani, Nakhon Si Thammarat, Phatthalung, Songkhla, Yala, the destination at Su-ngai Kolok as shown in **Figure 4.1.1-2**. Currently, Ranong Province does not have a rail link, which the development of the new railway line of the project will lead to the development of a new route from the former southern railway line in Chumphon to Ranong. According to the statistics of rail passenger volume in the past in Chumphon, it was found that in 2016, the total passengers volume was 1,054,545, decreasing from 2011 which has 1,205,268 passengers, at the rate of -2.63% per year. The station with the highest passenger volume is Chumphon station accounted for 45.89% of the total passenger volume in Chumphon, followed by Lang Suan Station, Sa Wee Station and Pathew Station, respectively.



Figure 4.1.1-2 Southern Railway Network and Cargo Terminal (CY and ICD)

- Bus terminal in study area, in Chumphon, there are 3 passenger terminals: (1) Chumphon Bus Terminal, it will serve the route from Bangkok to Chumphon - Ranong - Phang Nga - Phuket. (2) The bus station of Choke Anan and Rungkij Tour will provide an air-conditioned bus service on the route from Chumphon - Ranong - Phang Nga - Phuket along the Highway 4 (Phetkasem Road) and to end at Phuket. (3) Chumphon – Ranong Van Station, It will serve the route from Chumphon - Ranong along the Highway 4 Phetkasem Road) and to end at Ranong Bus Station. Ranong has one bus terminal and also has the pier, most of which is a pier for traveling to various islands and a linkage travel to Kaw Thoug (Myanmar). There is also a cargo port on the banks of Kraburi River, Ranong Province.

4.1.2 Current Survey and Analysis Traffic and Transportation Data

Apart from secondary data already gathered, the consultants conducted a survey of the passenger's travel demand volume and additional freight volumes to analyze the origin-destination, as well as travel behavior. The consultants completed the survey on Thursday, June 8 and Saturday, June 10, 2017 consist of:

- 1) Traffic volume survey on the main roads in the project area (Mid-Block Counts) by category and direction on the roads a total of 4 points. The result of traffic survey on the main roads in the project area is shown in **Figure 4.1.2-1** as follows.
 - Highway 4, during Chumphon District - Kra Buri District, has the most dense traffic volume (Survey point MB1) in the range of 10,000-11,000 vehicles / day or 12,000-14,000 pcu / day, with the peak hourly traffic volume in the range of 700 to 900 vehicles/hour or 900-1,000 pcu / hour accounted for 7-8% of traffic volume throughout the day.
 - For the proportion of vehicle type which travelers used in the area through the 4 survey sites, it was found that the most was pick-up trucks accounted for 35%, followed by personal car.

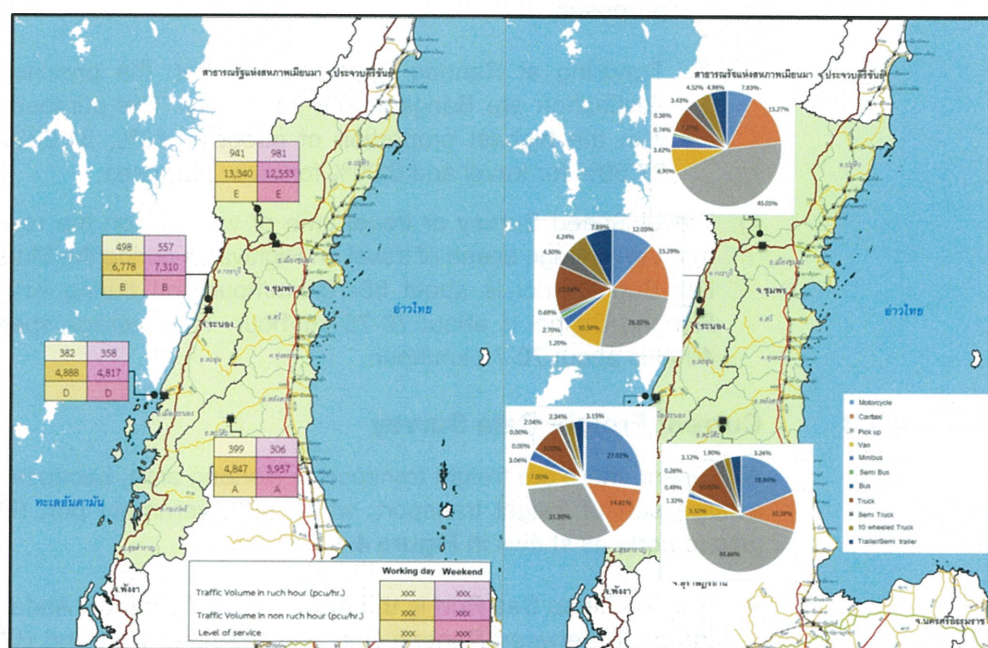


Figure 4.1.2-1 Results of the Traffic Volume Surveys and Vehicle Proportion on the Range of Roads in the Study Area

- 2) The Survey of origin-destination point of travelers by stopping the car for interview by the side of the road on both 2 directions, a total of 3 points, it was found that;
 - When considering the point of origin – destination classified by the survey point OD, found that, the survey point OD1 on Highway 4 during the Mueang Chumphon District – Kra Buri District, mostly traveling between Chumphon and Ranong accounted for 72%, followed by Ranong - Bangkok and the upper area accounted for 15%. Travel on the survey point OD2 on Highway 4 during the Kra Buri District - Mueang Ranong District, mostly traveling in Ranong accounted for 49%, followed by Ranong – Chumphon, accounted for 29% and

Ranong - Bangkok and Upper Thailand, accounted for 16%. Travel on the survey point OD3 on Highway 4006 is a journey between Chumphon and Ranong, accounted for 40%, traveling in Chumphon, accounted for 32% and traveling between Ranong and Lower South, accounted for 21%.

- When considering the purpose according to the survey point OD found that the survey point on Highway 4 (OD1 and OD2) were mostly for the purpose of going to work, accounted for 50-57%, followed by purpose to do personal business accounted for 17-27% and tourism accounted for 10-15%. Traveling on Highway 4006 (OD3) is going to work, accounted for 58%, 34% for personal business, and 7% for tourism.
- 3) Survey of passenger decision data and travel behavior by interviewing travelers at Ranong Bus Terminal and Ranong Airport, it was found that;
- Traveling at Ranong Bus Terminal found that, the province with the most travel destination is Chumphon, accounted for 30.93%, followed by other areas (Prachuap Khiri Khan, Phetchaburi and other region except the southern and Bangkok) accounted for 17.53% and Surat Thani accounted for 13.40%. The purpose of the trip was to make personal business with the highest proportion of about 45.00%, 28.00% for work, 20.00% for travel and 7.00% for other purposes.
 - Traveling at Ranong Airport found that, the provinces with the most travel destination are Bangkok and its vicinity. The purpose of the trip was to work with the highest proportion of about 34.48%, 31.03% for personal business, 27.59% for travel and 6.90% for other purposes.
- 4) Travel Speed Survey or travel time of vehicles on the road network. It was found that the average speed of travel on Highway 4 during the Mueang Chumphon District – Kra Buri District is about 65-70 km/hour and during Kra Buri District - Mueang Ranong District is about 70-75 km/hour. The average speed of travel on Highway 4006 is about 70-75 km/hour.

4.1.3 Current Freight Data Survey

At present, there are freight transport in Ranong area, because of Ranong province has a large port of freight transport, which of government port (Ranong Port) and many private ports as shown in **Figure 4.1.3-1**.

- Ranong Deep Sea Port is the main port in Thailand's Andaman Sea Freight, linking the route between Ranong Port and Myanmar Port and BIMSTEC countries which is a framework for economic cooperation, which Thailand join with six other countries: Bangladesh, Bhutan, India, Myanmar, Nepal and Sri Lanka. Currently there are only OFFSHORE products, no cargo through the port. According to the data collection, it was found that in the period 2008 – 2011 and 2015, Ranong Port has transported containers to BIMSTEC countries, which shipping lines used to carry cargo, were GATI, The SC Group, the NCL, and the SAK, but currently there is no container shipping, because there is no cargo at the back of the port, need to rely on goods from other areas. Moreover, there are problems connected to the network linking Ranong port, which is accessible by road only, causes operators are facing high transportation costs.

- There are also several small private ports located on the banks of the Kra Buri River, Khao Nanghong Sub-district, Ranong, and the same area as Ranong Deep Sea Port which can accommodate large vessels up to 500 tons gross, mainly freight transport for border trade to Myanmar (Kaw Thauung, Myeik and Dawei). Most of products are construction materials, cement and consumer goods.

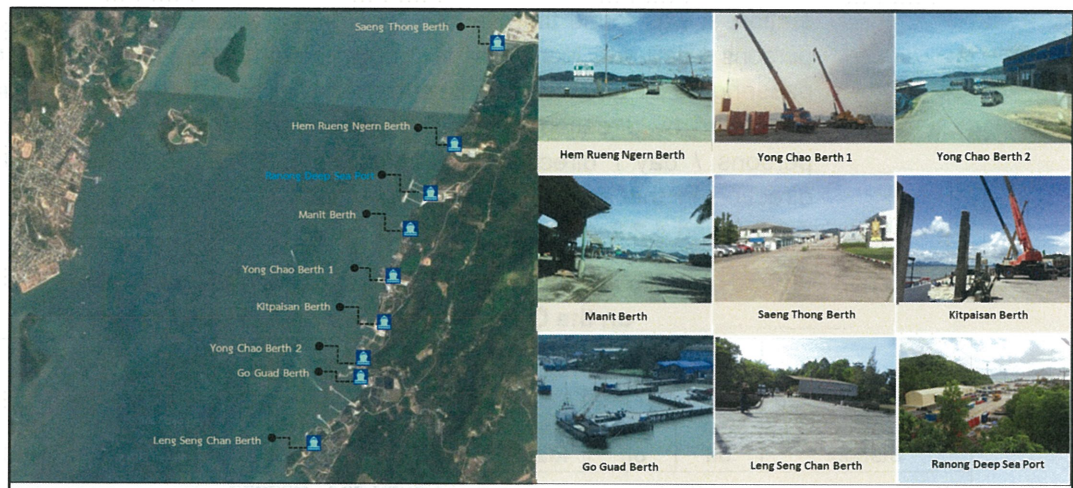


Figure 4.1.3-1 Berths on the Banks of Kra Buri River, Ranong Province

4.2 Analysis and Forecast of Passenger Volume

4.2.1 Tools Used to Forecast Passenger Volume

In forecasting of the passenger volume of the railway construction project has improved the national model of transportation and traffic (National Model: NAM) of Office of Transport and Traffic Policy and Planning (OTP), which covers all forms of travel and areas, both provincial and nationwide. In addition, considering the emerging traffic volume due to the ease of travel, which is the traffic volume generated from the construction of the Chumphon – Ranong Railway Project, which is an economical and convenient alternative to travel as follows.

- Improve subsystems used in traffic and transportation analysis and transportation network systems in the project area to be more elaborate, including the forecast of basic information and project plans for the future, such as the construction plan and improve the road network both of the new routes and the expanded into 4-lanes, as well as plans for the construction of double track in southern routes, etc.
- Calibrate the traffic and transportation model (Model Validation) with the traffic data surveyed. After the model has been developed for the project, the model will be used to forecast passenger volume in the target year. In analyzing the model, the consultant determines the base year for the study being year 2017 and will forecast passenger volume in year 2025, 2034, 2044 and 2054.
- In addition, considering the emerging traffic volume due to the ease of travel, which is the traffic volume generated from the construction of the route, resulted in travel due to the existing travel requirements but not travel (Latent Demand), thus increasing travel due to the construction of the Chumphon – Ranong Railway Project, which is an economical and convenient alternative to travel.

4.2.2 Result of Forecasting on Passenger Volume

The result of forecasting of total passenger volume using the Chumphon - Ranong Railway Project found that in 2025, which is assumed year that will be fastest service opened, there will be about 5,724 persons / day and increasing to 7,331, 9,331 and 11,710 persons / day in 2034, 2044 and 2054, respectively and when considering each station, it was found that Ranong Station had passenger volume in 2025 of about 1,800 persons / day and increased to 3,800 persons / day in 2054. In 2025, the number of passengers in each station is shown in **Table 4.2.2-1** and **Figures 4.2.2-1 - 4.2.2-2**, separated by direction and maximum number of passenger (max line load) is 2,039 persons / day / direction and increase to 2,625, 3,388 and 4,313 persons / day / direction in the analyzed year, respectively. These are shown by direction in **Figure 4.2.2-3** and **4.2.2-4**.

**Table 4.2.2-1 Forecast of Passenger Volume by Station
on the Chumphon – Ranong Railway Project**

Station	Passenger volume (person per day)											
	Year 2025			Year 2034			Year 2044			Year 2054		
	Get on	Get off	line load	Get on	Get off	line load	Get on	Get off	line load	Get on	Get off	line load
Chumphon - Ranong												
Bangkok and other areas	663	0	663	849	0	849	1,086	0	1,086	1,377	0	1,377
Lower South	371	0	371	476	0	476	617	0	617	782	0	782
Chumphon	858	0	858	1,101	0	1,101	1,425	0	1,425	1,804	0	1,804
Khun Krating	163	68	1,987	217	95	2,548	283	129	3,282	358	149	4,172
Bann Na	76	49	2,014	97	68	2,577	121	88	3,315	144	107	4,209
Wang Mai	95	108	2,001	122	138	2,561	153	179	3,289	187	226	4,170
Pak Chan	280	242	2,039	349	289	2,621	438	346	3,381	540	411	4,299
Kra Buri	200	330	1,909	242	436	2,427	296	523	3,154	355	663	3,991
Bang Yai	37	25	1,921	59	35	2,451	75	67	3,162	115	84	4,022
La-un	110	177	1,854	141	228	2,364	159	294	3,027	178	370	3,830
Ranong	0	1,854	0	0	2,364	0	0	3,027	0	0	3,830	0
Total	2,853	2,853		3,653	3,653		4,653	4,653		5,840	5,840	
Ranong - Chumphon												
Ranong	1,859	0	1,859	2,361	0	2,361	3,048	0	3,048	3,866	0	3,866
La-un	179	110	1,928	233	141	2,453	300	160	3,188	375	179	4,062
Bang Yai	25	40	1,913	52	63	2,442	67	81	3,174	84	122	4,024
Kra Buri	324	203	2,034	429	246	2,625	515	301	3,388	652	363	4,313
Pak Chan	241	288	1,987	288	361	2,552	345	452	3,281	408	556	4,165
Wang Mai	107	96	1,998	137	123	2,566	178	155	3,304	225	191	4,199
Bann Na	56	78	1,976	74	97	2,543	90	121	3,273	104	145	4,158
Khun Krating	80	170	1,886	104	225	2,422	135	294	3,114	156	372	3,942
Chumphon	0	792	792	0	1,018	1,018	0	1,317	1,317	0	1,666	1,666
Lower South	0	343	343	0	441	441	0	569	569	0	721	721
Bangkok and other areas	0	751	751	0	963	963	0	1,228	1,228	0	1,555	1,555
Total	2,871	2,871		3,678	3,678		4,678	4,678		5,870	5,870	
Total Boarding (passenger/day)	5,724	5,724	-	7,331	7,331	-	9,331	9,331	-	11,710	11,710	-
Max Line Load (passenger/day)			2,039			2,625			3,388			4,313

Source: Forecast by Consultant

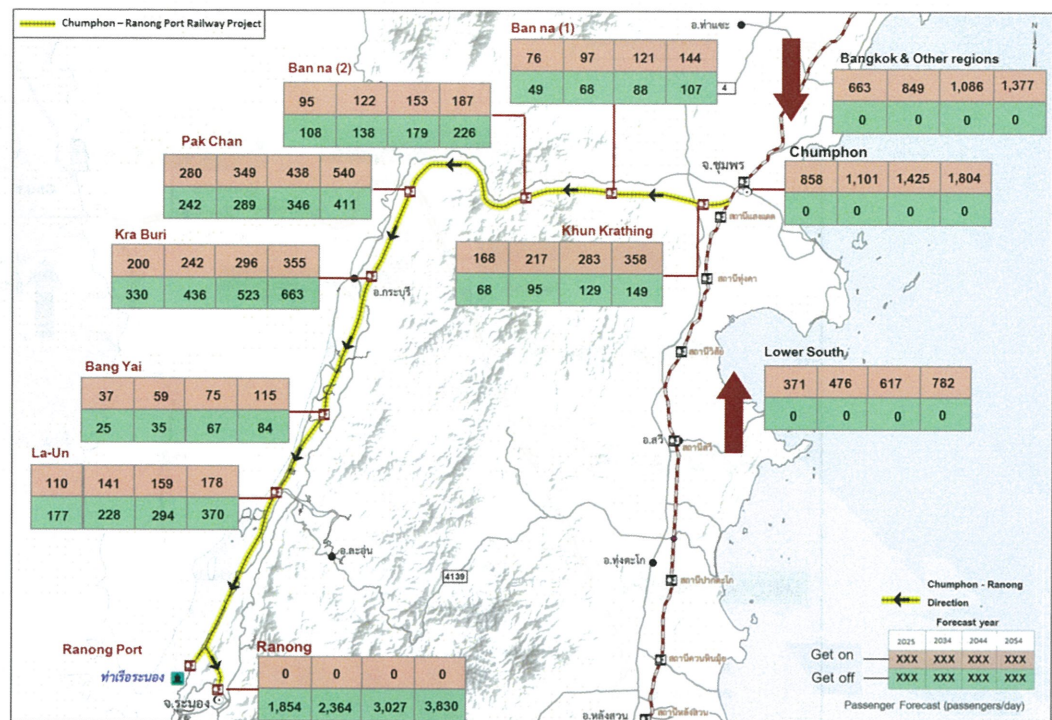


Figure 4.2.2-1 Forecast of Passenger Volume by Station, Chumphon - Ranong

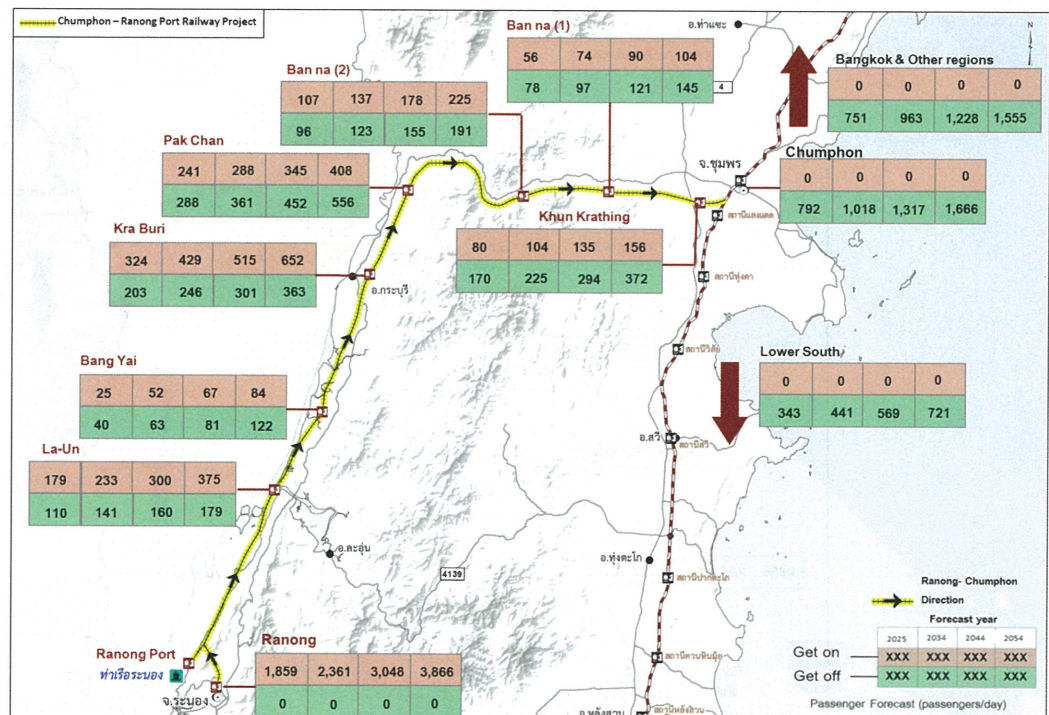


Figure 4.2.2-2 Forecast of Passenger Volume by Station, Ranong - Chumphon

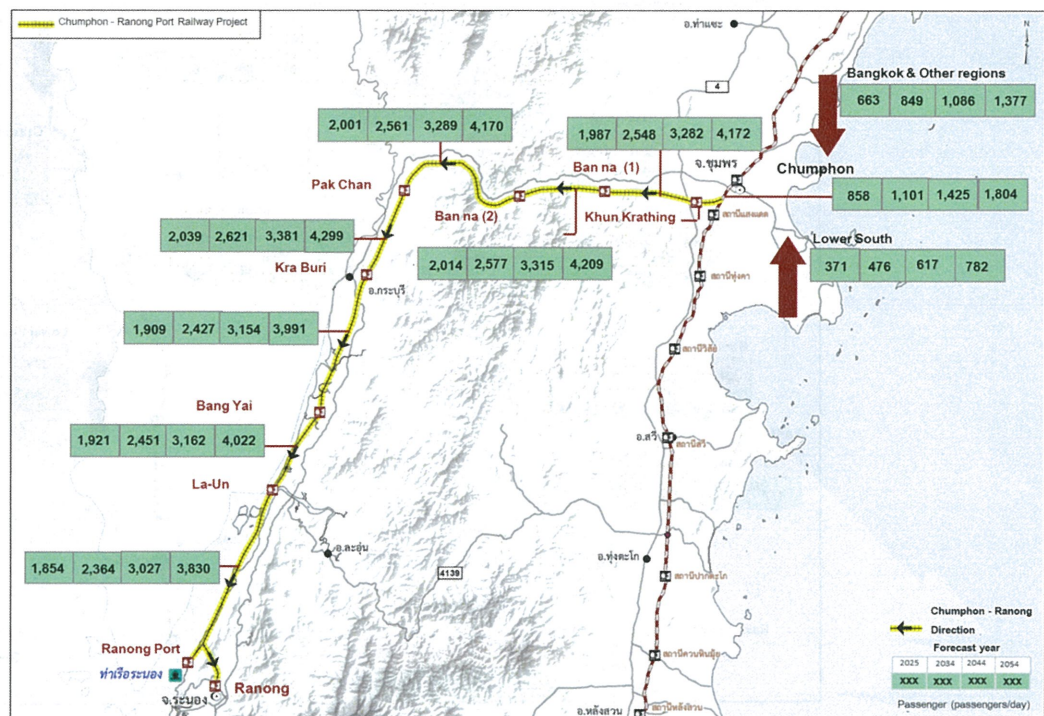


Figure 4.2.2-3 Forecast of Passenger Volume on Line load, Chumpon - Ranong

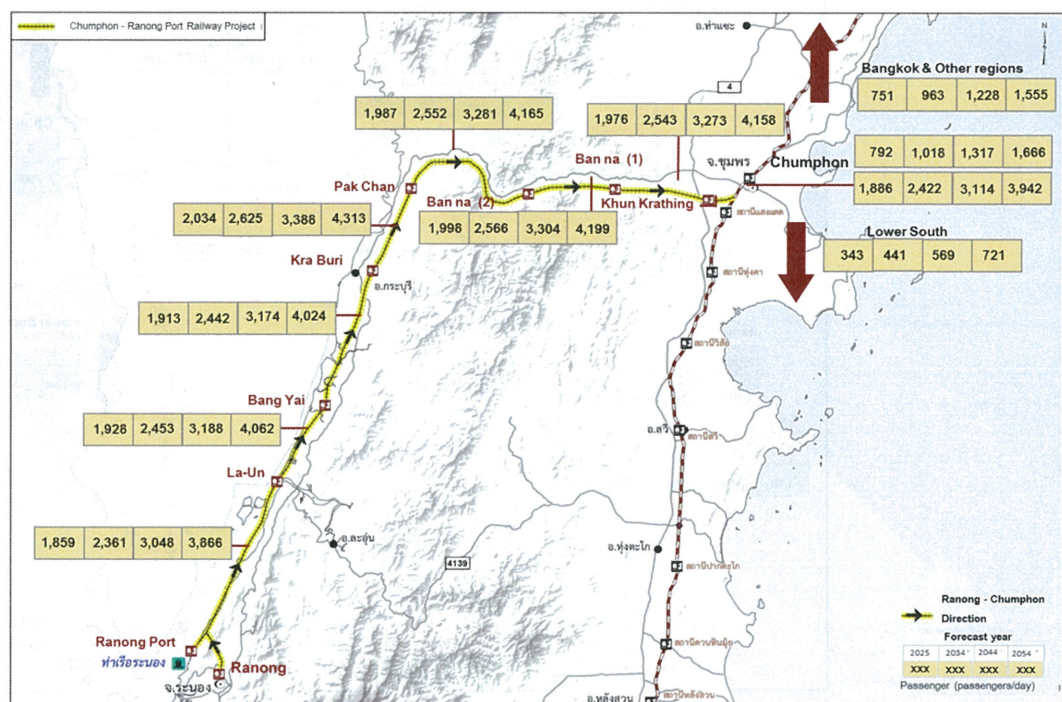


Figure 4.2.2-4 Forecast of Passenger Volume on Line load, Ranong – Chumpon

4.3 Analysis and Forecast of Product Volume

4.3.1 Guidelines for Forecasting on Product Volume

The consultants applied the Logit Model to simulate the decision behavior of selecting transportation routes through Ranong Port, which is based on the assumption that the operator does not consider only the monetary costs, but will focus on the total cost incurred throughout the transit route, contain with monetary cost and time value. The model has the following mathematical structure as follows:

$$\%diverted\ to\ Ranong = \frac{\exp(Utility\ of\ Ranong\ Route)}{\exp(Utility\ of\ Ranong\ Route) + \exp(Utility\ of\ Existing\ Route)}$$

$$Utility\ of\ Ranong = -\alpha[(Transit\ cost) + (Time\ value)(Transit\ time)]$$

$$Utility\ of\ Existing\ Route = \beta - \alpha[(Transit\ cost) + (Time\ value)(Transit\ time)]$$

By

- % diverted to Ranong = Proportion of transportation that will divert to Ranong Port (Unit: Percentage of total import and export transport with origin and destination are in the target country of analysis)
- Utility of Ranong Route = Satisfaction or utility from transportation through Ranong Port
- Utility of Existing Route = Satisfaction or utility from transportation through Laem Chabang Port or Bangkok Port
- Transit cost = Average cost of transportation (Dollars per container)
- Transit time = Average time of transit (days)
- Time value = Value of time (Dollars per day per container)
- α = The coefficients reflect the influence of the transit cost on satisfaction
- β = Homeport Bias is the coefficient representing the bias that Thai importers and exporters are satisfied with using existing port services, compared to the satisfaction with the use of Ranong Ports, i.e., if the use of Ranong Port and the current use of existing ports, have the cost of transit and time are equal, Thai operators are more likely to use existing ports than Ranong Port.

According to a review of the study of marine transportation in foreign countries found that study and analyze the decision to move containers happening around the world by Loratan Tavasszy, Michiel Minderhoud, Jean-François Perrin, and Theo Notteboom used the logit model for $\alpha = 0.0045^1$ and the value of time was \$ 100 per container per day. However, before applying this model to study, it is necessary to adjust the parameters in accordance with current transportation behavior and adjust the value of time in accordance with the value of goods imported and exported from Thailand. Based on the results of the Kanchanaburi -Thai / Myanmar border Motorway project (Ban Phu Num Ron) of the Department of Highways, which has developed a model to decide the route of transportation through the port of Dawei in the case of Motorway project, connecting to the port of Dawei compared to the choice of transportation through Laem

¹ A strategic network choice model for global container flows: Specification, estimation and application. Journal of Transport Geography, 2011

Chabang Port or Bangkok Port include additional shipment survey information. By calibration, the equation will be $\alpha = 0.00216$ and the value of the container freight time is \$ 65.23 per container per day, which is the value to be applied in this study.

The analysis of Homeport Bias is a comparison of the harbor selection behavior of operators located in the influence zone or the hinterland of the port, which requires that the Homeport Bias value is 3.17, it can be concluded that the opportunity for the operator to choose the current port (Bangkok Port / Laem Chabang Port) nearly 100% if transportation through the port and transportation through Ranong Port have the cost and transit time are equal (Difference of Utility = 0).

Forecasting on the product volume with a chance to transport by rail through Ranong Port, in addition to considering the freight costs, which consists of two parts: Ocean Freight and Inland Freight Charge, the shipping time should be considered. **Figure 4.3.1-1** shows the comparison period for freight transport through Ranong Port and Laem Chabang / Bangkok Port to BIMSTEC countries, which is the main source of products for export and import. For the products in the south region, most of them are bulk goods and a few container goods that are transported through the Sadao checkpoint to use Penang port to transport to BIMSTEC countries. Therefore, there is a chance to transport by rail through Ranong Port.

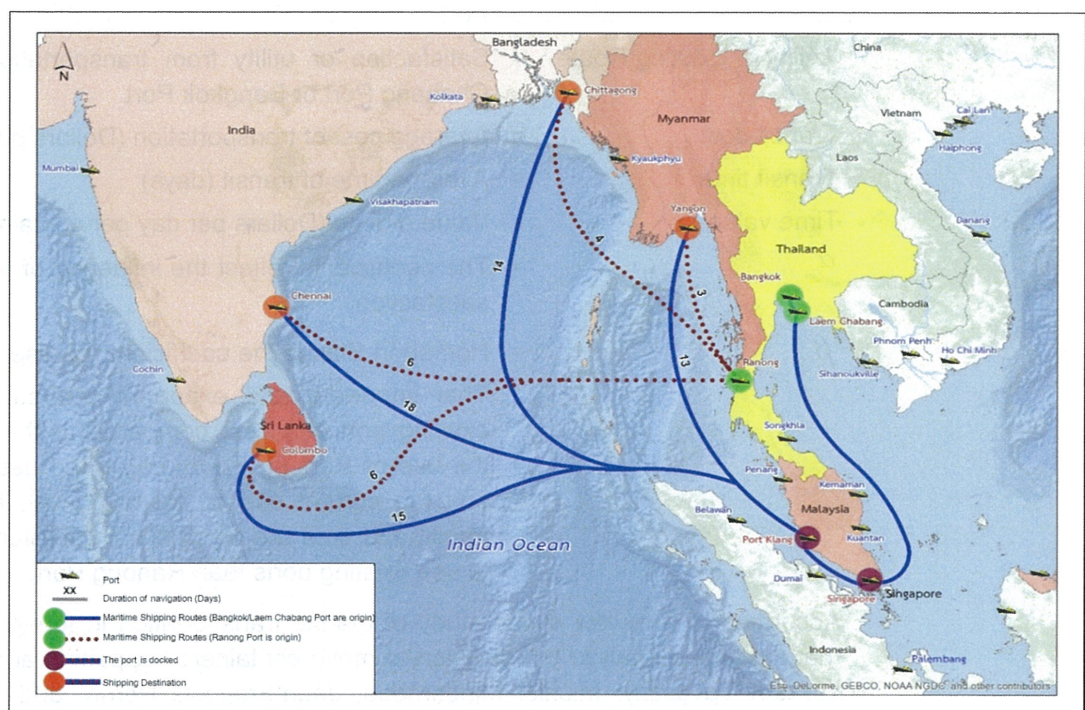


Figure 4.3.1-1 The Comparison Period for Freight Transport through Ranong Port and Laem Chabang / Bangkok Port to BIMSTEC Countries

4.3.2 Forecast of Freight Volume by the Railway Project through Ranong Port

From the Logit Model, when the new railway line services were launched from Chumphon linked to Ranong Port, it is likely to attract the product volume that have been exported and imported to BIMSTEC countries through Laem Chabang Port / Bangkok Port, switching to transport by railway project through Ranong Port. It is possible to analyze the forecasts of the volume of containers that will use Ranong port services to export and import products with BIMSTEC countries when the Chumphon - Ranong route has occurred in the future as shown in **Table 4.3.2-1**.

Table 4.3.2-1 Forecast of Volume of Export and Import Containers with BIMSTEC Countries to Use Ranong Port Service in 2025-2054 (classified by country)

Country of origin / destination	Volume of products (cabinets)							
	Year 2025		Year 2034		Year 2044		Year 2054	
	Export	Import	Export	Import	Export	Import	Export	Import
India	6,212	3,831	10,207	6,262	15,094	9,428	22,622	14,552
Myanmar	4,200	1,849	7,273	3,546	11,259	5,776	17,682	9,408
Sri Lanka	1,989	-	2,495	-	3,161	-	4,245	-
Bangladesh	14,946	88	15,386	88	15,964	88	16,905	88
Total	27,347	5,769	35,361	9,896	45,478	15,292	61,454	24,048

Source: Forecast by Consultant

When considering the result of forecasting on export and import volume with BIMSTEC countries, classified by product can be shown as **Figure 4.3.2-1**.

- Products with the highest export volume in the year of the project launch (2025) are: cement, accounted for 62% of export to BIMSTEC, followed by plastic and sugar, accounted for 12% and 10%, respectively. Considering the export volume of products in the 30th year of the project (2054), it was found that the highest export volume are cement, accounted for 27%, followed by sugar and consumer goods, accounted for 22% and 17%, respectively.
- Products with the highest import volume in the year of the project launch (2025) are: the goods in the group of salt, sulfur, soil and stone, materials such as plaster, accounted for 36% of the import volume from BIMSTEC, followed by wood and charcoal, and industrial products, accounted for 32% and 12%, respectively. Considering the import volume of products in the 30th year of the project (2054), it was found that the highest import volume are the goods in the group of salt, sulfur, soil and stone, materials such as plaster, accounted for 40%, followed by wood and charcoal, and industrial products, accounted for 39% and 16%, respectively.

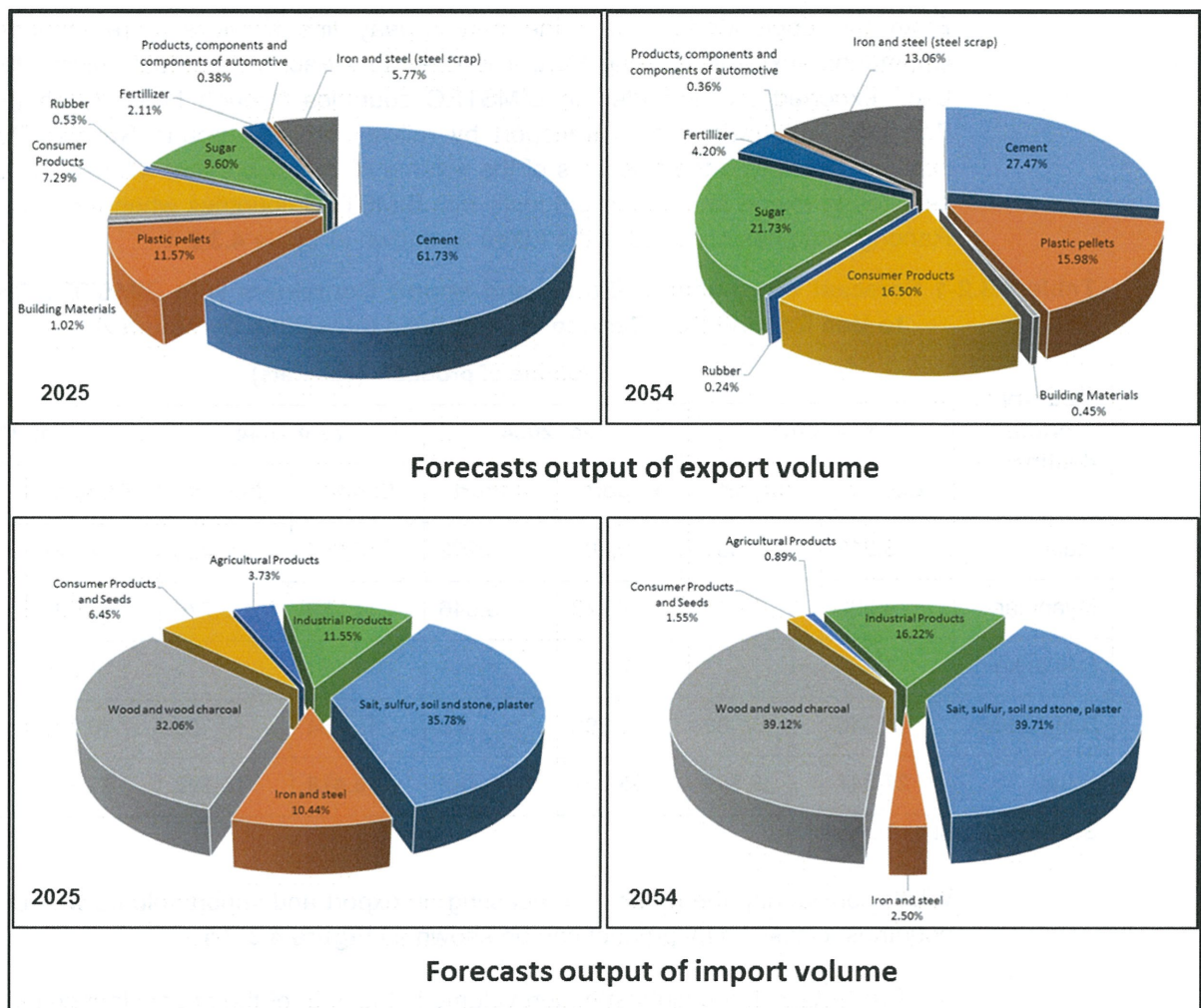


Figure 4.3.2-1 The Forecasts Output of Export and Import Volume (classified by product) with the Opportunity to Transport by Chumphon - Ranong Railway Project

Chapter 5

Engineering Design

Chapter 5

Engineering Design

5.1 Engineering Design

5.1.1 Route Alignment Design

Railway geometric design comply with the detailed design criteria and standards which are based on the standards of the State Railway of Thailand and the consistent universal standards, e.g. European Norm, British and American Standards, International Standards Organisation (ISO), The Union Internationale des Chemins de fers (UIC) and AREMA (American Railway Engineers and Maintenance of Way Association)

5.1.1.1 Railway Cross Section Design

The railway cross section design is set to have the right-of-way width of 50 m. for double track construction with side ditch for longitudinal drainage. A single track shall be constructed in the beginning and when there are sufficient passenger and freight volumes, a double track shall be constructed without having to expropriate more land in the future. The cross section designs are shown in **Figure 5.1.1-1** to **Figure 5.1.1-3**.

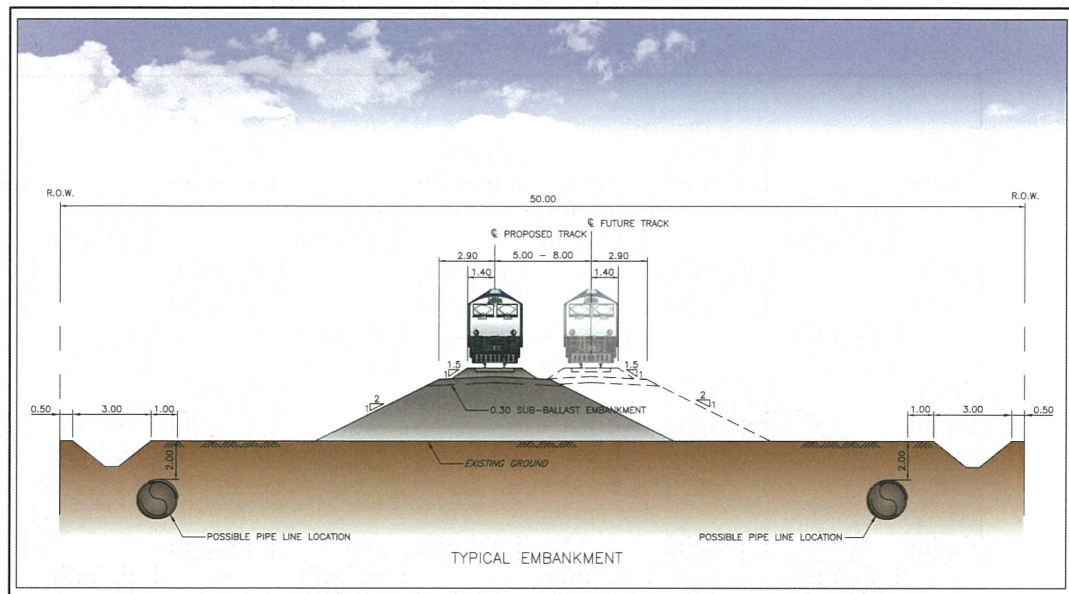


Figure 5.1.1-1 At-Grade Railway

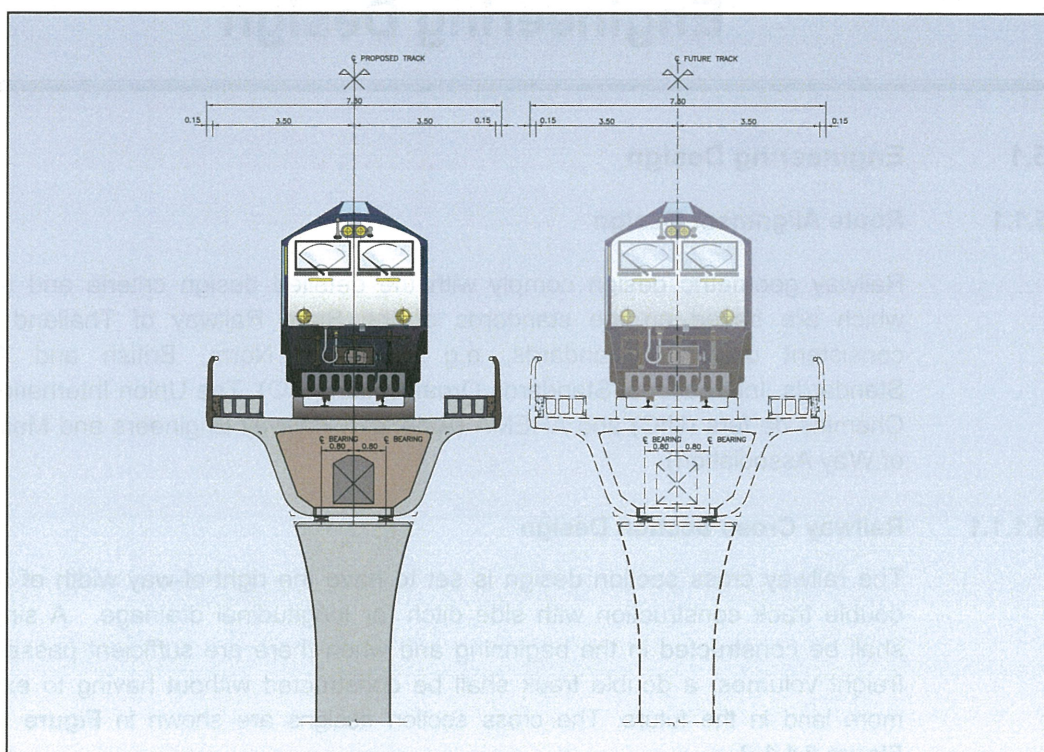


Figure 5.1.1-2 Elevated Railway

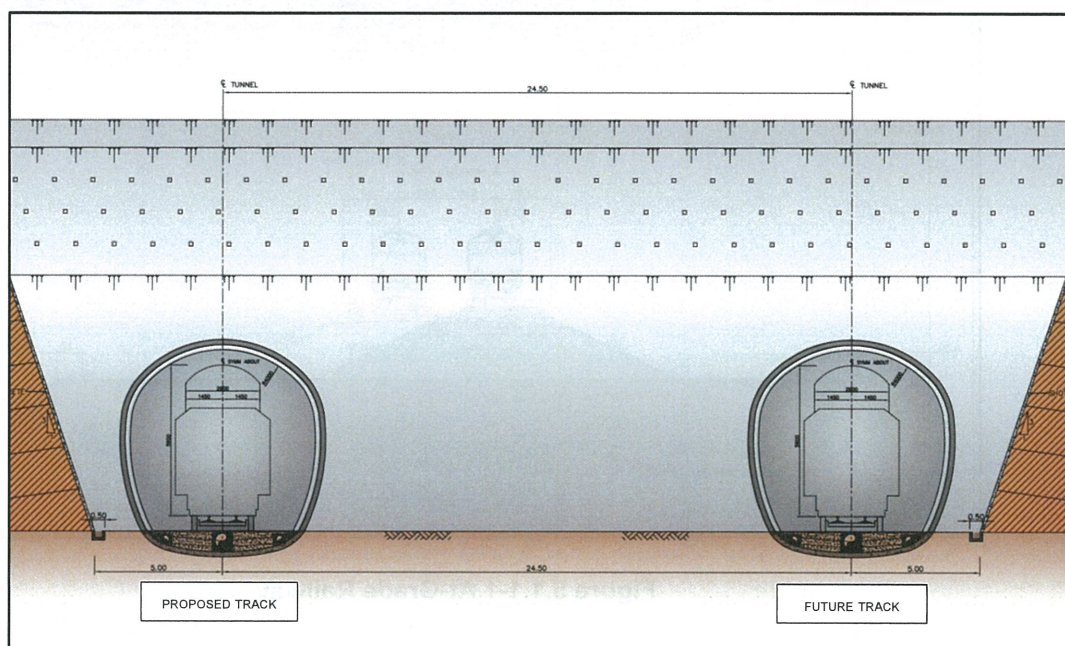


Figure 5.1.1-3 Railway Tunnel

5.1.1.2 Alignment Design

The alignment consists of 3 routes, i.e. the main line from Chumphon to Ranong Deep Sea Port, 102.797 km long, the chord line from the existing southern railway (Surat Thani) to the main line, 1.129 km long and the spur line or separate line to Ranong town, 5.082 km long, totaling 109.008 km long. The alignment shall locate 9 stations namely Khun Krathing Station, Ban Na (1) Station, Ban Na (2) Station, Pak Chan Station, Kra Buri Station, Bang Yai Station, La-Un Station, Ranong Deep Sea Port Station and Ranong Station. The design speed shall be 160 km/h in common area and 120 km/h in restricted area.

5.1.2 Track Layout

Track layout include siding track as shown in **Figure 5.1.2-1**, connection to the southern railway as shown in **Figure 5.1.2-2**, Ranong terminal station as shown in **Figure 5.1.2-3** and container yard track layout as shown in **Figure 5.1.2-4**.

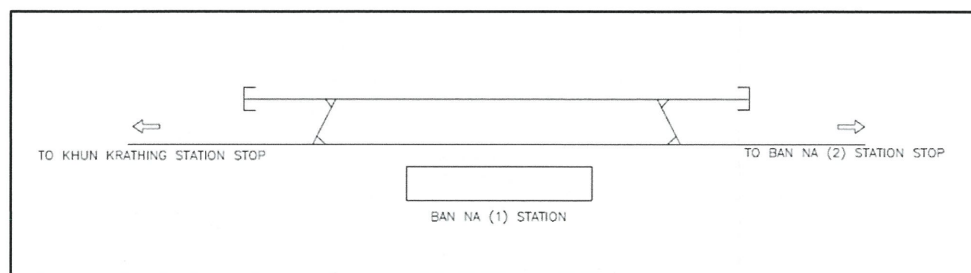


Figure 5.1.2-1 Siding Track

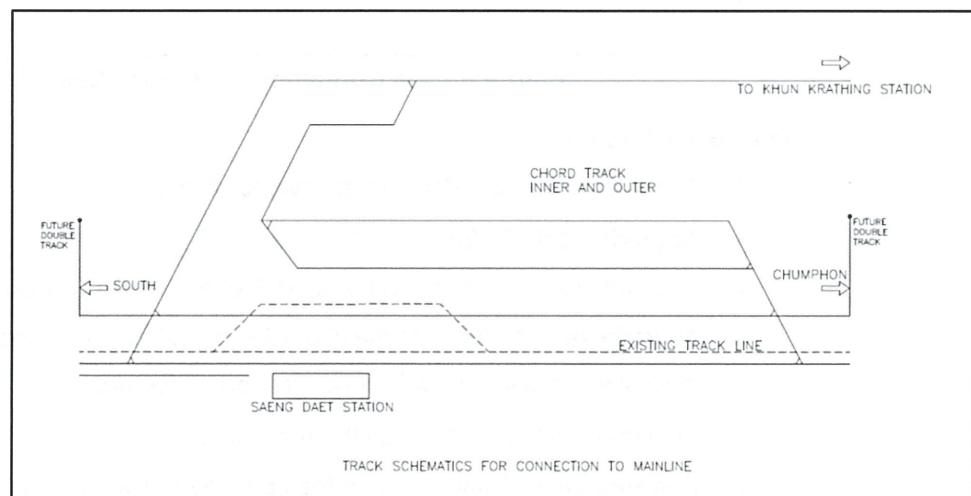


Figure 5.1.2-2 Connection to the Southern Railway

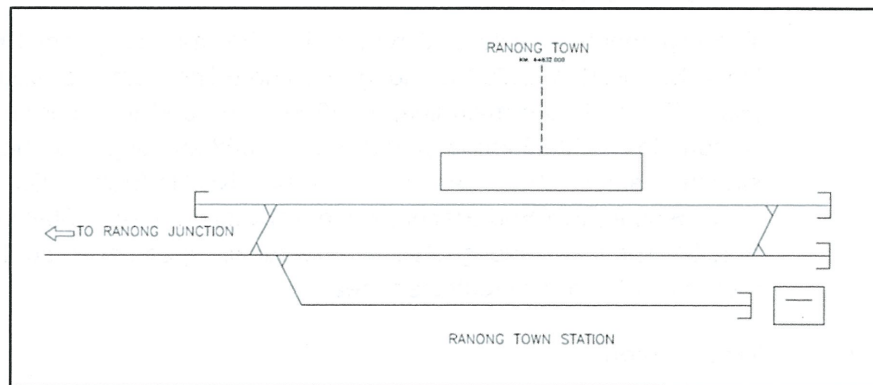


Figure 5.1.2-3 Ranong Terminal Station

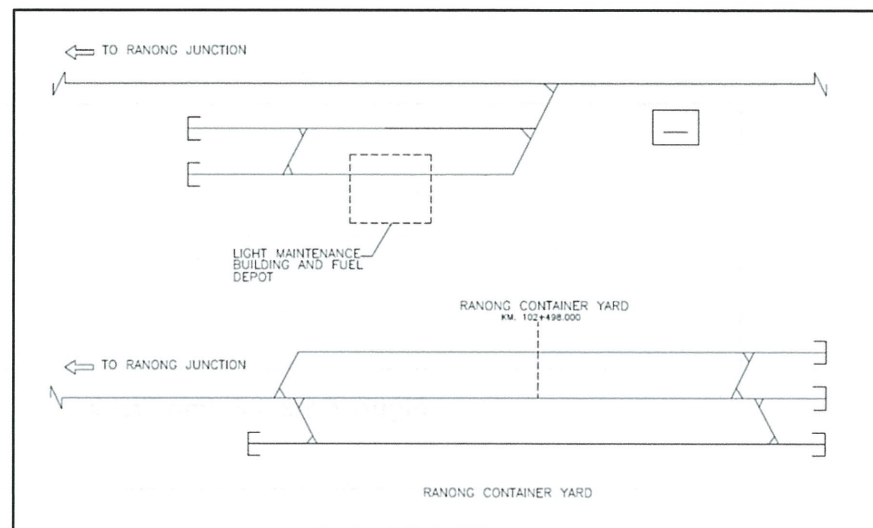


Figure 5.1.2-4 Container Yard Track Layout

5.1.3 Trackwork Design

- The ballasted track, 67,010 m long, divided as follows:
 - At-grade track, 63,908 m on the main line.
 - At-grade track, 1,972 m on the spur line to Ranong Station.
 - At-grade track, 1,130 m on the chord line connecting to the southern railway.
- The ballastless track, 42,000 m long, divided as follows:
 - Elevated track, 32,270 m on the main line.
 - Elevated track, 1,330 m on for the spur line to Ranong Station.
 - Track in tunnel, 6,620 m. on the main line.
 - Track in tunnel, 1,780 m on the spur line to Ranong Station.
- The ballasted track for the minor lines, divided as follows:
 - Track at container yard, 2,000 m long.
 - Siding track, 3,000 m long.
 - Track at Ranong Station, 900 m long.

5.1.4 Drainage Design

The Consultant has studied the size of watershed area which could affect the drainage along the railway by using the topographic map on the scale of 1:50,000. **Figure 5.1.4-1** shows the watershed area and flow direction. The preliminary estimation of the size of watershed outlet is shown in **Table 5.1.4-1**.

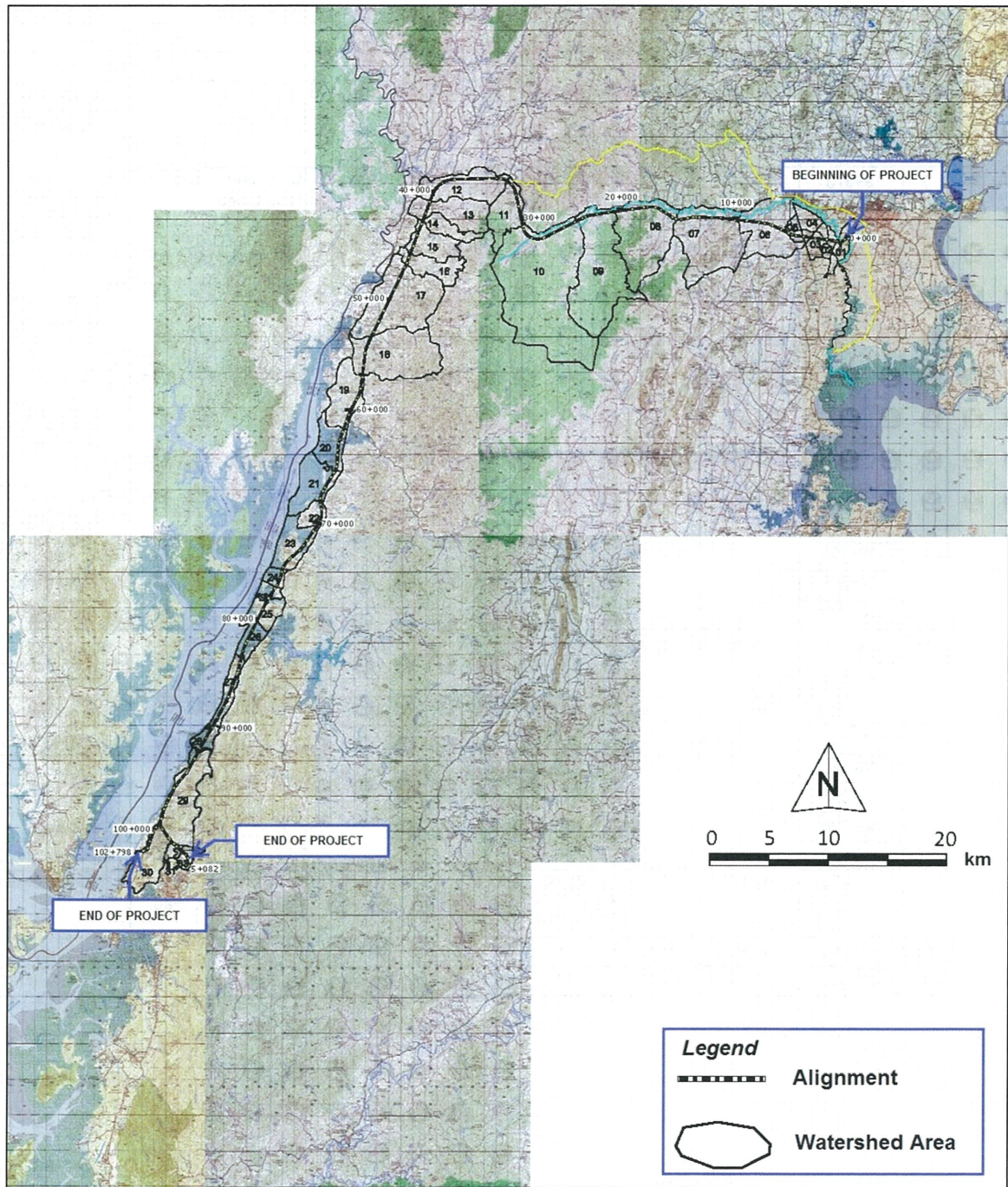


Figure 5.1.4-1 Watershed Area and Flow Direction

Table 5.1.4-1 Design of Watershed Outlet which passes the Railway

No.	Sta.	Watershed Area (km. ²)	Q (m. ³ /sec.)	Open Channel Required (km. ²)	Depth Required (m.)	Open Channel Width (m.)	Stream	Appropriate Watershed Outlet
1	0+850	R-01	70.20	35.10	2	17.55		Box culvert
2	1+250	R-02	30.15	15.08	2	7.54		Box culvert
3	2+235	R-03	44.47	22.23	2	11.12	Nakarat Canal	Elevated structure
4	3+375	R-04	60.46	30.23	2	15.11		Box culvert
5	5+674	R-05	34.72	17.36	2	8.68		Box culvert
6	6+840	R-06	221.10	110.55	2	55.27		Elevated structure
	7+800							Box culvert
	8+375							Box culvert
7	9+573	R-07	141.41	70.70	2	35.35	Chumphon Canal, Huai Clone	Box culvert
	14+641							Box culvert
8	15+310	R-08	106.50	53.25	2	26.62	Huai Clone, Huai Pae, Huai Luek Canal, Chumphon Canal	Elevated structure
	16+209							Box culvert
	17+553							Elevated structure
	19+745							Elevated structure
9	21+050	R-09	139.66	69.83	2	34.91	Chumphon Canal Branch, Khong Canal	Elevated structure
	21+593							Elevated structure
	21+949							Box culvert
	22+328							Box culvert
10	24+556	R-10	266.71	133.35	2	66.68	Chumphon Canal, Hin Sai Canal, Chumphon Canal Branch	Box culvert
	25+110							Elevated structure
	25+773							Elevated structure
	27+198							Elevated structure
	27+878							Elevated structure
	28+840							Elevated structure
11	29+918	R-11	123.42	61.71	2	30.86	Chumphon Canal, Hin Sai Canal, Chumphon Canal	Box culvert
	33+173							Elevated structure
12	34+283	R-12	156.90	78.45	2	39.22	Hin Wua Canal	Elevated structure
	35+333							Elevated structure
	36+360							Elevated structure
	38+233							Elevated structure
	38+735							Box culvert
	39+810							Elevated structure
13	42+025	R-13	70.00	35.00	2	17.50	Leak Canal, Chan Canal Branch, Wan Canal	Elevated structure
14	42+585	R-14	0.30	0.15	2	0.08		Box culvert
15	44+808	R-15	65.63	32.81	2	16.41	No name canal	Box culvert

Table 5.1.4-1 Design of Watershed Outlet which passes the Railway (Cont'd)

No.	Sta.	Watershed Area (km. ²)	Q (m. ³ /sec.)	Open Channel Required (km. ²)	Depth Required (m.)	Open Channel Width (m.)	Stream	Appropriate Watershed Outlet
16	45+805	R-16	66.34	33.17	2	16.58	No name canal, Ta Prue Canal, Nam Chuet Canal	Elevated structure
	46+765							Elevated structure
	48+098							Elevated structure
	49+190							Elevated structure
	50+590							Elevated structure
	50+970							Box culvert
	51+470							Elevated structure
	51+703							Box culvert
	52+500							Box culvert
	53+196							Box culvert
	54+070							Elevated structure
	55+663							Elevated structure
17	56+835	R-17	71.02	35.51	2	17.76	Pak Nam Canal, No name canal, Pak Nam Canal	Elevated structure
	57+135							Box culvert
	57+950							Box culvert
	57+868							Box culvert
	58+643							Elevated structure
	60+430							Elevated structure
18	63+381	R-18	32.30	16.15	2	8.08		Box culvert
19	63+728	R-19	5.12	2.56	2	1.28	Bang Song Ra Canal, No name canal	Elevated structure
20	66+425	R-20	77.86	38.93	2	19.46	Sib Tha Canal, No name canal	Elevated structure
	66+910							Box culvert
	67+440							Elevated structure
21	68+625	R-21	93.55	46.77	2	23.39	Bang Yai Nua Cana	Elevated structure
22	72+048	R-22	86.99	43.50	2	21.75	Bang Yai Canal, Hin Kong Canal	Box culvert
23	75+010	R-23	0.20	0.10	2	0.05		Elevated structure
	75+820							Elevated structure
	76+109							Box culvert
	76+651							Box culvert
24	77+000	R-24	0.15	0.08	2	0.04	Lud Canal, La-un Canal, No name canal	Box culvert
	77+438							Box culvert
	81+668							Elevated structure
	84+262							Box culvert

Table 5.1.4-1 Design of Watershed Outlet which passes the Railway (Cont'd)

No.	Sta.	Watershed Area (km. ²)	Q (m. ³ /sec.)	Open Channel Required (km. ²)	Depth Required (m.)	Open Channel Width (m.)	Stream	Appropriate Watershed Outlet
25	84+500	R-25	13.01	6.51	2	3.25	No name canal	Box culvert
	85+500							Box culvert
	86+125							Elevated structure
	88+645							Elevated structure
26	90+015	R-26	37.92	18.96	2	9.48	No name canal	Elevated structure
	90+895							Box culvert
	91+738							Box culvert
27	92+130	R-27	2.59	1.29	2	0.65		Box culvert
	92+878							Elevated structure
	93+941							Box culvert
	96+103							Elevated structure
	96+583							Box culvert
	97+000							Box culvert
	97+598							Elevated structure
	98+538							Elevated structure
28	99+135	R-28	4.42	2.21	2	1.10	No name canal	Box culvert
	102+332							Box culvert
29	2+500	R-29	2.60	1.30	2	0.65		Box culvert
30	2+750	R-30	42.84	21.42	2	10.71		Box culvert
31	0+000	R-31	5.29	2.65	2	1.32	Waterway	Box culvert
32	3+436	R-32	1.65	0.83	2	0.41	Bang Non Canal	Box culvert
	3+955							Elevated structure
33	4+500	R-33	32.29	16.14	2	8.07	Bang Non Canal	Box culvert

5.1.5 Railway Station Design

The forecast of passenger volumes is analyzed to categorize the station sizes and types according to the number of passengers and there are 2 station types as follows:

- 1) Station Type A: a provincial station; it is a medium station and there is 1 station. (Using the highest passenger volume forecasts, 2054), as shown in **Figure 5.1.5-1**.
- 2) Station Type B: a district/sub-district station; it is a small station and there are 7 stations. (Using the highest passenger volume forecasts, 2054), as shown in **Figure 5.1.5-2**.

Table 5.1.5-1 shows the size, type and location of each station.



Figure 5.1.5-1 Station Type A



Figure 5.1.5-2 Station Type B

Table 5.1.5-1 List of Stations, Type and Chainage

Code	Station Name	Type	Chainage
S-01	Khun Krating Station	Type B	KM. 003+688
S-02	Ban Na 1 Station	Type B	KM. 014+067
S-03	Ban Na 2 Station	Type B	KM. 022+000
S-04	Pak Chan Station	Type B	KM. 042+950
S-05	Kra Buri Station	Type B	KM. 052+900
S-06	Bang Yai Station	Type B	KM. 070+839
S-07	La-un Station	Type B	KM. 078+869
S-08	Ranong Port Station	-	KM. 102+498
S-09	Ranong Station	Type A	KM. 004+832 (Spur line)

5.1.6 Level Crossing Design

There are 84 nos. of grade separation as follows:

- 1) Type 1: Elevated railway consisting of 27 railway bridges crossing the existing road and 10 railway bridges crossing additionally constructed service road.
- 2) Type 2: 5 overpasses.
- 3) Type 3: 4 minor bridges.
- 4) Type 4: 32 service roads
- 5) Type 5: Box underpass consisting of 5 box underpasses on the existing road and 5 box underpasses on additionally constructed service road.
- 6) Type 6: 1 pedestrian bridge on the existing road and 1 pedestrian bridge on the service road.
- 7) Use the local road network to cross the nearby railway at 6 locations.
- 8) Close 4 nos. of the existing level crossings.

Grade separation structures are shown in **Figure 5.1.6-1** and the solution of level crossing problems are shown in **Table 5.1.6-1**.



Type 1 : Elevated Railway



Type 2 : Overpass



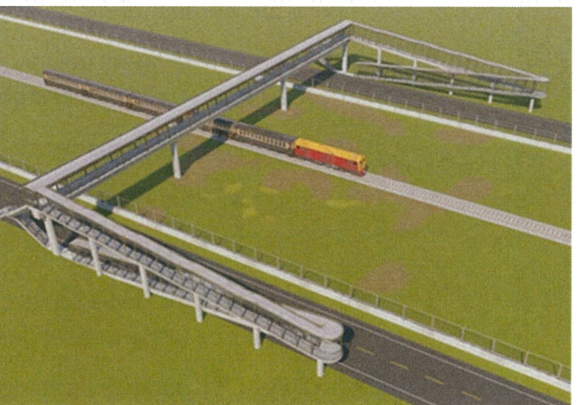
Type 3 : Minor Bridge



Type 4 : Service Road



Type 5 : Box Underpass



Type 6 : Pedestrian Bridge

Figure 5.1.6-1 Grade Separation Structures

Table 5.1.6-1 Solution of Level Crossing Problems

Main Line							
No.	Station (km)	Road Name	Type	No. of Lane	TM. (Year 2025)	Solution of Level Crossing Problems	Remark
1	1+159	Chor Por 3009	AC	2	267,512	Overpass	
2	1+958	Local Road	Non-Asphalt	1	*	Local Road	Cross at Sta. 1+159
3	3+406	Local Road	Concrete	2	*	Serviced Road	Cross at Sta. 4+032
	3+688	-	-	-		-	Khun Krating Station
4	4+032	Highway 41	AC	4	524,538	Overpass	
5	4+830	Local Road	Non-Asphalt	1	*	Local Road	Cross at Sta. 4+032
6	6+000	Local Road	Concrete	2	*	Pedestrian Bridge	
7	7+303	Local Road	Non-Asphalt	1	*	Serviced Road	Cross at Sta. 7+635
8	7+635	Local Road	Concrete	2	6,202	Box Underpass	
	8+305	-	-	-		Box Underpass	
9	9+795	Chor Por 2121	AC	2	7,882	Elevated Railway	Remain existing condition
10	10+223	Chor Por 1045	AC	2	8,775	Serviced Road	Cross at Sta. 9+795
11	11+186	Local Road	AC	2	7,070	Serviced Road	Cross at Sta. 12+088
12	12+075	Local Road	Non-Asphalt	1	*	Serviced Road	Cross at Sta. 12+088
	12+088	-	-	-		Elevated Railway	Construct new road
13	13+297	Local Road	Non-Asphalt	1	*	Serviced Road	Cross at Sta. 12+088
	14+067	-	-	-		-	Ban Na (1) Station
14	14+374	Local Road	Non-Asphalt	1	*	Serviced Road	Cross at Sta. 12+088/Sta. 14+945
15	14+945	Chor Por 1005	AC	2	29,545	Overpass	
16	15+889	Local Road	Concrete	1	*	Serviced Road	Cross at Sta. 16+190
	16+190	-	-	-		Box Underpass	
17	16+487	Local Road	Non-Asphalt	1	*	Local Road	Cross at Sta. 16+190
18	17+656	Local Road	Non-Asphalt	1	*	Elevated Railway	Remain existing condition
19	18+648	Local Road	Non-Asphalt	1	*	Dismiss the road	
20	19+657	Local Road	Concrete	1	13,259	Elevated Railway	Remain existing condition
21	21+236	Local Road	Concrete	1	*	Serviced Road	Cross at Sta. 21+550
	21+550	-	-	-		Elevated Railway	Construct new road
22	21+680	Local Road	Non-Asphalt	1	*	Serviced Road	Cross at Sta. 21+550
	22+000	-	-	-		-	Ban Na (2) Station
23	22+289	Local Road	Non-Asphalt	1	*	Dismiss the road	
24	22+422	Local Road	Non-Asphalt	1	*	Dismiss the road	
25	23+340	Local Road	Non-Asphalt	1	*	Dismiss the road	
26	23+849	Local Road	Concrete	2	14,562	Minor Bridge	
27	25+364	Local Road	Concrete	2	*	Elevated Railway	Remain existing condition
28	25+595	Local Road	Concrete	2	*	Serviced Road	Cross at Sta. 25+364
29	25+721	Local Road	Non-Asphalt	1	*	Serviced Road	Cross at Sta. 25+364
30	27+769	Local Road	Non-Asphalt	1	*	Elevated Railway	Remain existing condition
31	28+032	Local Road	AC	2	*	Elevated Railway	Remain existing condition
32	28+161	Local Road	Concrete	1	*	Serviced Road	Cross at Sta. 28+032
33	28+619	Chor Por 2052	AC	2	12,492	Local Road	Cross at Sta. 28+032

Table 5.1.6-1 Solution of Level Crossing Problems (Cont'd)

No.	Station (km)	Road Name	Type	No. of Lane	TM. (Year 2025)	Solution of Level Crossing Problems	Remark
34	29+372	Local Road	Non-Asphalt	1	*	Serviced Road	Cross at Sta. 29+620
35	29+620	Local Road	Non-Asphalt	1	*	Minor Bridge	
	29+970	-	-	-		Box Underpass	
36	30+017	Local Road	Non-Asphalt	1	*	Serviced Road	Cross at Sta. 29+970
37	32+984	Local Road	Non-Asphalt	1	*	Elevated Railway	Remain existing condition
38	33+418	Ror Nor 3117	AC	2	13,489	Elevated Railway	Remain existing condition
39	34+299	Local Road	Concrete	1	*	Elevated Railway	Remain existing condition
40	35+878	Ror Nor 1017	AC	2	12,282	Elevated Railway	Remain existing condition
41	38+835	Local Road	Concrete	1	*	Box Underpass	
42	39+583	Local Road	Non-Asphalt	1	*	Serviced Road	Cross at Sta. 39+820
	39+820	-	-	-		Elevated Railway	Construct new road
	40+870	-	-	-		Pedestrian Bridge	
43	40+904	Local Road	Concrete	1	17,052	Serviced Road	Cross at Sta. 39+820
44	41+617	Ror Nor 1003	AC	2	22,963	Local Road	Cross at Sta. 42+587
45	42+587	Ror Nor 1003	AC	2	22,963	Overpass	
	42+950	-	-	-		-	Pak Chan Station
46	45+725	Ror Nor 1003	AC	2	22,963	Serviced Road	Cross at Sta. 45+780/Sta. 46+688
47	46+158	Local Road	AC	1	17,474	Serviced Road	Cross at Sta. 46+688
48	46+688	Local Road	AC	2	*	Elevated Railway	Remain existing condition
49	46+977	Local Road	AC	2	*	Serviced Road	Cross at Sta. 46+688
50	47+850	Ror Nor 1018	AC	2	15,731	Elevated Railway	Remain existing condition
	48+391	-	-	-		Elevated Railway	Construct new road
51	48+597	Local Road	AC	2	*	Serviced Road	Cross at Sta. 48+391
52	51+660	Local Road	Concrete	1	*	Box Underpass	
53	52+119	Local Road	AC	2	19,601	Elevated Railway	Remain existing condition
	52+900	-	-	-		-	Kra Buri Station
54	53+377	Ror Nor 1014	AC	2	720	Overpass	
55	54+110	Local Road	Concrete	1	*	Elevated Railway	Remain existing condition
56	56+771	Ror Nor 1008	AC	2	15,903	Elevated Railway	Remain existing condition
57	56+859	Highway 4	AC	4	154,717	Elevated Railway	Remain existing condition
58	61+661	Local Road	AC	2	15,903	Serviced Road	Cross at Sta. 61+865
	61+865	-	-	-		Elevated Railway	Construct new road
59	62+555	Local Road	Concrete	2	*	Elevated Railway	Remain existing condition
60	62+969	N/A	Non-Asphalt	1	*	Elevated Railway	Remain existing condition
61	69+162	Local Road	Concrete	1	*	Elevated Railway	Remain existing condition
62	70+559	Local Road	Concrete	1	*	Serviced Road	Cross at Sta. 71+170
	70+839	-	-	-		-	Bang Yai Station
	71+170	-	-	-		Elevated Railway	Construct new road
63	74+568	Local Road	AC	2	*	Serviced Road	Cross at Sta. 74+600
	74+600					Elevated Railway	Construct new road
	76+685	-	-	-		Box Underpass	
64	76+884	Ror Nor 3080	AC	2	*	Serviced Road	Cross at Sta. 76+685
	78+580	-	-	-		Elevated Railway	Construct new road

Table 5.1.6-1 Solution of Level Crossing Problems (Cont'd)

No.	Station (km)	Road Name	Type	No. of Lane	TM. (Year 2025)	Solution of Level Crossing Problems	Remark
65	78+669	Ror Nor 3028	Concrete	2	*	Serviced Road	Cross at Sta. 78+580
	78+869	-	-	-		-	La-un Station
66	79+149	Ror Nor 3028	Concrete	2	*	Serviced Road	Cross at Sta. 78+580
67	83+260	Local Road	AC	2	*	Elevated Railway	Remain existing condition
68	85+229	Local Road	Non-Asphalt	1	*	Local Road	Cross at Sta. 85+463
69	85+463	Local Road	Concrete	1	*	Box Underpass	
70	85+999	N/A	Non-Asphalt	1	*	Elevated Railway	Remain existing condition
71	87+354	Ror Nor 4076	AC	2	*	Minor Bridge	
72	89+055	Local Road	Concrete	1	*	Elevated Railway	Remain existing condition
73	93+248	Ror Nor 4010	AC	2	*	Elevated Railway	Remain existing condition
74	95+931	Local Road	Non-Asphalt	1	*	Elevated Railway	Remain existing condition
75	96+353	Local Road	Concrete	1	*	Elevated Railway	Remain existing condition
76	96+629	Local Road	Concrete	1	*	Box Underpass	
77	96+722	Local Road	Non-Asphalt	1	*	Serviced Road	Cross at Sta. 96+629
78	98+428	Local Road	Concrete	1	*	Elevated Railway	Remain existing condition
79	102+107	Ror Nor 4010	AC	2	33,912	Minor Bridge	
80	102+357	Ror Nor 4010	AC	2	*	Serviced Road	Cross at Sta. 102+107
	102+498	-	-	-		-	Ranong Port Station
Spur Line							
No.	Station (km)	Road Name	Type	No. of Lane	TM. (Year 2025)	Solution of Level Crossing Problems	Remark
81	2+552	Ror Nor 1002	AC	2	15,539	Serviced Road	Cross at Sta. 2+732
	2+732	-	-	-		Elevated Railway	Construct new road
82	2+942	Local Road	Concrete	1	*	Elevated Railway	Remain existing condition
83	3+540	Local Road	AC	2	*	Serviced Road	Cross at Sta. 3+760
	3+760	-	-	-		Elevated Railway	Construct new road
84	4+400	Local Road	Concrete	2	*	Serviced Road	Cross at Sta. 4+452
	4+452	-	-	-		Box Underpass	
	4+832	-	-	-		-	Ranong Station

Remark: * TM. Less than 10,000 trains-vehicles per day

5.1.7 Geotechnical Engineering Design

5.1.7.1 Geological and Geotechnical Survey

- 1) Soil survey for railway embankment: 10 soil samplings (TP-1 to TP-10)
- 2) Soil survey for bridge foundation and other structures: 9 boreholes (BH-1 to BH-9)
- 3) Field and Laboratory Testing: The results of soil investigation are interpreted and summarized in **Table 5.1.7-1** that present the soil profile along the alignment. And the sample of testing results from Test Pits is shown in **Figure 5.1.7-1**.

Table 5.1.7-1 Summary of Soil Profile along the Alignment

Km. (Approximately)	Soil and Rock Description
Km.0 to Km.45 At Mueang Chumphon District, Chumphon and Kra Buri District, Ranong	The top soil is stiff to very stiff silty /sandy clay of 0.5-5.5 m thick, then the layer of hard silty/sandy clay of 1.5-11.5 m thick. At Sta.32+226, BH-1, the topsoil is medium dense to dense sand of 6 m. thick. After that it is the claystone tuff and granite rock bed until the end of the hole.
Km.45 to Km.66 At Kra Buri District, Ranong	The top soil is stiff to very stiff silty/sandy clay of 3-4 m. thick, then it is the medium dense to very dense sand layer of 4-5 m. thick. After that it is the sandstone rock bed until the end of the hole.
Km.66 to Km.102 At Kra Buri District and La-Un District, Ranong	The top soil is stiff to very stiff silty/sandy clay of 7-10 m. thick except at Sta. 88+577, BH-8, the top soil is soft clay. After that it is hard silty/sandy clay layer of 2-9 m thick, then gneiss, granodiorite and hornfels rock bed until the end of the hole.

Summary of Test Pit Results																									
Test Pit No.	Sta.	Sample Discription	Atterberg Limits			Sieve Analysis										Classification			Compaction Test ¹		CBR Test ¹		Direct Shear		
			(%)			% Passing (US Standard Sieve)										USCS Group	AASHTO Group	UIC ¹ 99R Class	MDD ² (t/m ³)	OMC ³ (%)	CBR (%)	Swell (%)	c' (t/m ²)	c (kPa)	Φ (deg.)
			LL	PL	PI	1" 3/4"	1/2" 3/8"	#4	#10	#40	#100	#200													
TP-1	4+000	Silty CLAY	65.4	36.0	29.4					100	98	96	87	85	CH	A-7.5 (33)	QS1 [1.1]	1.415	28.2	2.5	2.298	3.95	38.7	10.0	
TP-2	10+000	Sandy CLAY	37.5	20.0	17.5			100	90	88	81	74	69	65	CL	A-6 (9)	QS1 [1.1]	1.702	18.7	8.7	0.211				
TP-3	20+000	Silty SAND	54.4	32.8	21.6	100	92	87	84	63	42	31	25	23	SM	A-2.7 (1)	QS1 [1.3]	1.685	20.2	9.7	0.000	2.92	28.6	21.3	
TP-4	30+000	Sandy CLAY	37.6	21.2	16.4					100	98	78	60	56	CL	A-6 (7)	QS1 [1.1]	1.711	18.0	7.1	0.145				
TP-5	41+000	Silty CLAY	54.0	31.0	23.0			100	99	98	96	84	81	CH	A-7.6 (22)	QS1 [1.1]	1.448	28.2	3.8	0.109	2.39	23.4	17.3		
TP-6	52+000	Sandy CLAY	44.6	27.8	16.8					100	100	96	65	62	CL	A-7.6 (10)	QS1 [1.1]	1.565	22.9	6.6	0.138				
TP-7	58+000	Silty CLAY	36.5	21.2	15.3			100	100	100	97	83	79	CL	A-6 (11)	QS1 [1.1]	1.673	20.4	8.0	0.196	2.09	20.5	19.1		
TP-8	76+000	Silty CLAY	60.2	36.8	23.4					100	100	99	96	95	CH	A-7.6 (35)	QS1 [1.1]	1.386	31.2	2.7	0.175				
TP-9	90+000	Sandy CLAY	56.4	29.3	27.1					100	100	76	65	63	CH	A-7.6 (16)	QS1 [1.1]	1.600	22.4	5.9	0.196	2.48	24.3	17.7	
TP-10	99+000	Clayey SAND	34.5	22.7	11.8	100	94	90	88	84	78	60	48	46	SC	A-6 (2)	QS1 [1.1]	1.680	18.8	6.9	0.167				
Notes																									
1 Compaction test followed AA SHTO T 99 (Standard) and 4 days soaked CBR is reported at 95 % maximum dry density for each sample.												4 Degree of dispersion Non = Non dispersive (% of dispersive < 30) Int = Intermediate (% of dispersive 30 - 50) Disp = Dispersive (% of dispersive > 50)													
2 MDD : Maximum Dry Density																									
3 OMC : Optimum Moisture Content																									

Notes:

1 Compaction test followed AASHTO T 99 (Standard) and 4 days soaked CBR is reported at 95 % maximum dry density for each sample.

2 MDD: Maximum Dry Density

3 OMC: Optimum Moisture Content

4 Degree of dispersion

Non. = Nondispersive (% of dispersive < 30)

Int. = Intermediate (% of dispersive 30 - 50)

Disp. = Dispersive (% of dispersive > 50)

Figure 5.1.7-1 Sample of Testing Results from Test Pits

5.1.7.2 Trackbed Embankment Structure Design

1) Trackbed embankment structure include as following;

- Embankment Fill
- Prepared Subgrade: minimum layer thickness due to 500 mm.
- Sand Drain: minimum layer thickness due to 100 mm.
- Subbase: minimum layer thickness due to 200 mm.
- Subballast: minimum layer thickness due to 300 mm.
- Ballast: minimum layer thickness due to 300 mm.

2) Slope Protection and Settlement Analysis and Design

Checked as follows:

(1) Bearing Capacity Failure

(2) Toe Slope Failure: slope stability analysis has results as shown in **Table 5.1.7-2**.

(3) Settlement of Embankment: results of settlement calculation of boreholes along the alignment are shown in **Table 5.1.7-3**. For soil bearing capacities and slope stability of boreholes along the alignment are shown in **Table 5.1.7-4**.

(4) Erosion Protection of Slope

- Planting is the method to have the roots such as vetiver or others etc.
- Soil surface protection such as mattress/gabion or shotcrete or rip-rap etc.

Table 5.1.7-2 Summary of Simplified Slope Stability

Soil Type	SPT N	Factor of Safety for Embankment Height, m.					
		H = 4	H = 5	H = 6	H = 7	H = 8	H = 9
Clay	N = 6	1.808	1.645	<u>1.498</u>			
	N = 7			1.695	1.552	<u>1.415</u>	
	N = 8					1.577	<u>1.453</u>
Sand	N = 16			1.691	1.598	1.507	

Table 5.1.7-3 Settlement Calculation of Boreholes along the Alignment

Borehole No.	Sta.	Embankment Height	Immediate Settlement	Total Consolidation Settlement	Total Settlement	Consolidation Settlement		Remain Settlement	
				m	m	at 1 Year	at 2 Year	after 1 Year	after 2 Year
						m	m	m	m
BH-1	15+792	7	0.014	0.474	0.488	0.472	0.474	0.002	0.000
BH-2	22+481	7	0.023	0.775	0.798	0.438	0.581	0.337	0.194
BH-4	44+925	6	0.027	0.820	0.847	0.262	0.369	0.558	0.451
BH-7	79+873	6	0.027	0.820	0.847	0.262	0.369	0.558	0.451
BH-9	101+709	7	0.032	0.903	0.935	0.289	0.406	0.614	0.497

Table 5.1.7-4 Soil Bearing Capacity and Slope Stability of Boreholes along the Alignment

Borehole No.	Sta.	Embankment	Settlement	Soil Bearing Capacity	Slope Stability	Soil Improvement
		Height	after 2 Years	FS. > 1.5	FS. > 1.5	
		m	m			
BH-1	15+792	7	0.000	Yes	Yes	No
BH-2	22+481	7	0.194	Yes	Yes	No
BH-4	44+925	6	0.451	Yes	Yes	Adjusted by Ballast Filling
BH-7	79+873	6	0.451	Yes	Yes	Adjusted by Ballast Filling
BH-9	101+709	7	0.497	Yes	Yes	Adjusted by Ballast Filling

5.1.7.3 Pile Foundation Analysis and Design

Summary of pile tip level at design load is shown in **Table 5.1.7-5**

Table 5.1.7-5 Summary of Pile Tip Level at Design Load

Type of Pile		Driven Pile		Bored Pile	
		Square 0.35	Square 0.40	Ø1.00	Ø1.20
Factor of Safety, FS.		2.5	2.5	2.5	2.5
Required Service Load (tons)/Pile		50	50	450	650
Borehole	Km.	Pile Tip for Required Service Load (m)			
BH-1	15+792	6 (41.5)	6 (49.5)	7 (313.4)	7 (424.1)
BH-2	22+481	7 (48.1)	7	9 (326.3)	9 (439.5)
BH-3	32+226	6 (19.6)	6 (25.0)	8 (264.5)	8 (365.3)
BH-4	44+925	7	6	14 (385.7)	14 (510.6)
BH-5	59+751	7 (49.9)	6	10 (279.6)	10 (383.4)
BH-6	65+678	8	8	11 (330.8)	11 (444.8)
BH-7	79+873	9	8	16 (413.8)	16 (544.3)
BH-8	88+577	10 (34.9)	10 (41.9)	13 (334.6)	13 (449.3)
BH-9	101+709	11	9	22	22 (619.2)

Note –The underline numbers are the allowable pile capacities which are less than design load.

5.1.7.4 Tunnel Design

The designing and selecting the tunnel support in weak rock, the rock condition has to be investigated and assessed. Generally, the assessment of rock condition and the tunnel support in weak rock is based on the Rock Mass Rating (RMR). The RMR method classifies the rock into 5 categories, as shown in **Table 5.1.7-6**.

Details of the location and size of the tunnel are shown in **Table 5.1.7-7**.

**Table 5.1.7-6 Rock Mass Rating (RMR)
and the Recommended Tunnel Support (Bieniawski, 1989)**

Rock Mass Class	Excavation	Rock Bolts Installation	Shotcrete Spraying	Steel Sets Installation
I - Very good rock <i>RMR: 81-100</i>	Full face, 3 m advance. Complete support 20 m from face	No support required except spot bolting		
II - Good rock <i>RMR: 61-80</i>	Top heading and bench 1.5 - 3 m advance in top heading. Commence support after each blast. Complete support 20 m from face.	Bolts in crown 3 m long, spaced 2.5 m with occasional wire mesh	50 mm in crown where required	None
III - Fair rock <i>RMR: 41-60</i>	Top heading and bench 1.5 - 3 m advance in top heading. Commence support after each blast. Complete support 10 m from face.	Systematic bolts 4 m long, spaced 1.5 - 2 m in crown and walls with wire mesh in crown	50 - 100 mm in crown and 30 mm in sides	None
IV - Poor rock <i>RMR: 21 - 40</i>	Top heading and bench 1 - 1.5 m advance in top heading. Install support concurrently with excavation, 10 m from face.	Systematic bolts 4- 5 m long, spaced 1 - 1.5 m in crown and walls with wire mesh	100-150 mm in crown and 100 mm in sides	Light to medium rib spaced 1.5 m where required.
V - Very poor rock <i>RMR: <20</i>	Multiple drifts 0.5 - 1.5 m advance in top heading. Install support concurrently with excavation. Shotcrete as soon as possible after blasting	Systematic bolts 5-6 m long, spaced 1-1.5 m in crown and walls with wire mesh. Bolt invert.	150 - 200 mm in crown, 150 mm in sides, and 50 mm on face.	Medium to heavy rib spaced 0.75 m with steel lagging and fore poling if required. Close invert

Table 5.1.7-7 Location and Size of Project Tunnels

Tunnel	STA.		Length (m)	Location
	From	To		
Tunnel 1	30+815	32+480	1,665	Choporo Sub-district, Kra Buri District
Tunnel 2	55+925	56+660	735	Nam Chuet Sub-district, Kra Buri District
Tunnel 3	58+815	59+185	370	Nam Chuet Sub-district, Kra Buri District
Tunnel 4	60+945	61+465	520	Lam Liang Sub-district, Kra Buri District
Tunnel 5	94+120	95+635	1,515	Pak Nam Sub-district, Mueang Ranong District
Tunnel 6	100+185	102+000	1,815	Pak Nam Sub-district, Mueang Ranong District
Tunnel 7 (Spur Line)	0+530	2+310	1,780	Pak Nam and Bang Non Sub-districts, Mueang Ranong District

5.1.8 Structural Design

The results of the structural design are as follows:

- 1) Design for railway bridges; location and type of railway bridges for this project are shown in **Table 5.1.8-1**
- 2) Design for road bridges; location of overpass and location of box underpass shown in **Table 5.1.8-2** and **Table 5.1.8-3** respectively.

Table 5.1.8-1 Location and Type of Railway Bridges

Station	Proposed Bridges		
	Type	Total Span (m)	Superstructure Type
KM 2+117 TO KM 2+327	EL, PC	6X 35.00m.	SG
KM 6+490 TO KM 7+190	EL, PC	20X 35.00m.	SG
KM 9+135 TO KM 10+010	EL, PC	25X 35.00m.	SG
KM 11+650 TO KM 12+280	EL, PC	18X 35.00m.	SG
KM 15+205 TO KM 15+415	EL, PC	6X 35.00m.	SG
KM 17+430 TO KM 17+675	EL, PC	7X 35.00m.	SG
KM 19+430 TO KM 20+060	EL, PC	18X 35.00m.	SG
KM 20+910 TO KM 21+190	EL, PC	8X 35.00m.	SG
KM 21+540 TO KM 21+645	EL, PC	3X 35.00m.	SG
KM 24+830 TO KM 25+390	EL, PC	16X 35.00m.	SG
KM 25+685 TO KM 25+860	EL, PC	5X 35.00m.	SG
KM 27+145 TO KM 27+250	EL, PC	3X 35.00m.	SG
KM 27+650 TO KM 28+105	EL, PC	13X 35.00m.	SG
KM 28+770 TO KM 28+910	EL, PC	4X 35.00m.	SG
KM 32+595 TO KM 33+750	EL, PC	33X 35.00m.	SG
KM 34+020 TO KM 34+545	EL, PC	15X 35.00m.	SG
KM 35+210 TO KM 35+455	EL, PC	7X 35.00m.	SG
KM 35+765 TO KM 36+955	EL, PC	34X 35.00m.	SG
KM 38+145 TO KM 38+320	EL, PC	5X 35.00m.	SG
KM 39+722 TO KM 39+897	EL, PC	5X 35.00m.	SG
KM 41+850 TO KM 42+200	EL, PC	10X 35.00m.	SG
KM 44+030 TO KM 44+345	EL, PC	9X 35.00m.	SG
KM 45+190 TO KM 45+505	EL, PC	9X 35.00m.	SG
KM 45+735 TO KM 45+875	EL, PC	4X 35.00m.	SG
KM 46+625 TO KM 46+905	EL, PC	8X 35.00m.	SG

Table 5.1.8-1 Location and Type of Railway Bridges (Cont'd)

Station	Proposed Bridges		
	Type	Span (m)	Superstructure Type
KM 47+765 TO KM 48+430	EL, PC	19X 35.00m.	SG
KM 49+050 TO KM 49+330	EL, PC	8X 35.00m.	SG
KM 50+485 TO KM 50+695	EL, PC	6X 35.00m.	SG
KM 51+400 TO KM 51+540	EL, PC	4X 35.00m.	SG
KM 53+440 TO KM 54+700	EL, PC	36X 35.00m.	SG
KM 55+540 TO KM 55+785	EL, PC	7X 35.00m.	SG
KM 56+730 TO KM 56+940	EL, PC	6X 35.00m.	SG
KM 58+520 TO KM 58+765	EL, PC	7X 35.00m.	SG
KM 60+185 TO KM 60+675	EL, PC	14X 35.00m.	SG
KM 61+855 TO KM 65+600	EL, PC	107X 35.00m.	SG
KM 66+145 TO KM 66+705	EL, PC	16X 35.00m.	SG
KM 67+125 TO KM 67+755	EL, PC	18X 35.00m.	SG
KM 67+995 TO KM 69+255	EL, PC	36X 35.00m.	SG
KM 71+155 TO KM 72+940	EL, PC	51X 35.00m.	SG
KM 74+590 TO KM 75+430	EL, PC	24X 35.00m.	SG
KM 75+715 TO KM 75+925	EL, PC	6X 35.00m.	SG
KM 77+645 TO KM 78+590	EL, PC	27X 35.00m.	SG
KM 79+935 TO KM 83+400	EL, PC	99X 35.00m.	SG
KM 85+985 TO KM 86+265	EL, PC	8X 35.00m.	SG
KM 87+910 TO KM 89+380	EL, PC	42X 35.00m.	SG
KM 89+700 TO KM 90+330	EL, PC	18X 35.00m.	SG
KM 92+300 TO KM 93+455	EL, PC	33X 35.00m.	SG
KM 95+770 TO KM 96+435	EL, PC	19X 35.00m.	SG
KM 97+405 TO KM 97+790	EL, PC	11X 35.00m.	SG
KM 98+380 TO KM 98+695	EL, PC	9X 35.00m.	SG
KM 2+500 TO KM 3+270 at Spur Line	EL, PC	22X 35.00m.	SG
KM 3+745 TO KM 4+280 at Spur Line	EL, PC	16X 35.00m.	SG

Note: EL, PC denotes prestressed concrete elevated railway bridge.
SG denotes segmental box girder type

Table 5.1.8-2 Location of Overpass

Station	Proposed Bridge		
	Type	Span (m)	Superstructure Type
KM 1+159	MS,PC	12X36.00 m.	IG
KM 4+032	MS,PC	15X30.00 m.	IG
KM 14+945	MS,PC	9X30.00 m.	IG
KM 42+587	MS,PC	10X30.00 m.	IG
KM 53+377	MS,PC	17X30.00 m.	IG
KM 23+849	SS,PC and RC	10.00+30.00 m.	RS + IG
KM 29+620	SS,PC and RC	10.00+30.00+10.00 m.	RS + IG
KM 87+354	SS,PC and RC	10.00+30.00+10.00 m.	RS + IG
KM 102+107	SS,PC and RC	10.00+30.00 m.	RS + IG

Note: MS, PC denotes prestressed concrete medium span overpass.

SS, PC and RC denote prestressed concrete and reinforced concrete short span overpass.

IG denotes prestressed concrete I-girder.

RS denotes reinforced concrete slab.

Table 5.1.8-3 Location of Box Underpass

Station	Type	Dimension
KM 7+635	UP, CIP-RC	3.00x3.00m, 2Cells, L= 50.00m.
KM 8+305	UP, CIP-RC	3.00x3.00m, 2Cells, L= 50.00m.
KM 16+190	UP, CIP-RC	3.00x3.00m, 2Cells, L= 50.00m.
KM 29+970	UP, CIP-RC	3.00x3.00m, 2Cells, L= 50.00m.
KM 38+835	UP, CIP-RC	3.00x3.00m, 2Cells, L= 50.00m.
KM 51+660	UP, CIP-RC	3.00x3.00m, 2Cells, L= 50.00m.
KM 76+685	UP, CIP-RC	3.00x3.00m, 2Cells, L= 50.00m.
KM 85+463	UP, CIP-RC	3.00x3.00m, 2Cells, L= 50.00m.
KM 96+629	UP, CIP-RC	3.00x3.00m, 2Cells, L= 50.00m.
KM 4+452 at spur line	UP, CIP-RC	3.00x3.00m, 2Cells, L= 50.00m.

Note: UP, CIP-RC denotes box culvert underpass

5.1.9 Design of Entrance-Exit to Station

- 1) The entrance-exit to station has to connect the surrounding areas i.e. road, parking lot, pick up and drop point.
- 2) The entrance-exit to station should have sufficient area for the passengers and for evacuation in case of emergency.
- 3) The entrance - exit of the station should be easily seen.
- 4) The determining of entrance-exit to station should consider the adjacent buildings, road, passage width, surrounding vacant area and movement direction of the passengers.
- 5) The construction material of entrance-exit to station should harmonize with the station, be durable and easy to maintain.

5.1.10 Signalling and Telecommunication System Design

5.1.10.1 Signalling System

The signalling system of the project was designed as a single track, bi-directional, track circuit block system with continuous 2 or 3 aspect colour light lineside signaling to inform the train drivers to know the route ahead and decide to stop or slow down the speed preparing to stop the train.

5.1.10.2 Telecommunication System

The systems which are specified for this project are followings;

- 1) The data transmission network shall connect the existing data transmission network at Chumphon Central Traffic Control (CTC).
- 2) Telephone System
- 3) Radio Communication System
- 4) Master Clock System
- 5) Power Supply and UPS System
- 6) Interface to SRT Nationwide Communication System in the Future

5.2 Infrastructure Design

5.2.1 Electrical Engineering Design

Electrical Engineering Design includes a number of related tasks as followings;

- Low Voltage Power Distribution.
- Lighting and Electrical systems.
- Emergency lighting and Emergency exit signs.
- Uninterrupted power supply system.
- lightning protection system.
- Grounding system.
- Fire alarm system.
- Power supply for mechanical equipment.
- Public telephone line outlet.
- Emergency Call for the disabled persons.

The electrical load for Type A station = 37.6 KVA and Type B station = 34.2 KVA.

5.2.2 Mechanical Engineering Design

- 1) Air Conditioning and Ventilation System is the split type system.
- 2) Sanitary System includes water supply system, drainage(sewage and ventilation system), rain leader system and wastewater treatment system. Summary of the quantity of water and wastewater for both types of station are 40 cubic meters and 12 cubic meters, respectively.

5.3 Train Operation Plan

5.3.1 Concept for Service Operation Plan as shown in Table 5.3.1-1

5.3.2 Train Formation

- 1) Commuter Train as shown in Table 5.3.2-1.
- 2) Long Haul Train as shown in Table 5.3.2-2.

5.3.3 Train Trip and Timetable Planning

Train Trip and Timetable Planning as shown in Figure 5.3.3-1 to Figure 5.3.3-4. The quantity of rolling stock has been defined based on the number of rolling stocks required for each period as shown in Tables 5.3.3-1

Table 5.3.1-1 Station and Train Services in The Chumphon - Ranong Project

No.	Station	Station Size	Chainage (Km)	Distance between Stations	Type of Service	
					Express	Commuter
0	Chumphon	Big			x	x
1	Khun Krathing	Small	3+688	7.25		x
2	Ban Na(1)	Small	14+067	10.375	x	x
3	Ban Na(2)	Small	22+000	7.575		x
4	Pak Chan	Small	42+950	20.950	x	x
5	Kra Buri	Small	52+900	9.950		x
6	Bang Yai	Small	70+893	17.970		x
7	La-Un	Small	78+869	8.03	x	x
8	Ranong	Big	4+832 (Spur line)	25.234	x	x

Table 5.3.2-1 Train Formation for Commuter Train

Type of Coach	Pass/Car	2025		2034		2044		2054	
		Car	Pass/Train	Car	Pass/Train	Car	Pass/Train	Car	Pass/Train
DMU Cars (seat and standing)	100	4	400	4	400	5	500	6	600

** Designed to have three diesel trains running alternately to serve passengers during rush hours, such as morning and evening.

Table 5.3.2-2 Long Haul Train Formation and Capacity

Type of Coach	Pass/ Car	2025		2034		2044		2054	
		Car	Pass/ Train	Car	Pass/ Train	Car	Pass/ Train	Car	Pass/ Train
1st class day/night	24	1	24	1	24	1	24	1	24
2nd class day/night	40	3	120	3	120	3	120	3	120
2nd seat only	80	5	400	7	560	10	800	11	880
Restaurant car	0	1	0	1	0	1	0	1	0
Total		10	544	12	704	15	944	16	1,024

** Number of passengers/train depend on the train formation

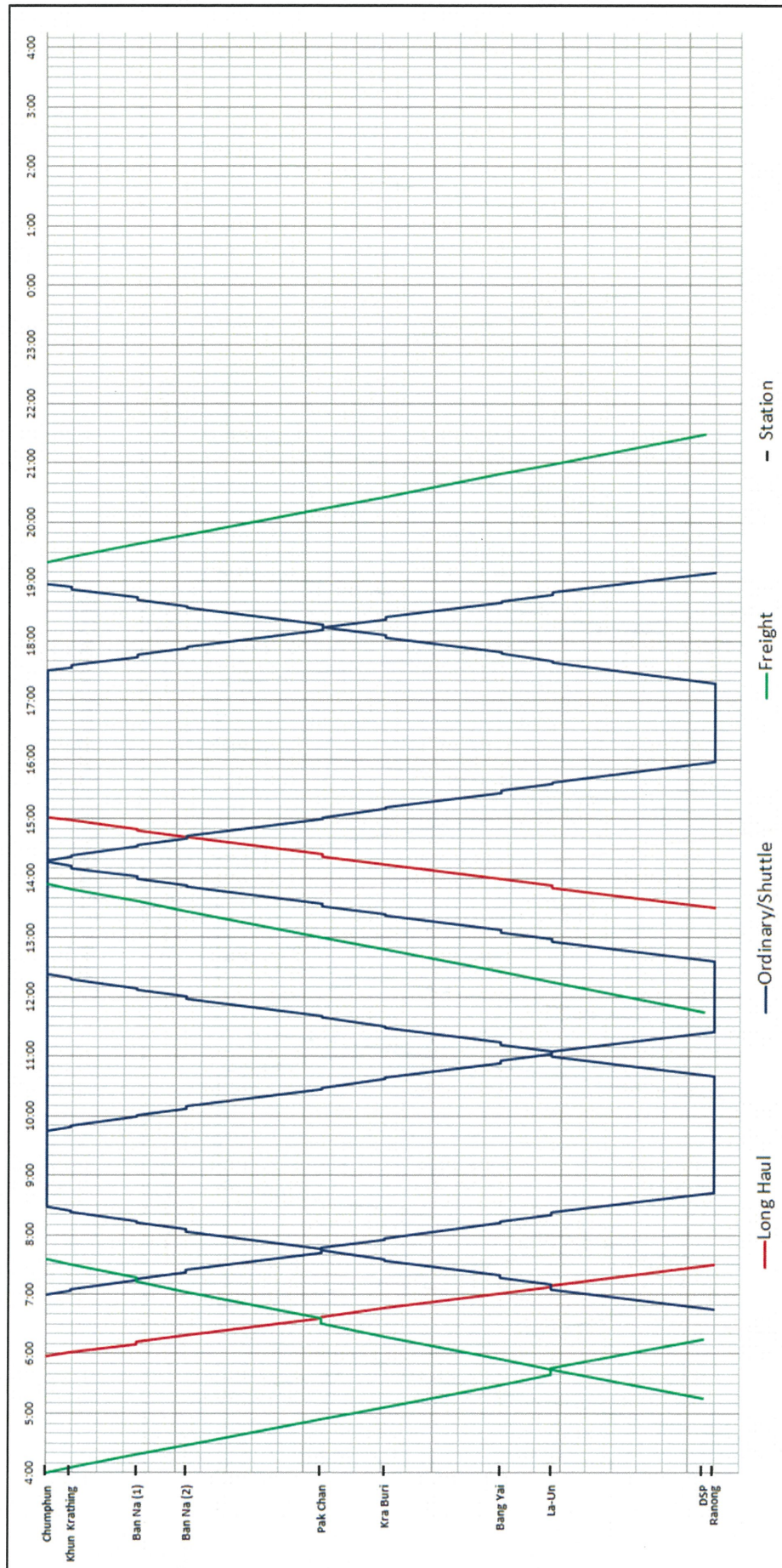


Figure 5.3.3-1 Train Diagram Year 2025

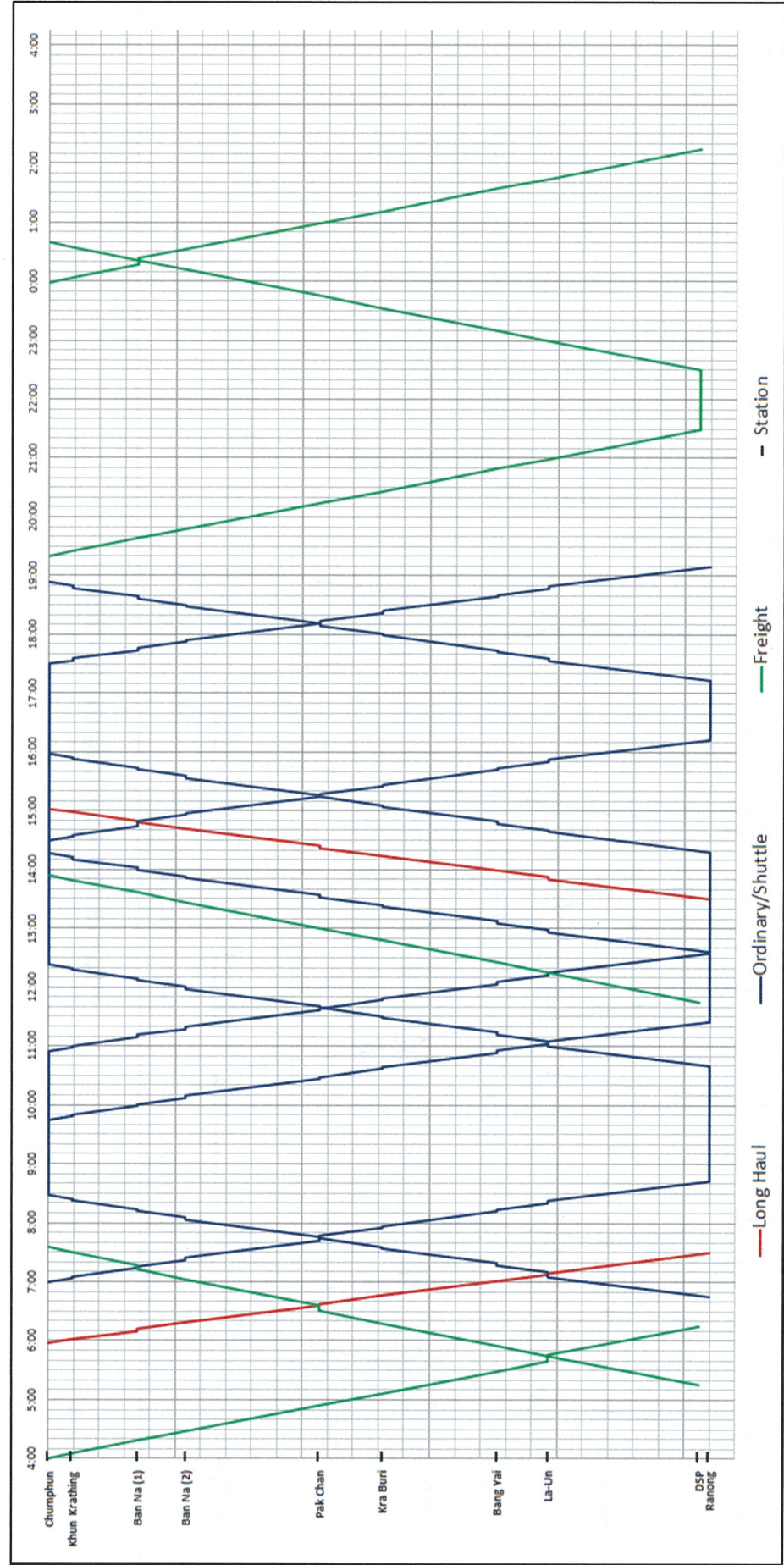


Figure 5.3.3-2 Train Diagram Year 2034

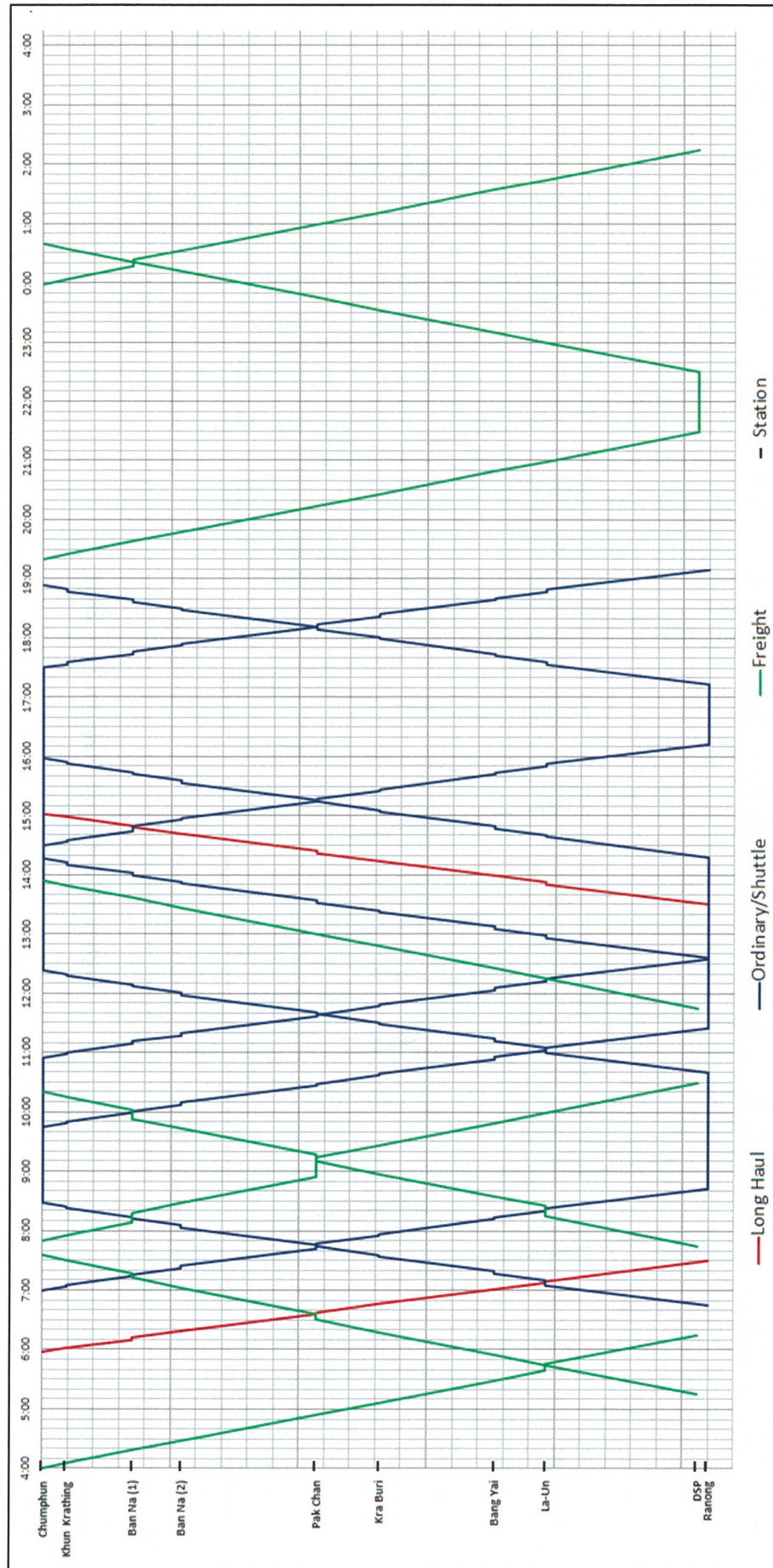


Figure 5.3-3 Train Diagram Year 2044

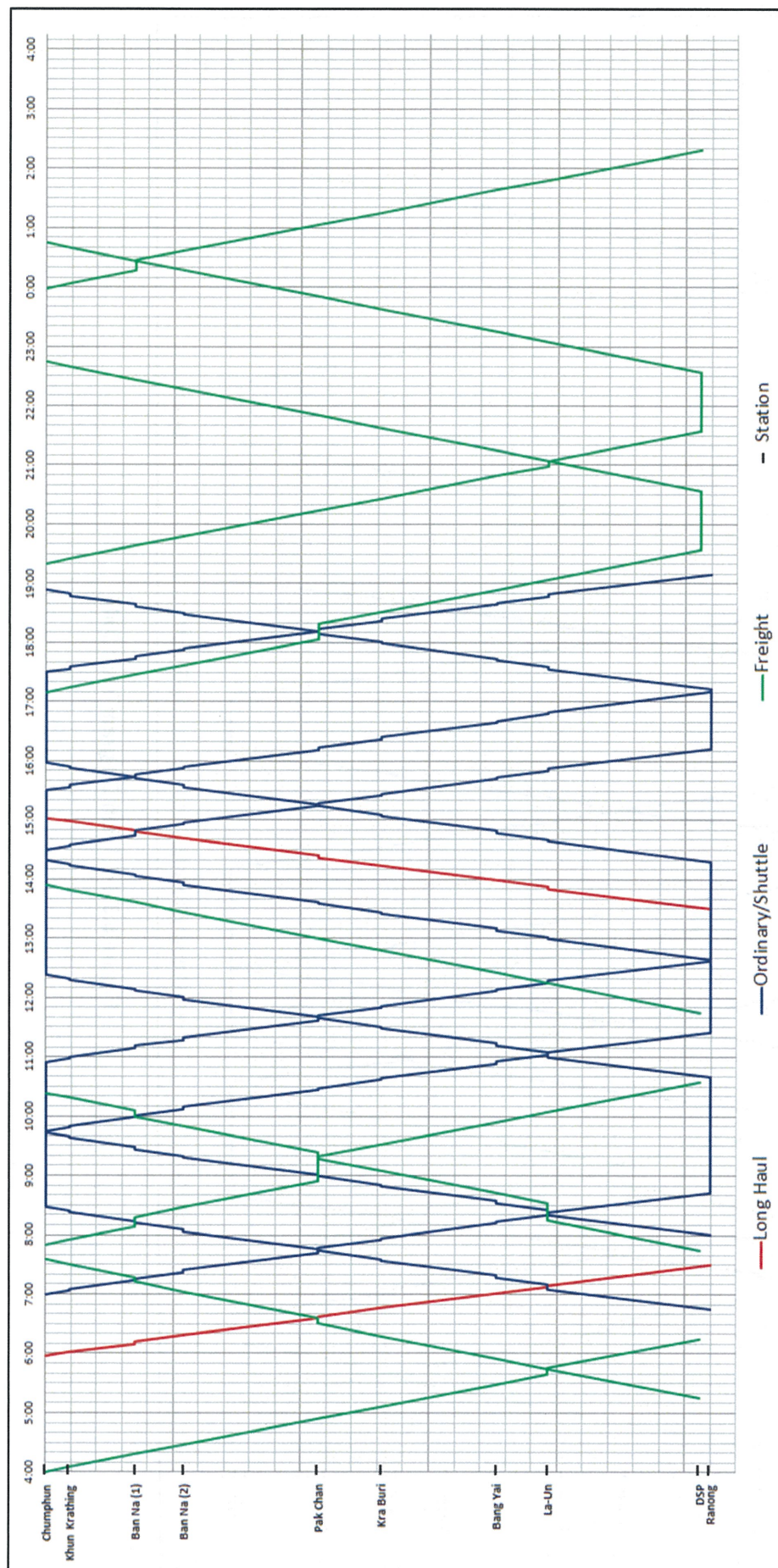


Figure 5.3.3-4 Train Diagram Year 2054

Table 5.3.3-1 Number of Rolling Stocks Required

Type of Rolling Stock	2025	2034	2044	2054
DMU (Car)	12	12	15	18
Locomotive (Passenger Train)	1	1	1	1
Locomotive (Freight Train)	3	4	5	6
Container Wagon	150	194	250	338
Passenger Coach (Car)	10	12	15	16

5.4 The Preparation of Right of Way Plan and Land Acquisition

The preparation of right of way plan and land acquisition is to provide basic information for the estimation of land expropriation cost and compensation cost for buildings. The Consultant has prepared the right of way plan on the same scale as the preliminary design by having the satellite image overlaid the cadastral map to show the cadastral boundary as a background. Then, the land expropriation cost and compensation cost were estimated based on this information. The detailed process is as follows.

5.4.1 Land Expropriation Cost

The land expropriation cost was estimated based on the appraisal cost of each land parcel of the Treasury Department for years 2016-2019. If it cannot be verified, the estimated price from the adjacent land was used for analysis e.g. land adjacent to road, lane and land without access. After multiplying the land area with the unit land price, the result was adjusted 200% for the market price and added 10% for land devaluation. The total amount was then added 20% for litigation and appeal and for budgeting. The compensation cost for perennial trees and crops was estimated 10% of the land expropriation cost.

5.4.2 Building Compensation Cost

The estimating the compensation cost for buildings, the Consultant has classified the types, sizes, materials, number of storeys according to the types and price per square meter of the Treasury Department of March 2017. After estimating the compensation cost, this cost was added 20% for provisional sum (litigation and appeal) and for budgeting.

5.4.3 The Summary of Land Expropriation and Building Compensation Cost

Land in 678 land parcels or 3,840.40 rai shall have to be expropriated consisting of 1) Land that has the title deed or the certificate of utilization (N.S.3K.) 585.07 rai, 2) Royal land 54.80 rai 3) Land declared as a land reform zone under the supervision of the Agricultural Land Reform Office (Sor Por Kor.) 702.02 rai 4) Monastery land 0.62 rai 5) Occupied land 2,498.19 rai. The total land expropriation cost is 1,033.36 Million Baht. For building compensation cost, 254 buildings shall have to be compensated for the amount of 607.00 Million Baht.

The total expropriation cost was estimated at 1,640.36 Million Baht.

5.5 Preliminary Cost Estimation

The preliminary cost is divided into 3 periods; pre-construction period, during construction period and operation period. Details of preliminary cost estimation is shown in **Table 5.5-1**.

Table 5.5-1 Preliminary Cost Estimation

Description	Amount including VAT (Million Baht)
Pre-Construction Period	
1. Design Fee	300
During Construction Period	
1. Land Expropriation Cost	1,640.36
2. Construction Supervision Consultant Fee	692.16
3. Environmental Cost	
3.1 Cost for monitoring of Environmental Quality	29.44
3.2 Cost for Reforestation and Maintenance	14.21
4. Cost for Civil Work	21,548.16
5. Cost for Trackwork	1,859.12
6. Cost for Signaling & Telecommunication System	1,247.71
7. Cost for Rolling Stock	2,191.50
Subtotal : During Construction Period	29,222.66
Operation Period (30 years)	
1. Execution Cost for Train Operation	9,290.66
2. Maintenance Cost	1,894.48
3. Environmental Cost	
3.1 Cost for monitoring of Environmental Quality	10.53
3.2 Cost for maintenance of Reforestation Throughout the Period	65.58
4. Procurement Cost for Additional Rolling Stock	1,244.74
5. Maintenance Cost for Rolling Stock	3,815.36
Subtotal : Operation Period	16,321.35
Total Amount	45,844.01

5.6 Project Implementation Plan

The Consultant has prepared the probable project implementation plan which the project can be operated soonest as shown in **Figure 5.6-1**. This plan was used with other government infrastructure projects on the assumption that the work of each sequence in the plan is smooth, continuous and effective. The sequences are as follows: after the feasibility study project was approved, the SRT will select the Consultant to undertake the detailed design and prepare the environmental impact assessment report (EIA) which will take about 12 months. The SRT will submit the EIA report to the environmental agencies such as the Office of Natural Resources and Environmental Policy and Planning (ONEP) by having the Expert Committee to Consider Environmental Impact Assessment Report initially approved the report, then the report will be submitted to the National Environment Board (NEB) for approval. After approval, the selection process of Contractor could be started. The construction is expected to take about 48 months. During submission the EIA report to the environmental agencies, the SRT will select the Construction Supervision Consultant to review and update the tender documents prior to the engagement of the Contractor which is expected to take at least 12 months. Therefore, the process after the feasibility study till the first day of operation will take approximately 7 years.

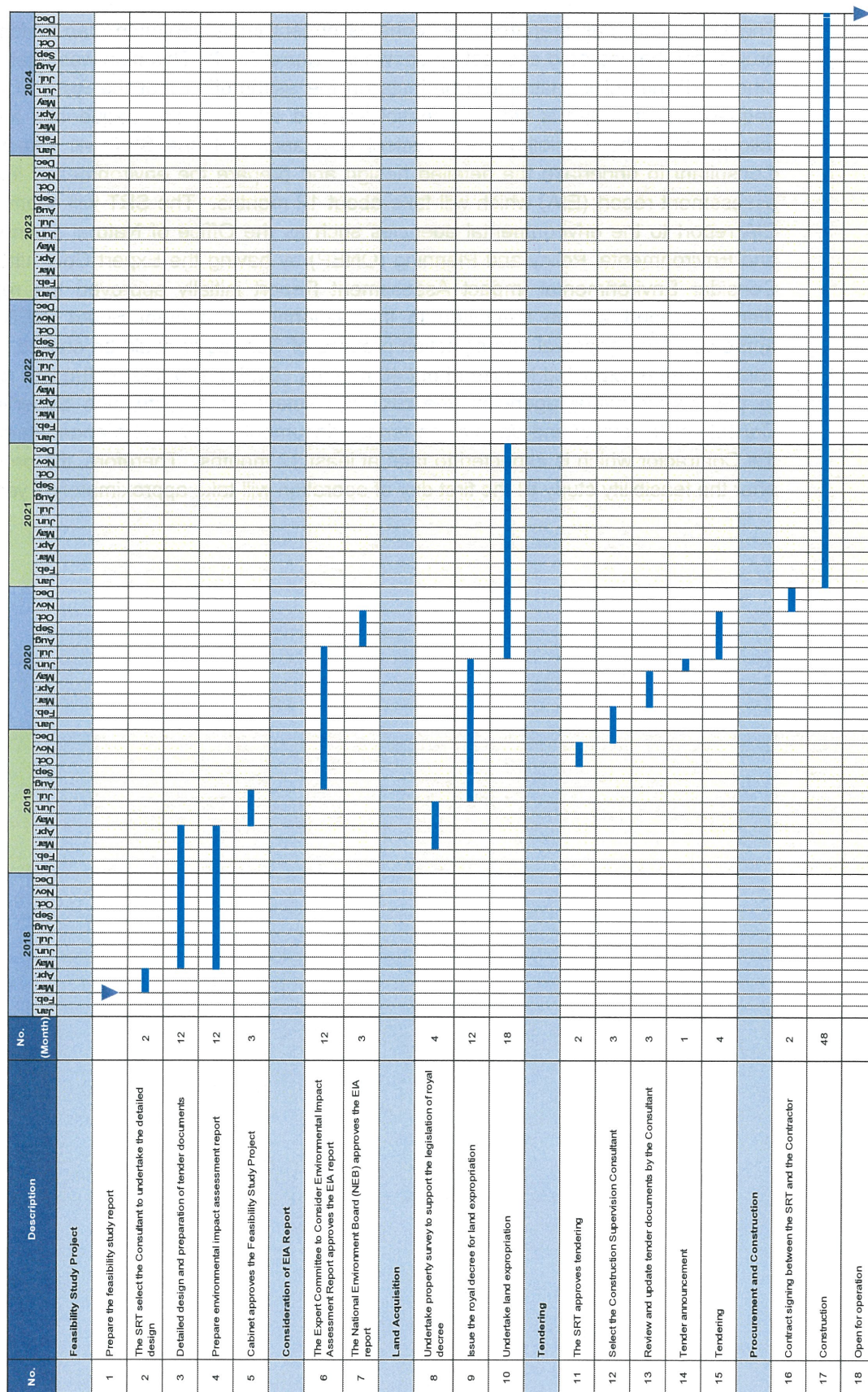


Figure 5.6-1 Project Implementation Plan (for Feasibility Study Project)

Chapter 6

Initial Environmental Examination: IEE

Chapter 6

Initial Environmental Examination: IEE

6.1 Guideline of Environmental Study

The environmental impact assessment is the processes that evaluating the effects that may occur due to development projects in both construction Phase and operation Phase that cover in four areas, which are; physical environmental resources. Biological environmental resources, human use values and quality of life. By proceed accordingly with the guidelines of the Environmental Impact Assessment Division of Natural Resources and Environmental Policy and Planning Office.

6.2 Location of Project and Study Area

Environmental Impact Assessment Study of the Project covers the area along the project route. Cut through and adjacent areas from the center line of the project line (center line) of 500 meters or more, if considered to be affected. It is included in 4 districts and 15 subdistricts of Chumphon and Ranong Province. By developing the project, it is a single track railway with total distance of 109 kilometers. Track structure consists of at grade, elevated and single tunnel. There are 8 new stations excluding the Container Yard (CY) at Ranong Port Station, as shown in **figure 6.2-1**

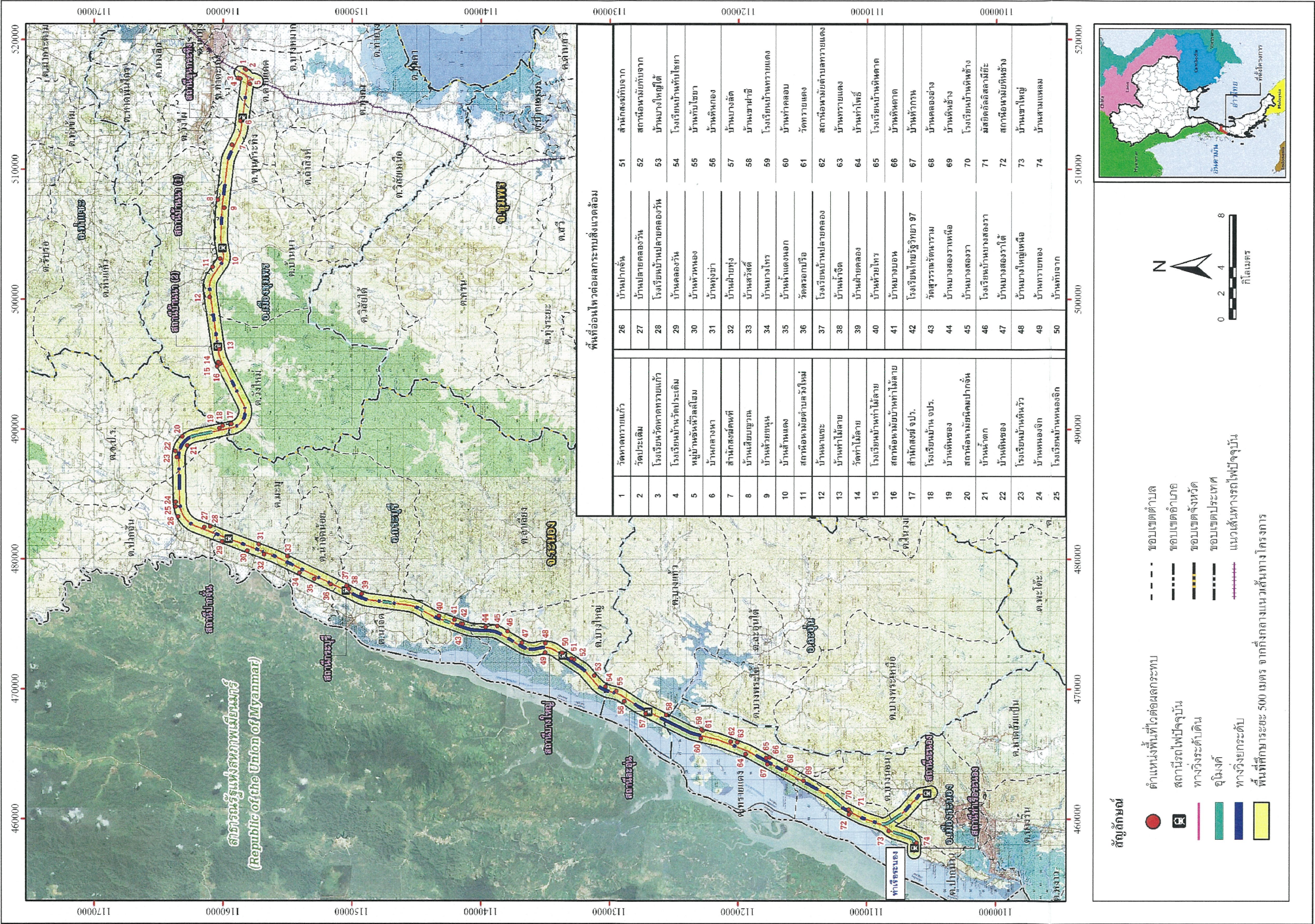


Figure 6.2-1 Project Location and Sensitive Areas

6.3 Result of Initial Environmental Examination

The result of IEE can be summarized that the major environmental impacts of that the New Railway Project for Chumphon Province – Ranong Port include topography, soil resources and soil erosion, surface hydrology, forest, watershed classification, transportation, drainage control and flood prevention, land use, severance and land acquisition and expropriation. The magnitude and direction of environmental impact studies are summarized in **Table 6.3-1 and the details of the evaluation and mitigation measures in each field can be summarized in Table 6.3-2.**

Table 6.3-1 Summary of Magnitude and Direction of Environmental Impacts

No.	Environmental Factors	Environmental Impact			
		Construction Phase		Operation Phase	
		Direction	Magnitude	Direction	Magnitude
1	Topography	-	Moderate	0	0
2	Soil resources and soil erosion	-	Moderate	0	0
3	Geology and Earthquakes	-	Low	0	Low
4	Sub-surface hydrology	-	Low	0	0
5	Surface hydrology	-	Moderate	-	Low
6	Surface Water Quality	-	Low	-	Low
7	Air and Atmosphere	-	Low	-	Low
8	Noise	-	Low	-	Low
9	Vibration	-	Low	-	Low
10	Watershed Classification	-	Moderate	0	0
11	Forest	-	High	0	0
12	Wild Life	-	Moderate	-	Low
13	Aquatic Ecology	-	Low	-	Low
14	Transportation	-	Moderate	+	Moderate
15	Public Utility	-	Low	0	0
16	Drainage control and flood prevention	-	Moderate	0	0
17	Land Use	-	High	+	Low
18	Agriculture	-	Low	-	Low
19	Socio-Economics	-	Low	+	Low
20	Land Acquisition and Expropriation	-	High	0	0
21	Severance	-	Moderate	-	Low
22	Public Health / Occupational Health	-	Low	+	Low
23	Sanitary	-	Low	-	Low
24	Accidents and Safety	-	Low	-	Low
25	Specific area of local community	-	Low	0	0
26	Historic and Archaeology Site	-	Low	-	Low
27	Aesthetic and Tourism	-	Low	+	Low

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
1) Topographic	<p>Construction Phase: The project area along the distance 190 km is across from the coastal plain, low land, hilly and high mountains. The structure design of the railway is mainly at grade/elevated/tunnel. Anyhow the construction is limit only in the ROW of the railway. The alignment design tried to avoid high slopes except for the mountainous area that require tunnel excavation. So, the impact that occurs during the construction period is expected to be moderate.</p> <p>Operation Phase: When construction completed. There will be no change in terrain thus there is no impact on the terrain.</p>	<p>Construction Phase: - Specify the ROW and construction area clearly. And to adjust the area only in the designated area.</p> <p>Operation Phase: -</p>	<p>Construction Phase: -</p> <p>Operation Phase: -</p>
2) Soil resources and soil erosion	<p>Construction Phase: During the construction period, the area will be cleared and open the ground for foundation construction and the soil shall be stock in the construction area. For the tunnel construction sites, a large number of excavations and excavations stock area is required. The construction of the tracks on the ground must be open the soil surface throughout the line. This can cause soil erosion when it is raining. However, the nature of the activity is temporary and limited to the construction area, so the impact is moderate.</p>	<p>Construction Phase: - Important construction activities should be conducted during the dry season such as excavation and site reclamation. - When the area is leveling, the cover crops should be planted in open spaces such as mulch and grass. - Control the materials stockpile in the right place and avoid areas that are easily eroded and should not be stored for too long period.</p>	<p>Construction Phase: -</p>

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
2) Soil resources and soil erosion (cont.)	<p>Operation Phase: In the operation period of the project, the area that had opened their surface will be replaced by the construction. So the soil erosion does not occur. In addition, the surrounding area of the railway station will be landscaped by planting trees and green area arrangement. This allows the beautiful shady to the place and also prevents soil erosion, so it is expected that the project will not affect the soil resources and soil erosion.</p>	<p>Operation Phase: - Take care and maintenance of the ground cover crop along the project route, such as along the embankment and the drainage way in good condition. - Followed the resolution of the Cabinet on November 7, 1989 on the definition of the watershed class in the southern area and recommendations on land use measures.</p>	<p>Operation Phase: -</p>
3) Geology and Earthquakes	<p>Construction Phase/ Operation Phase: The project route is located on the VII Mercury-level of the earthquake risk area, with a highly risk of damage. Active fault is close to the project route namely Ranong fault.</p>	<p>Construction Phase/ Operation Phase: - Structural design of the railways requires AASHTO standards.</p>	<p>Construction Phase/ Operation Phase: -</p>
4) Sub-surface Hydrology	<p>Construction Phase: The area that is expected to be affected by groundwater is the railway tunnel construction area. This may affect the amount of flow direction and groundwater quality. However, the tunnel length is not very long. In addition to the rock layer, the water has less water, so the impact on sub-surface hydrology is low.</p> <p>Operation Phase: Operation period of the project is expected not to affect sub-surface hydrology.</p>	<p>Construction Phase: - To investigate the quantity and quality of groundwater around the construction area of the railway tunnel. - Inspect and maintain construction machinery to prevent the leaks of lubricants and hazardous substances.</p> <p>Operation Phase: -</p>	<p>Construction Phase: -</p> <p>Operation Phase: -</p>

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
5) Surface Hydrology	<p>Construction Phase: Along the railway alignment of project, there are canal and natural water way. Construction activities of the project may hinder the flow and drainage capacity of the river. The impact on surface hydrology is moderate.</p> <p>Operation Phase: The railway of the project will designed to have drainage systems to use as a drain and pass through for those near the railroad. The impact on surface hydrology is low.</p>	<p>Construction Phase: - For areas with flood problems, the contractor must prepare the water pump and the water storage to get water flowing into the drain quickly in case of rain - Set up the complaint center.</p> <p>Operation Phase: - Dredging and weeding at the drainage ditches at least once a year during March - April.</p>	<p>Construction Phase: -</p> <p>Operation Phase: -</p>
6) Surface Water Quality	<p>Construction Phase: The number of canals and streams that the project route intersects passes through 50 places. The potential surface water quality impact during construction may be caused by rainwater that leaks and sludge into the canal. And wastewater contamination from construction workers but in small quantities and temporary impact on construction period only, so it is expected that the impact on surface water quality is low.</p> <p>Operation Phase: Contamination from the Container Yard (CY) caused by using lubricants and hazardous substances from maintenance activities. These may leachate into water resources.</p>	<p>Construction Phase: - Install the mesh to prevent debris from falling beneath the construction site through the water bodies. - Construction of the temporary offices or temporary worker camps must keep a distance of at least 150 meters from the water resources.</p> <p>Operation Phase: - The treated wastewater must be considered for other uses such as watering the trees, washing the roads to reduce water consumption.</p>	<p>Construction Phase: - Program : Monitoring on water quality and aquatic biology 2 times a year (wet and dry period) through construction period. - Parameter : Temperature, pH, DO, BOD, TSS, TDS, Oil & Grease, Conductivity, TCB, FCB, PO₄, NO₃. - Responsibility Unit : Third Party hired by Project owner - Budget : 140,000 baht per time - Location : Klong Chumphon, Klong Lam Liang, Klong La-Un and Klong Bang None</p> <p>Operation Phase: - Program : Monitoring on water quality 2 times a year (wet and dry period) in the first 3 years, and after that the monitoring is conducted every 5 years during project operation. - Parameter : Temperature, pH, DO, BOD, TSS, TDS, Oil & Grease, Conductivity, TCB, FCB, PO₄, NO₃. - Responsibility Unit : Third Party hired by Project owner - Budget : 360,000 baht per time - Location : Klong Chumphon, Klong Lam Liang, Klong La-Un, Klong Bang None, Ranong Railway Station and Ranong Port.</p>

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
7) Air and Atmosphere	<p>Construction Phase: Construction activities Period since the preparation of space, such as demolition of buildings, open soil surface, soil excavation, compaction of soil and sand, compaction, etc. These activities cause the diffusion of dust. In addition the mechanical and vehicles for construction may cause emissions such as dust, carbon monoxide and hydrocarbons. However, due to the condition of the construction site are away from the community and in the wide open agricultural area. It is expected that the spread of dust and air pollution is not so great so the expected impact is low.</p>	<p>Construction Phase: Provide temporary solid fence with a height not less than 2 m, block surrounding the opened soil surface or drilling area. The trucks used for construction materials hauling must be covered with canvas and control the speed of <40 km/h. Provide the wheel washing area to clean before leaving the construction area. Inspection and maintenance of engine equipment to meet the standards of the Department of Land Transport.</p>	<p>Construction Phase: - Program : Monitoring on air quality once a month through construction period - Parameter : TSP, PM₁₀, PM_{2.5}, NO₂, CO, THC and WSWD - Responsibility Unit : Third Party hired by Project owner - Budget : 11,928,000 baht - Location : Wat Pradoem, Ban Plai Khlong Wan School, Sai Daeng Sub-district Health Promoting Hospital and Moo Ban Villa Boutique</p>
	<p>Operation Phase: Implementation of the project is the development of double tracks railway transport. The train uses diesel engines, so it can affect the exhaust emissions by the number of train trips increased and also the exhaust from the vehicle run in/out the station. But because of the route and the railway stations located in the wide open area that can be breathable, bad weather happens is well distributed and can't cause air pollution. So in the overall, it is expected that the project implementation will impact on air quality at the low level.</p>	<p>Operation Phase: - Install the label "Do not start the engine when parking". And announcing the driver to stop the engine if the car parked for a long time especially at the railway station. - Coordinate with local traffic police. To facilitate the reduction of congestion in the project area. Especially the station area. - Establishment of buildings, ventilation control systems and safety equipment. Emergency For the tunnel structure.</p>	<p>Operation Phase: - Program : Monitoring on air quality 2 times a year (wet and dry period) in the first 3 years, and after that the monitoring is conducted every 5 years during. - Parameter : TSP, PM₁₀, NO₂, CO, THC and WSWD - Responsibility Unit : Third Party hired by Project owner - Budget : 540,000 baht - Location : Wat Pradoem, Ban Plai Khlong Wan School, Sai Daeng Sub-district Health Promoting Hospital and Moo Ban Villa Boutique</p>

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
8) Noise	<p>Construction Phase: The noise level generated by the construction activity is from the machinery. The evaluation results of the compared with the standard values still in accordance with the Notification of the National Environmental Board No. 15 (2540 B.E.) which specific the maximum sound level at 115 decibels (A) was found to be no more than a standard threshold. It is expected to be affected low.</p>	<p>Construction Phase:</p> <ul style="list-style-type: none"> - Provide a minimum of 2 m. high solid fences in communities and sensitive areas such as schools, religious sites and hospitals. - Set the time of constructions which generate a loud noise level between 6 am - 6 pm. to avoid public rest. - Provide the community complaint center located near the route. 	<p>Construction Phase:</p> <ul style="list-style-type: none"> - Program : Monitoring on noise level once a month through construction period - Parameter : Leq 1hr., Leq 24hrs., Lmax, L90 and Ldn - Responsibility Unit : Third Party hired by Project owner - Budget : 5,040,000 baht - Location : As same as air quality monitoring.
	<p>Operation Phase: During operation, there will be source of noise from various vehicles. The train run on the railway system i.e.; passenger and freight train including the vehicles coming in/out the station. So the noise level at the station is caused by cars and trains which have a low impact on the community because of the discrete sprint and most stations are located away from the community. While the noise level from the Depot due to maintenance activities may cause noise to the surrounding community thus the impact is considered as low.</p>	<p>Operation Phase:</p> <ul style="list-style-type: none"> - Design of noise reduction materials in various components such as the railway system, the platform area and the train system. - Installing the noise barrier in the required areas adjacent to the project alignment 	<p>Operation Phase:</p> <ul style="list-style-type: none"> - Program : Monitoring on noise level 2 times a year (wet and dry period) in the first 3 years, and after that the monitoring is conducted every 5 years during. - Parameter : Leq 1hr., Leq 24hrs., Lmax, L90 and Ldn - Responsibility Unit : Third Party hired by Project owner - Budget : 4,212,000 baht - Location : As same as air quality monitoring.

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
9) Vibration	<p><u>Construction Phase:</u> Vibration from piling in construction may affect buildings or structures within the construction area and adjacent areas. But such effects will occur in a short time. It is expected that the impact during the construction period is low</p> <p><u>Operation Phase:</u> Service of the project It may affect the community and some important places. But since all the trains ran with discontinuity, vibration occurs in a short period of time. The impact on vibration during the operation period is low.</p>	<p><u>Construction Phase:</u></p> <ul style="list-style-type: none"> - Drilling, pile driving, excavation, hammering and high vibration impact activities should be done during the daytime, do not done at night because it will interfere with the people. <p><u>Operation Phase:</u></p> <ul style="list-style-type: none"> - Monitor vibration levels in areas that are expected to be affected by vibration regularly. - Design of rail systems and types of electric vehicles with low vibration technology. 	<p><u>Construction Phase:</u></p> <ul style="list-style-type: none"> - Program : Monitoring on vibration once a month through construction period - Parameter : Peak Particle Velocity - Responsibility Unit : Third Party hired by Project owner - Budget : 10,080,000 baht - Location : As same as air quality monitoring. <p><u>Operation Phase:</u></p> <ul style="list-style-type: none"> - Program : Monitoring on vibration 2 times a year (wet and dry period) in the first 3 years, and after that the monitoring is conducted every 5 years during operation phase. - Parameter : Peak Particle Velocity - Responsibility Unit : Third Party hired by Project owner - Budget : 1,080,000 baht - Location : As same as air quality monitoring.
10) Watershed Classification	<p><u>Construction Phase:</u> The railway alignment cuts through the upstream area which can divide WSC₁ 1,720 m in length, and WSC₂ 17.78 km in length. The impact is moderate.</p> <p><u>Operation Phase:</u> When construction completed. There will not disturb the land cover of watershed class 1-2.</p>	<p><u>Construction Phase / Operation Phase:</u></p> <ul style="list-style-type: none"> - Followed the resolution of the Cabinet on November 7, 1989 on the definition of the watershed class in the southern area and recommendations on land use measures. 	<p><u>Construction Phase / Operation Phase:</u></p> <ul style="list-style-type: none"> -

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
11) Forest	<p>Construction Phase: Due to the construction area of the project will cause the loss of forest areas in many areas permanently. Classified as 337 rai of mangrove forest and 251 rai of forest land. It is expected that the impact on forest will be high.</p>	<p>Construction Phase: Record the species and number of trees that move out of the construction area. Coordinate with the Royal Forest Department, Natural Resources and the Office of Chumphon and Ranong Province including other associated agencies to impose the construction measures in the vicinity of the National Reserved Forests, the Mangrove Forest and the Watersheds Class 1. Reforestation of both forest and mangroves in accordance with regulations of the Royal Forest Department (251 x 3 = 753 rai) and Department of Marine and Coastal Resources (337 x 20 = 6,740 rai).</p>	<p>Construction Phase: Forest plantation and maintain the seedlings to grow in the 1-2 years.</p>
	<p>Operation Phase: In the operation period, there are no activities that interfere with forest resources and wildlife resources. So it does not affect the ecosystem and the plant society at all.</p>	<p>Operation Phase: Green area or landscaping is added to reduce air pollution and noise pollution. Maintain and decorate the tree branches that are compensated regularly and continuously.</p>	<p>Operation Phase: Continue to replant and maintain the forest. For 30 years</p>
12) Wild Life	<p>Construction Phase: The wildlife that can be found in the project area were mostly small birds. It were moving fast and can be lived in the nearest area. It is expected that the impact on wildlife will be moderate.</p>	<p>Construction Phase: If wildlife is found in the construction site, remove or relocate the wildlife. Hunting wild animals strictly by penalties.</p>	<p>Construction Phase:</p>
	<p>Operation Phase: Because of environment is permanently changed. It may affect the wildlife, but it can adapt to the environment the impact on wildlife will be moderate of the project.</p>	<p>Operation Phase: To maintain the trees and the environment appropriate for the livelihood of wildlife.</p>	<p>Operation Phase:</p>

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
<p>13) Aquatic Ecology</p>	<p><u>Construction Phase:</u> The number of canals and streams that the project route intersects passes through 50 places. The potential aquatic ecology impact during construction may be caused by rainwater that leaks and sludge into the canal. And wastewater contamination from construction workers but in small quantities and temporary impact on construction period only, so it is expected that the impact on surface water quality is low.</p> <p><u>Operation Phase:</u> Waste water is generated within the railway station and Container Yard (CY) may cause the effect the aquatic ecology. To install the sanitary sewage treatment system and discharge water quality standards before drain it to water resources, so it is expected that the impact on aquatic ecology is low.</p>	<p><u>Construction Phase:</u></p> <ul style="list-style-type: none"> - Install the mesh to prevent debris from falling beneath the construction site through the water bodies. - Do not drain the project office and temporary workers' camp into natural water resources. And must treat the wastewater before venting into the water resources. - Construction of the temporary offices or temporary worker camps must keep a distance of at least 150 meters from the water resources. <p><u>Operation Phase:</u></p> <ul style="list-style-type: none"> - Provide sanitary toilets for staff and staff at all railway stations. - The treated wastewater must be considered for other uses such as watering the trees, washing the roads to reduce water consumption. - Control the collection of hazardous materials including used lubricants and contaminated containers in the proper way. 	<p><u>Construction Phase:</u></p> <ul style="list-style-type: none"> - Program : Monitoring on aquatic biology 2 times a year (wet and dry period) through construction period. - Parameter : Plant Plankton, Zoo Plankton and Benthos - Responsibility Unit : Third Party hired by Project owner - Budget : 140,000 baht per time - Location : Klong Chumphon, Klong Lam Liang, Klong La-Un and Klong Bang None <p><u>Operation Phase:</u></p> <ul style="list-style-type: none"> - Program : Monitoring on aquatic biology 2 times a year (wet and dry period) in the first 3 years, and after that the monitoring is conducted every 5 years during project operation. - Parameter : Plant Plankton, Zoo Plankton and Benthos - Responsibility Unit : Third Party hired by Project owner - Budget : 360,000 baht per time - Location : Klong Chumphon, Klong Lam Liang, Klong La-Un, Klong Bang None, Ranong Railway Station and Ranong Port.

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
14) Transportation	<p>Construction Phase:</p> <p>The project will transport the materials by the railway and then transported by car through the highway. This results in more traffic on the road and possibly damage to the road surface. For the underpass/overpass crossing construction at the intersections of railways and roads may result in inconvenience of travel. But people can also use the original crossing to travel between the two sides of the railway. This is a negative impact on the moderate level</p>	<p>Construction Phase:</p> <ul style="list-style-type: none"> - Coordinate with local administration and police station to facilitate construction area. - Install warning signs and lighting signals to alert road users to aware of the vehicles entering and leaving the construction area. - Control the weight and speed of the truck as required by law. 	<p>Construction Phase:</p> <ul style="list-style-type: none"> -
	<p>Operation Phase:</p> <p>When operating the project, this will be the new choice for traveling with the railway system that can save time and secure. The development of more efficient transportations network at the national level, it will alleviate major highway traffic problems especially during the important festivals. In the regional and local level, the road network that connects to the railway station and container yard will make transportation more convenient. This is a positive impact on the highly level.</p>	<p>Operation Phase:</p> <ul style="list-style-type: none"> - Install the label and traffic signs to control the traffic at each station. - Design adequate access entering and leaving the station to minimize traffic congestion on main highways. - Provide staff at the entrance, exit of the railway stations and the container yard. 	<p>Operation Phase:</p> <ul style="list-style-type: none"> -

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
15) Public Utility	<p>Construction Phase: During the construction of railway alignment cut through the community, it is necessary to remove the public utilities, such as electricity poles, telephone lines and plumbing. However, due to the project's activities, the construction time will not be long. This is a negative impact on the low level.</p> <p>Operation Phase: There is no impact on public utilities.</p>	<p>Construction Phase:</p> <ul style="list-style-type: none"> - Inform the construction plan of the project to the local administrative organization along the railway line - Coordinate with responsible agencies such as Provincial Electricity Authority, The Electricity Generating Authority of Thailand, Provincial Waterworks Authority, etc., to inform the operation plan. And jointly set measures to reduce the impact on users of public utilities. <p>Operation Phase:</p> <ul style="list-style-type: none"> - 	<p>Construction Phase:</p> <ul style="list-style-type: none"> -
16) Drainage control and flood prevention	<p>Construction Phase: Construction of the railway project, especially the bridge across the river and drainage systems. The drainage channels have to be drained and the drainage conditions changed. Floods can occur in lowland areas. The impact on land use is expected to be moderate.</p> <p>Operation Phase: There is no impact on drainage control and flood prevention.</p>	<p>Construction Phase:</p> <ul style="list-style-type: none"> - If flooding occurs. Water supply or drainage must be provided from the flooded area. - The drainage system must be designed to be large enough or have a safety factor of more than 1. <p>Operation Phase:</p> <ul style="list-style-type: none"> - To ensure that the drainage of the building is fully utilized. If a defect is found, it must be corrected immediately. 	<p>Construction Phase:</p> <ul style="list-style-type: none"> - <p>Operation Phase:</p> <ul style="list-style-type: none"> -

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
17) Land Use	<p>Construction Phase:</p> <p>Most of construction area located in the forest area, agricultural area, and community areas. The activities in the construction period will only be carried out in the ROW area which changes the use of land to be the railway alignment about 3,840-2-79 rai. The impact on land use is expected to be high</p>	<p>Construction Phase:</p> <ul style="list-style-type: none"> - Control construction activities to be done in the construction area only. 	<p>Construction Phase:</p> <ul style="list-style-type: none"> -
	<p>Operation Phase:</p> <p>There is no change in the land use pattern throughout the route. There is also the development of the road network linking the railway station and the container yard causing the land use high returns such as land use change from agricultural to commercial. The expected impact is a low positive impact.</p>	<p>Operation Phase:</p> <ul style="list-style-type: none"> - Coordinate with the local government and the Department of Public Works and Town Planning to determine land use plans in both directions of the project. To ensure consistency between the expansion of the community and development of utilities to accommodate the population increase. 	<p>Operation Phase:</p> <ul style="list-style-type: none"> -
18) Agriculture	<p>Construction Phase:</p> <p>The construction of the 50 meter railroad project will cut through the various agricultural areas, such as rubber, palm oil and coconut. The loss of agricultural land is not significant compared to the total area of Chumphon and Ranong. The impact on land use is expected to be low.</p>	<p>Construction Phase:</p> <ul style="list-style-type: none"> - If it is necessary to use agricultural land for construction as worker accommodation, material stockpile, office of the construction supervision or temporary road. It should be used after harvesting. 	<p>Construction Phase:</p> <ul style="list-style-type: none"> -
	<p>Operation Phase:</p> <p>The railroad line may block access to agricultural areas and waterways. The expected impact is a low negative impact.</p>	<p>Operation Phase:</p> <ul style="list-style-type: none"> - To control the activities of project which located in the ROW area and station location of the project. 	<p>Operation Phase:</p> <ul style="list-style-type: none"> -

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
19) Socio-Economics	<p>Construction Phase: Construction activities may cause nuisance to the community. The alienate labor problems. The anxiety of traveling on the construction site. Some construction areas may block entrance-exit that effected for those who come to the shop, hospital, school and community. The expected impact is a low positive impact.</p>	<p>Construction Phase: Training and supervision of workers not cause trouble or conflict with the people in the area</p>	<p>Construction Phase: - Program : Survey public opinion every year through construction period. - Parameter : Acknowledgement and opinion to project, and Impact during construction phase. - Responsibility Unit : Third Party hired by Project owner - Budget : 2,000,000 baht - Location : Communities and sensitive areas nearby project area within 500 meter distance of railway.</p>
	<p>Operation Phase: The travel and transportation are flexible, reduce transportation costs and energy and travel safety including growth in tourism. So, the positive impact in the low level.</p>	<p>Operation Phase: Survey the public opinion for the problems arising from the implementation of the project to carry out and correct it appropriately.</p>	<p>Operation Phase: - Program : Survey public opinion every year in the first 5 years, and after that the monitoring is conducted every 5 years during operation phase. - Parameter : Opinion to project and impact during operation phase. - Responsibility Unit : Third Party hired by Project owner - Budget : 4,500,000 baht - Location : Communities and sensitive areas nearby project area within 500 meter distance of railway.</p>
20) Land Acquisition and Expropriation	<p>Construction Phase: The construction areas involve the expropriation of 3,840-2-79 rai of additional land, most of which are forest, rubber plantations and oil palm plantations. Therefore, the effects of expropriation and compensation of property are high.</p>	<p>Construction Phase: Compensation of property must according to the procedures of the relevant law, transparent and fair</p>	<p>Construction Phase: - Including in Socio-Economics monitoring.</p>
	<p>Operation Phase: -</p>	<p>Operation Phase: -</p>	<p>Operation Phase: - Including in Socio-Economics monitoring.</p>

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
21) Severance	<p>Construction Phase:</p> <p>Construction activity in some areas may obstruct the access to housing or lands. It may be caused the inconvenience in communities along the railway. The impact is expected to be moderate</p> <p>Operation Phase:</p> <p>After the construction of the project was completed. Some areas may be affected in terms of ease of access. The project has set the pattern of crossing and crossing to facilitate the commute between the community, such as overpass, service road, underpass, and minor bridge. The impact of operation phase is expected to be low.</p>	<p>Construction Phase:</p> <ul style="list-style-type: none"> - Promote people in the vicinity of the construction site to know the construction plan. - Design the location of underpass and overpass in a suitable place. <p>Operation Phase:</p> <ul style="list-style-type: none"> - To investigate overpass, underpass and minor bridge. 	<p>Construction Phase:</p> <ul style="list-style-type: none"> -
22) Public Health / Occupational	<p>Construction Phase:</p> <p>The communities where located near the construction site may be affected by public health and occupational health during project construction. Because of dust spread noise and vibration. However, due to the project's activities, the construction time will not be long. This is a negative impact on the low level.</p> <p>Operation Phase:</p> <p>During the operation phase will improve the quality of life by the travel to access the hospital. The positive impact of operation phase is expected to be low.</p>	<p>Construction Phase:</p> <ul style="list-style-type: none"> - Implement measures to prevent and reduce environmental impacts in the implementation phase, especially air quality, noise, vibration and water quality. - Provide first aid units and emergency vehicles at the construction site. <p>Operation Phase:</p> <ul style="list-style-type: none"> - Implement measures to prevent and reduce environmental impacts in the implementation phase, especially air quality, noise, vibration and water quality. 	<p>Construction Phase:</p> <ul style="list-style-type: none"> - <p>Operation Phase:</p> <ul style="list-style-type: none"> -

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
23) Sanitary	<p>Construction Phase:</p> <p>During the construction phase Most of the waste is generated. The construction contractor must collect the waste at the waste container. The impact of operation phase is expected to be low.</p>	<p>Construction Phase:</p> <ul style="list-style-type: none"> - Sorting waste that can be reused and waste materials cannot be recycled to reduce the amount of waste to be disposed of. 	<p>Construction Phase:</p> <ul style="list-style-type: none"> -
	<p>Operation Phase:</p> <p>During the project phase waste water and solid waste are generated by the users of the train station. The project has provided sufficient waste water treatment and disposal facilities. The impact of operation phase is expected to be low.</p>	<p>Operation Phase:</p> <ul style="list-style-type: none"> - Set up a suitable bin at the appropriate station or location to match the amount of waste. 	<p>Operation Phase:</p> <ul style="list-style-type: none"> -
24) Accidents and Safety	<p>Construction Phase:</p> <p>Transportation of construction materials And large machining moves are expected to occur during the construction phase may be the risk area. So, it must be careful to reduce the risk of accidents arising from project activities. The impact of construction phase is expected to be low.</p>	<p>Construction Phase:</p> <ul style="list-style-type: none"> - Controlling truck drivers for construction materials to speed up to 40 km / h while driving through the community. - Avoid transporting materials and machinery for construction in rush hour. 	<p>Construction Phase:</p> <ul style="list-style-type: none"> -
	<p>Operation Phase:</p> <p>There is no impact on the operation phase.</p>	<p>Operation Phase:</p> <ul style="list-style-type: none"> - Training the officer to follow the rules to prevent accidents. 	<p>Operation Phase:</p> <ul style="list-style-type: none"> -

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
25) Specific area of local community	<p>Construction Phase: Preparation area Placement of construction materials. Railways are only operated in the railway area, so the impact is expected to be low.</p> <p>Operation Phase: Based on the survey data, there is not important to the community. In the study area, so the impact is expected to be low.</p>	<p>Construction Phase: Strictly follow the vibration measures throughout the construction period.</p> <p>Operation Phase: -</p>	<p>Construction Phase: -</p> <p>Operation Phase: -</p>
	<p>Construction Phase: Project construction may obscure the scenery, the elegance of cultural sites, historic sites and archaeological sites. Because some of these places are close to the route. Activities in the construction phase may effect on vibration, dust and noise, such as Chulachomklao Royal Military Academy Monument, Phra Chayang Cave, and Wat Suthawasdharam. The impact will be a short-term effect so the impact is expected to be low</p> <p>Operation Phase: When construction completed, the impact on historic sites and religious is mainly caused by the noise level, vibrations and dust. Therefore, in the design of the project, measures must be taken to prevent such effects so the impact is expected to be low.</p>	<p>Construction Phase: Use of spun piling and high frequency machinery as well as the trenching for the wave cut off from the source to the receiving point to reduce the effect of vibration. If there are archaeological and historical evidence such as pottery fragments, stone tools, etc., has to stop the activities in that area immediately and notify the responsible agency.</p> <p>Operation Phase: The railway line near historic sites and monuments must be provide the noise barrier to prevent noise pollution, dust and vibration to occur as low as possible</p>	<p>Construction Phase: -</p> <p>Operation Phase: -</p>

Table 6.3-2 Summary of Major Environmental Impacts and Environmental Measures of the New Railway Project for Chumphon – Ranong Port (cont.)

Environmental Factors	Environmental Impacts	Mitigation Measures	Monitoring Measures
27) Aesthetic and Tourism	<p><u>Construction Phase:</u></p> <p>The contractor must keep the areas and construction activities are not dirty, not to be confused and unattractive, it can also hinder travel to access to leisure and tourist attractions. It is expected to have a negative impact on low levels.</p>	<p><u>Construction Phase:</u></p> <ul style="list-style-type: none"> Provide routing as well as signposts for easy access to the recreational and tourist attractions. Specify a condition of the construction contract; the contractor will maintain the cleanliness of the construction site regularly. Implement the complete landscape designed before the project is implemented. 	<p><u>Construction Phase:</u></p> <ul style="list-style-type: none"> -
	<p><u>Operation Phase:</u></p> <p>The railway line of the project will promote direct benefits to tourism. Because it is a beautiful station design and the development of a double track system that makes travelers travel quickly. Can be seen on both sides of the train. It also encourages visitors to visit various attractions and scenic along the project line. It is expected to have a positive impact on the low level.</p>	<p><u>Operation Phase:</u></p> <ul style="list-style-type: none"> Design the bridge buoy structure to thin and in harmony with the surrounding environment and historic sites. Focus on transparency and simple architectural style. Tree maintenance and landscape improvements at various railway stations. It will make the scenery of the project look shady and beautiful. 	<p><u>Operation Phase:</u></p> <ul style="list-style-type: none"> -

Chapter 7

Economic Feasibility Study

Chapter 7

Economic Feasibility Study

7.1 Concepts and Procedures for Analyzing the Economic Feasibility of the Project

The analysis of economic project is intended to assist in the decision making of the relevant authorities whether the new railway route at Chumphon - Ranong Deep Sea Port, should be undertaken. If the results of economic analysis show that the project yields a return on investment, the project is considered economically feasible. In addition, the analysis of economic projects can indicate how the project should be implemented to maximize the benefits to the people.

Analysis of the economic suitability of the project is to study and analyze benefits and disadvantages of the project in view of society and the nation (Social Viewpoint) due to the limited resources available, compared with the benefits expected from the project. That is the analysis of the value of resources use, by comparing between in the case of "with project" and "without the project" with the method "Cost-Benefit Analysis", which this method is generally accepted as the basis for the appropriate reason for the analysis of the project that has an impact on society and the economy as a whole, by consider in terms of improving the efficiency of the transportation network, the benefits are calculated in comparison with the costs incurred by the project throughout the period of analysis, which is calculated as the main economic index as follows:

- (1) NPV: Net Present Value
- (2) EIRR: Economic Internal Rate of Return
- (3) B/C: Benefit Cost Ratio

The consultants have reviewed the economic analysis requirements of the past studies with the same characteristics to determine the assumptions for using in the project study as follows:

- The costs of the project consist of the investment value and maintenance costs for both the train infrastructure and the signal system.
- The benefits of the project consist of the direct benefits such as the cost savings in transportation and indirect benefits affecting the socio-economic system.
- Investment value and expenses will be considered as the value at the current year (2017).
- The fastest assumed year of project launch is the year 2025 with a 30-year project analysis period after the launch year (2025-2054), excluding the construction period. The steps are as follows:

- Feasibility study	1 year	(2017)
- Project detailed design and prepare EIA	1 year	(2018)
- EIA are approved and project approval	1 year	(2019)
- Wait for issuance of decree on land expropriation and ownership	1.5 years	(2020-2021)
- Project construction	3.5 years	(2021-2024)
- Duration of project services	30 years	(2025-2054)

- 12% discount rate (the rate which the World Bank and the Office of the National Economic and Social Development Board have studied the cost of investment in Thailand. Currently, this is the rate used for analyzing public sector projects in many agency, such as the State Railway of Thailand (SRT), the Department of Highways (DOH) and the Office of Transport and Traffic Policy and Planning (OTP), etc.)
- The salvage value of the project will be determined by the infrastructure in the final year of the project. The assumption is to have an average usage is 50 years and the train will have a lifetime of 30 years and will be calculated as a proportion relative to the useful life remaining. The value of land in the final year is determined to be the same value, which will be deducted from the expense at the end of the project analysis period.

7.2 Evaluation of Expenditure on Economic Investment of the Project

Financial costs used in economic assessment consist of investments, operating and maintenance expenses and expenses in accordance with measures to reduce and monitor environmental impacts, which require a multiplier to adjust financial value to economic value (Conversion factor) consist of:

- 1) **Investment value of the project;** it is the result of engineering design because it relates to the form and railway design standards. The investment value of the project is summarized in **Table 7.2-1**.

**Table 7.2-1 Investment Cost of the Railway Construction Project
Chumphon - Ranong Deep Sea Port**

Rank	Item	Financial Value (Million Baht)
1	Consultant fee for detailed design and prepare EIA	300.00
2	Cost for land ownership arrangement and compensation for buildings	1,640.36
3	Construction control cost	692.16
4	Construction cost for civil works	21,548.16
5	Construction cost for the track and signal system	3,106.82
Total		27,287.50

- 2) **Operating and Maintenance Expenses** consist of operating fee and annual maintenance costs, maintenance costs over a specified period of time (Periodic Maintenance), which will be divided into two parts as follows.
 - **Structural & stations maintenance and civil works**
Estimation of operating and maintenance costs consist of the maintenance costs for runways and stations including the other civil works, both annual and scheduled maintenance.
 - **Railway administration and management**
It is divided into two parts: 1) Train procurement estimation 2) Estimation of service and maintenance costs.
- 3) **Environmental costs** will include the plans of environmental impact mitigation plan (EIMP) consist of prevent correct and reduce environmental impacts, which will be implemented during the construction phase including the environmental monitoring plan throughout the project implementation period.

7.3 Economic Benefits of The Project

The project benefits assessment is done by comparing between in the case analysis of "with project" and "without the project, which will indicate the efficiency of the transportation system under various transportation modes, covering both freight (tons-kilometers) and traffic conditions on the overall road network (PCU-Kilometer and PCU-Hour), which will be used for further economic analysis. The economic benefits due to the implementation of the project consist of direct benefits and indirect benefits as follow.

7.3.1 Direct Benefits Assessment

It will consider the transport traffic benefits that occur on all transport networks due to the implementation of the project. The use of rail transport forms is a form of efficient transport, which has low cost and energy consumption and also reduces traffic volume on the road network. In addition when the train is used for travel and transportation more, it will result in reduced pollution (Environmental Cost Saving) because the railway system is more efficient in transport than the road system, making rail transport less polluting than road transport, as well as the train is a form of transport that is more secure than the road. The benefit assessments will cover both the benefits of who switch to rail transport and road users for both freight and travel who will also benefit from streamlined road traffic. Such direct benefits include:

- Saving in Vehicle Operating Costs (VOC)
- Saving in Travel Time (Time Costs)
- Saving in Accident Costs (Accident Costs)
- Savings in Shipping Costs
- Reducing Greenhouse Gas Emissions from Transportation

Analytical results economic direct benefit of the new railway project Chumphon - Ranong Deep Sea Port can be summarized in **Table 7.3.1-1**.

Table 7.3.1-1 Travel Benefits of the Passengers of the Project

Unit: Million Baht

Year	Economic Benefits				Total Economic Benefits
	Saving in VOC	Saving in Time Cost	Saving in Accident Costs	Saving in Emissions from Transportation	
2025	630.71	181.29	23.07	502.39	1,337.46
2034	1,087.87	468.01	37.12	980.63	2,573.63
2044	1,404.66	941.52	47.48	1,254.37	3,648.03
2054	1,673.98	1,189.20	53.91	1,424.29	4,341.38

Source: Consultant

7.3.2 Indirect Benefits Assessment

In addition to the direct benefit, this project railway route is also contributes benefits in other ways to the society and economy in many aspects due to the travel is more convenient and accessible and can set travel time as it does not have to face the traffic density on the road, which is an indirect benefit such as promotion of tourism, stimulating development of study area contributes to urban and community development, promoting trade & investment and improving living standards.

In principles, the economic benefits from development (Developmental Benefits) are the benefits of additional economic activity due to the availability of new infrastructure

investment program; Chumphon - Ranong railway project, there would be more tourism in such areas, resulting in economic benefits from the development. **The Asian Development Bank (ADB, 2013 p. 248-9)** suggest that to avoid counting duplicate benefits (Double-Counting), the economic benefits from development should be estimated with the benefit of newly generated traffic volumes due to the construction of the new railway project, which is included in the analysis and forecast of travel volume.

7.3.3 Freight Benefit Assessment

The freight benefits assessment will be calculated from the saving due to the change of the current transportation route (Via Laem Chabang Port / Bangkok Port) by switching to the railway line project through Ranong Port as shown in **Table 7.3.3-1** consist of:

- The benefits of total cost savings (Freight and time) due to the switching to the railway line project through the Ranong Port will calculate the value of total cost savings in transportation from the difference of the total cost of freight on the current route (Via Laem Chabang Port / Bangkok Port) and the total cost of freight transport by the railway line project through the Ranong Port, multiply by the results of forecasts for container volume in future years, in conclusion as the total cost savings in freight transport by the railway line project through Ranong Port.
- Transport emissions, especially greenhouse gases are an important factor in the global warming that is affecting global change. The reduction of transport emissions resulting from the reduction of private car travel is one of the major economic benefits of the development of mass transit projects, calculated from the difference in amount of carbon dioxide emissions between the case "with" and "without" Chumphon-Ranong railway projects, multiply with carbon price.

Table 7.3.3-1 Benefits of Switching to the Rail Freight by Railway Line Project

Year	Freight benefits (Million Baht)		
	Total cost saving of transportation	Benefit from reducing air pollution	Total
2025	443.03	6.94	449.97
2034	713.43	8.89	722.32
2044	1,128.00	11.42	1,139.42
2054	1,852.34	15.48	1,867.82

Source: Analysis by consultants

7.4 Analysis of Economic Feasibility of the Project

Economic analysis of the project will consider the investment value of the new railway line construction project at Chumphon - Ranong Deep Sea Port, which was compared to the economic benefits expected from the construction of this project throughout the analysis period, is calculated in the main economic index as follows.

Economic analysis of the construction of the new railway route construction project at Chumphon - Ranong Deep Sea Port throughout the 30-year can be summarized as follows.

- Economic Internal Rate of Return (EIRR) = 8.55 %
- Net Present Value (NPV) = -4,507 Million Baht
- Benefit Cost Ratio (B/C) = 0.68

The results of economic analysis, it can be concluded that the new railway route construction project at Chumphon Railway - Ranong Deep Sea Port has no economic suitability when it is constructed concurrently and opened in 2025. This is because the project provides a return on the net present value (NPV) less than zero and returns on the ratio of the present value of the benefit to the cost (Benefit Cost Ratio: B/C Ratio) less than 1 as well as a return on the economic Internal rate of return (EIRR) less than the opportunity cost of the resources in view of the society, which is equal to 12%. However, the consultant has further analyzed that if the project is delayed for another 9 years (2034) after the launch year (2025), resulting in the economic return of the project is 12.19 percent, which exceeds the limit. This is due to the project slowdown, the project will support the increased travel volume throughout the analysis period.

7.5 Sensitivity Analysis

In analyzing and evaluating the economic impact of the project, it is necessary to test the sensitivity of the project that if the value of the investment and / or the benefits of the project have changed due to the various factors as shown in **Table 7.5-1**.

- Test of sensitivity to Traffic and Transportation Predictions, if the passenger volume of new railway route construction project at Chumphon – Ranong Deep Sea Port more than expected, it will increase the estimated benefit by 10-20% or if less than expected, it will less than the estimated 10-20%.
- Test of sensitivity of project investment, If the value of the investment and the cost of the new railway route construction project at Chumphon - Ranong Deep Sea Port have changed in both case of decreased and increased from the estimated 10-20%.

Table 7.5-1 Economic Sensitivity Analysis of the Project

Economic index	Basic case	Change case 10 %			Change case 20%		
		Benefit	Costs and expenses	Benefit and cost	Benefit	Costs and expenses	Benefit and cost
Benefits increases or costs and expense decrease							
EIRR (%)	8.55%	9.35%	9.43%	10.26%	10.09%	10.46%	12.15%
NPV (mil.baht)	-4,507	-3,562	-3,484	-2,166	-2,616	-1,921	175.33
B/C Ratio	0.68	0.74	0.75	0.83	0.81	0.85	1.02
Benefits decreases or costs and expense increase							
EIRR (%)	8.55%	7.72%	7.79%	6.99%	6.82%	7.13%	5.51%
NPV (mil.baht)	-4,507	-5,452	-5,903	-6,848	-6,397	-7,299	-9,189
B/C Ratio	0.68	0.61	0.62	0.55	0.54	0.56	0.45

Source: Consultant

Based on sensitivity analysis, it was found that the economic return of the project when the project is most positively affected is that in the case of a 20% increase in benefits or project costs and expenses decreased by 20% would increase the EIRR to 12.15, this will make the project economically appropriate, which is higher than the set threshold of 12 percent. However, if there is a negative impact, in the case of a 20% decrease in benefits or a 20% increase in project costs, the project will be lower than the threshold and the EIRR will fall to only 5.51.

Chapter 8

Study on Financial Feasibility and Investment Model

Chapter 8

Study on Financial Feasibility and Investment Model

8.1 Guidelines for Financial Feasibility Analysis of the Project

Guidelines and procedures for analyzing the project financial feasibility, as shown in **Figure 8.1-1**.

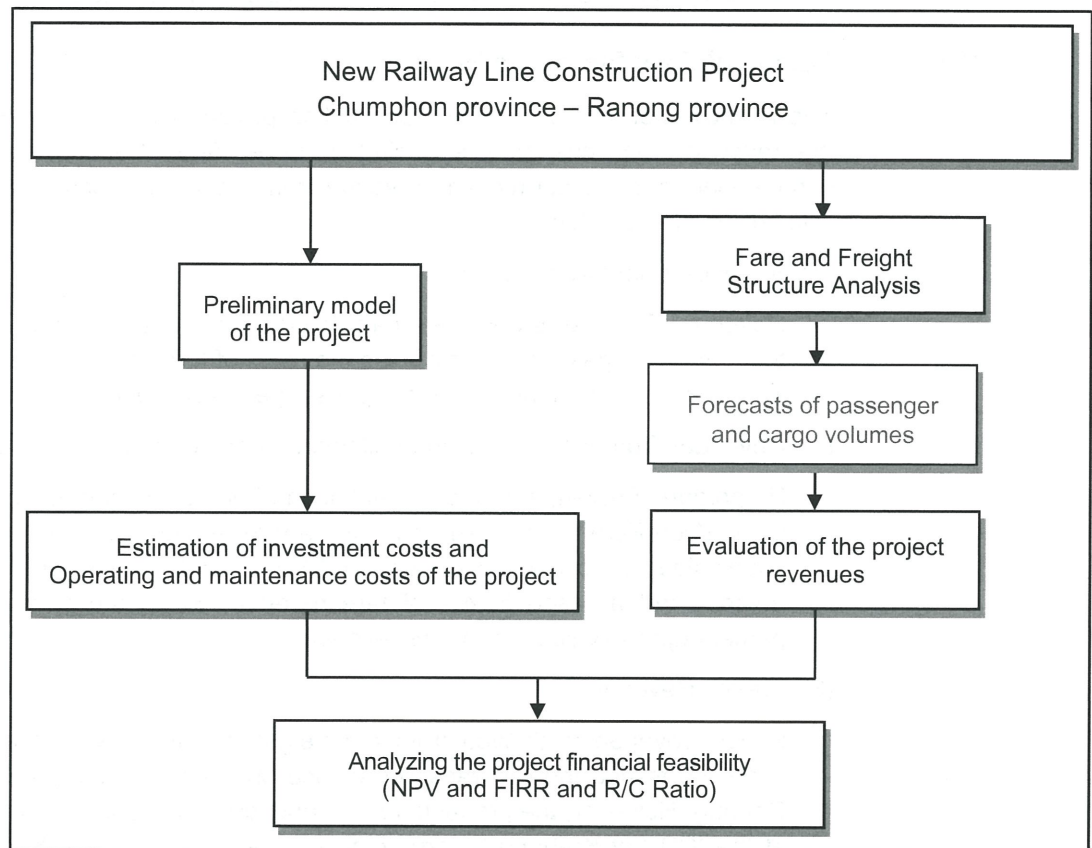


Figure 8.1-1 Guidelines for Financial Feasibility Analysis

The study and financial analysis of the new railway line project in Chumphon Province – Ranong has the financial assumptions are as follows.

- Period of Project Analysis: 30 years
- Discount Rate: 5.0 % per year
- Inflation: 2.5% which will be used to adjust the investment value and expenses incurred to the value and expenses for that year.
- Depreciation is charged in straight line and the salvage value remains at the end of the project analysis period, accounted for proportion of project lifetime.

- The lifetime of the engineering work such as structural work, stations and buildings, etc., scheduled to last for 40 years.
- The lifetime of the S & T Signal System, scheduled to last for 30 years.
- The lifetime of the rail system (Rolling Stock), scheduled to last for 30 years.
- Value Added Tax (VAT) is 7% per year, which is included in the fare and freight rates, if implemented by the state, it will not be responsible for this tax burden.
- Corporate Income Tax (If there is a co-investment), accounted for 20% of net profit per year.
- Weight Average Cost of Capital of private sector (WACC) is 7.71% per year.

8.1.1 Financial Benefits of the Project

The financial benefits of the new railway line project; Chumphon – Ranong consist of the revenue from bus service, including fares, fees, billboard installation fee and commercial space rental fee and revenue from freight services, including freight cost. The details are as follows.

(1) Revenue from fares and fees

Revenues from fares and fees, calculated by using fares & fee rates, multiplied by the number of passengers, by using the rates of fares & fees of the State Railway of Thailand (SRT) and the number of passenger trains each route is forecasted.

(2) Revenues from the installation of billboards and commercial space for rent

Proportion of revenue from the installation of billboards and the lease of commercial land (Non-Fare Revenue) will be approximately 5-15%. According to the "Consolidated Accounting Report" in 2017 of SRT, it was found that the non-fare revenue will average 5.24% of fare revenue, which the consultant will use this percentage to evaluate non-fare revenue.

(3) Freight Revenue

Freight revenue is derived from the freight rate multiply by the products volume expected to use the rail transport service on the new railway project; Chumphon - Ranong. However, the products to be transported to Ranong Port will be considered at the ICD Lat Krabang by arranging special cargo ICD Lat Krabang - Ranong. It has been estimated that the volume of freight to be transported by rail in the future in the form of 20-foot containers.

8.1.2 The Financial Feasibility Analytical Results of the Project

Financial return analysis of new railway line project; Chumphon - Ranong will use cash flow analysis by distributing all revenues and expenditures in the year in which the revenues and expenditures actually occur. Then calculate income and expenses as financial indicators and then compare them with the financial criteria. The financial feasibility analytical results of the project is shown in **Table 8.1.2-1**.

Table 8.1.2-1 The Financial Feasibility Analytical Results of the Project

Financial indicators	Analytical results	Evaluation criteria
NPV	-20,891 mil.baht	NPV > 0
FIRR	2.01%	FIRR* > WACC*
B/C	0.39	B/C > 1

Source: Consultants, 2017

Note: * The WACC is 7.71%

New railway line project in Chumphon - Ranong is no financial suitability due to it requires a high investment, but because it is a public project, the project cannot collect fares, fees and freight that reflect actual project costs.

8.2 Models of Co-Investment between Public and Private Sector

Analysis of the suitability of models of co-investment between public and private sector will consider only the passenger train section. The roles and responsibilities of each party will be differentiated according to the three possible models of co-investment, as shown in **Table 8.2-1**.

Table 8.2-1 Possible Investment Models

Model	Investment			Management		
	Infrastructure	Signal system	Train	Maintenance	Management of train service	Revenue collection
1	SRT					
2	Public		SRT			
3	Public		<ul style="list-style-type: none"> - Private: train procurement, maintenance and management of the train including all of revenue collection. If the performance is greater than the threshold (FIRR = 8%), it must pay excess revenue to SRT. - SRT: Infrastructure maintenance and management 			

Source: Consultants, 2017

Model 1 is the same model used to analyze the financial feasibility of the project, which SRT is responsible for all of project. Models 2 and 3, the state will participate in investment in infrastructure and signaling systems. Model 3, Private sector will participate in the train investment as well as the management and maintenance related to all train operation. The rest, SRT will be responsible.

In studying the investment models, only possible routes in practice will be considered. By models 1 and 2, SRT is provider of train operation, the route of passenger train will consider the long line route between Bangkok – Ranong and the short line route between Chumphon and Ranong and the freight train will consider the route between ICD Lat Krabang - Ranong. Meanwhile, the model 3 that gives the private sector a role in providing the passenger train and freight train services, the route of passenger train will consider the short line route between Chumphon and Ranong only and the freight train will consider the route between ICD Lat Krabang - Ranong.

8.2.1 The Financial Feasibility Analytical Results of Investment Model 1

For the investment model 1, SRT is responsible for cost and all expenses incurred, which consist of land expropriation fee and compensation for private property, civil infrastructure, signal system, rolling stock, including the expenditures at service time, which consist of management & maintenance costs of infrastructure and train and environmental protection measures. All revenues will be collected by SRT, which consist of fares, fee, freight, the installation of advertising media and commercial space rental. However, the investment in this format will make the SRT not get the worthy financial return, which shows through financial indicators that do not pass the evaluation criteria all indexes, as shown in **Table 8.2.1-1**.

Table 8.2.1-1 Financial Return of Investment Model 1 (All investments by SRT)

Financial indicators	Financial return analytical results
	SRT**
NPV (mil.baht)	-20,891
FIRR (%)	2.01*
B/C	0.39

Source: Consultants, 2017

Note: * Due to the pattern of net cash flow is positive and negative alternately, cause the problem of Multiple IRRs or Saddle Points, which makes it cannot find the correct FIRR. The consultants use the Modified IRR (MIRR) instead

** The investment model 1 covers the passenger train 2 routes: Bangkok – Ranong and Chumphon - Ranong and the freight train 1 route: ICD Lat Krabang - Ranong.

Summary of investment model 1, the state will get a financial return that is not worth.

8.2.2 The Financial Feasibility Analytical Results of Investment Model 2

For the investment model 2, private sector has no role in this investment model, but the government will take part in investing in the fundamental factor of the project, which consist of land expropriation fee and compensation for private property, civil infrastructure, signal system, the SRT is responsible for the rolling stock including the expenditures at service time, which consist of management & maintenance costs of infrastructure and train and environmental protection measures. All revenues will be collected by SRT, as shown in **Table 8.2.2-1**.

**Table 8.2.2-1 Financial Return of Investment Model 2
(State support the infrastructure and signaling system)**

Financial indicators	Financial return analytical results
	SRT
NPV (mil.baht)	1,409
FIRR (%)	9.87
B/C	1.12

Source: Consultants, 2017

Note: The investment model 2 covers the passenger train 2 routes: Bangkok – Ranong and Chumphon - Ranong and the freight train 1 route: ICD Lat Krabang - Ranong.

The results of the financial evaluation based on governmental criteria found that the SRT receiving the worthy financial return because the FIRR is 9.87%, which is higher than the long-term government bond yield with a value of 3.15%. In addition, the NPV is 1,409 million baht, which is greater than zero and B / C is 1.12, which is more than one.

8.2.3 The Financial Feasibility Analytical Results of Investment Model 3

For the investment model 3, the government will take part in investing in the fundamental factor of the project, which consist of land expropriation fee and compensation for private property, civil infrastructure, signal system, SRT is responsible for the management & maintenance costs of infrastructure and the environment. In this investment model, the private sector will invest in the passenger and freight trains, including the management & maintenance costs of the train and the passenger & freight trains operation. The private sector will collect all revenues from fares, fees and freight and will pay back to SRT if the private sector has a financial internal rate of return (FIRR) higher than 8%, as shown in **Table 8.2.3-1**.

Table 8.2.3-1 Financial Return of Investment Model 3 (Private sector will invest in train)

Financial indicators	Financial return analytical results	
	Passenger train*	Freight train*
NPV (mil.baht)	-21	-692
FIRR (%)	7.73	2.76**
B/C	0.98	0.81

Source: Consultants, 2017

Note: * The investment model 3 covers the passenger train 1 route: Chumphon - Ranong and the freight train 1 route: ICD Lat Krabang - Ranong

** Due to the pattern of net cash flow is positive and negative alternately, cause the problem of Multiple IRRs or Saddle Points, which makes it cannot find the correct FIRR. The consultants use the Modified IRR (MIRR) instead.

From the results of the study, private who operate passengers train will receive higher returns than private who operate freight train, even though they have a negative NPV. However, when considering the internal rate of return, it is found that private who operate passengers train will obtain FIRR at 7.73%, which is higher than the weighted average cost of capital (WACC), which is 7.71%. The FIRR of the private who operate the freight train is only 2.76%. Therefore, the participation of private sector in investment, there is a possibility for operating passenger trains only.

Chapter 9

Process of Creating People Perception and People Participation

Chapter 9

Process of Creating People Perception and People Participation

9.1 Introduction

Implementation of Feasibility Study of Economics, Engineering and Environment on the New Railway from Chumphon Province to Ranong Deep Sea Port. This is a government project that may have an impact on natural resources and environmental quality that requires a process of public participation since the beginning of the project to the public and all stakeholders to know the project information properly and adequately. And also have the opportunity to exchange ideas and provide feedback on project development lead to decision making in various stages of the project carefully in order to get the project has been recognized by the people, the local community and all parties involved.

9.2 Target Areas

The public participation targeted areas focused on the areas along the railway alignment from Chumphon Province to Ranong Deep Sea Port and nearby, which, as shown **table 9.2-1**

Table 9.2-1 Target Areas

Province	District	Sub-District	Local Administrative Organization
Chumphon	Muang Chumphon	Khun Krating Tak Daet	Khun Krating Subdistrict Municipality Tak Daet Subdistrict Administrative Organization
		Ban Na Wang Mai	Ban Na Subdistrict Administrative Organization Wang Mai Subdistrict Municipality
Ranong	Kra Buri	Jor Por Lor Nam Chuet Nam Chuet Noi	Jor Por Lor Subdistrict Municipality Nam Chuet Subdistrict Municipality Nam Chuet Noi Subdistrict Administrative Organization
		Bang Yai	Bang Yai Subdistrict Administrative Organization
		Pak Chan	Pak Chan Subdistrict Administrative Organization
		Ma Mu Lam Liang	Ma Mu Subdistrict Administrative Organization Lam Liang Subdistrict Administrative Organization
	La-un	Bang Kaew	Bang Kaew Subdistrict Administrative Organization
	Muang Ranong	Sai Daeng	Sai Daeng Subdistrict Administrative Organization
		Pak Nam Bang Non	Pak Nam Subdistrict Municipality Bang Non Subdistrict Municipality

9.3 Work Plan for People Participation and Public Relation

The activities of people participation and public relation for the project has been conducted since the beginning of the project (May, 2017) to date (February, 2018) throughout the study period. Summarizing the activities and implementation of public participation in **Table 9.3-1**

Table 9.3-1 Summarize of People Participation and Public Relation Work Plans

Activities	Date/Venue	Objectives	No. of Participants
1. Meetings with the local government officials			
Visiting officials, government agencies, provincial and districts level of Chumphon and Ranong Province	May – September 2017	<ul style="list-style-type: none"> To inform the background, objectives and implementation guidelines of the project. Including a comment on the route selection of the project. 	14
2. Project Seminar			
2.1 Public Participation Meeting 1 st (Project Orientation)	13 July 2017, 08.30 AM.-12.00 PM. at Pud Pitchaya Room, Nanaburi Hotel, Mueang Chumphon District, Chumphon Province	<ul style="list-style-type: none"> To introduce and clarify background information of the project including the rationale for the development of the project as well as important guidelines and procedures. To hear feedback and suggestions from attendees about the study and development planning and to determine the route selection. Including important issues that may arise from the development and recommendations and issues that should be cautious or important in the study. 	100
	14 July 2017, 08.30 AM.-12.00 PM. at Ruangraj Room, Tinidee at Ranong Hotel, Mueang Ranong District, Ranong Province		121
2.2 Public Participation Meeting 2 nd (Summary of Route Selection)	9 November 2017, 08.30 AM.-12.00 PM. at Pud Pitchaya Room, Nanaburi Hotel, Mueang Chumphon District, Chumphon Province		104
	10 November 2017, 08.30 AM.-12.00 PM. at Ruangraj Room, Tinidee at Ranong Hotel, Mueang Ranong District, Ranong Province		106

Table 9.3-1 Summarize of People Participation and Public Relation Work Plans. (cont.)

Activities	Date/Venue	Objectives	No. of Participants
2.3 Meeting of Focus Group	<u>1st meeting at Chumphon Province</u>	<ul style="list-style-type: none"> To introduce the project and inform the background of the project. Including reasons for the project development as well as important guidelines and procedures of the study. To hear the feedback and suggestions from attendees about the project study and development plan, route selection including important issues that may arise from the development. Also the recommendations and issues that should be cautious or important in the study area, the ways to deal with expected problems to occur in the area. 	54
	<ul style="list-style-type: none"> Group 1st on 29 November 2017, 09.00 AM.-12.00 PM. at Tak Daet Subdistrict Administrative Organization Meeting Room Group 2nd on 29 November 2017, 14.00 PM.-16.30 PM. at Wang Mai Subdistrict Municipality Meeting Room 		158
	<u>2nd meeting at Ranong Province</u>		82
	<ul style="list-style-type: none"> Group 1st on 30 November 2017, 09.00 AM.-12.00 PM. at Kra Buri Vocational College Meeting Room Group 2nd on 30 November 2017, 14.00 PM.-16.30 PM. at Bang Kaew Subdistrict Administrative Organization Meeting Room Group 3rd on 1 December 2017, 09.00 AM.-12.00 PM. at Ranong Municipality Office Meeting Room 		43
2.4 Public Participation Meeting 3 rd (Summary of Project Results)	<ul style="list-style-type: none"> 1 February 2018, 08.30 AM.-12.00 PM. at Pud Pitchaya Room, Nanaburi Hotel, Mueang Chumphon District, Chumphon Province 	<ul style="list-style-type: none"> To inform the study results on the detailed design of the project, route alignment, typical and composition of the project. To inform the results of the environmental impact study including measures to deal with the expected impact. To hear feedback and suggestions from attendees. This will be considered for further improvement, recommendations, measures to address the impact in the IEE report, as well as to improve the feasibility study. And as a guideline for further design of the project. 	89
	<ul style="list-style-type: none"> 2 February 2018, 08.30 AM.-12.00 PM. at Ruangraj Room, Tinidee at Ranong Hotel, Mueang Ranong District, Ranong Province 		113

9.4 Result of the Activities of People Participation and Public Relation

By the conducting of People participation and public relation has collected the comments and suggestions for improvement the feasibility study, preliminary design and initial impact examination, as shown in **Table 9.4-1**

Table 9.4-1 Suspicious issues and recommendations from the public participation

Comments / Suggestions	Improvement of the study results
1. Engineering	
1.1 Criteria and procedures for the route selection	Consultant has considered the terrain, avoiding the conservation area, and the ability to connect to the communications network. Then, To propose the 4 routes for route selection by the scoring method or Multi-Attribute Utility Theory (MAUT). The key factors consists of economic and investment aspect, engineering factors, and environmental and social impact factors. It also has the project's committee that includes the representatives from relevant agencies, such as OTP, SRT DOH and ONEP to review and comment on the implementation of the study under the scope of work to hire a consultant (Terms of Reference: TOR).

Table 9.4-1 Suspicious issues and recommendations from the public participation (cont.)

Comments / Suggestions	Improvement of the study results
1. Engineering (cont.)	
1.2 The study and design of the railway station of project, local architectural patterns should be integrated for designing the railway station where can be promoted as the new landmark of Chomphon and Ranong Province	1.2 The design of the project's railway stations will determine the location, utility area, and to connect the transport network. It also considers buildings and structures of historic places of Chumphon and Ranong Province, such as Krom Luang Chumphon Khet Udomsak Royal Palace and Rattanaungsan Throne Hall. The new railway station should be the sceneric place and landmark Chomphon and Ranong Province.
1.3 Providing facilities and services to passengers, including the tourist, the disabled and the elderly.	1.3 The consultants have designed various facilities. The railway station is consistent with the use of space within the station. Including designs for all types of users or Universal Design.
1.4 Because of Chumphon and Ranong Province has a high rainfall. Therefore, the design of the railway route of project must not obstruct the flow and natural drainage in the area	1.4 The design of drainage systems throughout the project alignment has considered the catchment area, rainfall and drainage direction, the return period of 100 years to prevent the flooding problems on both sides of the railway. It also provides the measures to reduce the drainage effects in lowland areas where floods have been affected.
1.5 The railway alignment should be avoided at the railway lines used during World War II to conserve historic rail lines	1.5 Studying the project alignment has considered the data of railway line that used in the World War II from the Fine Arts Department. It consists in the design of the railway and the location of the railway station for supporting the tourism of Ranong Province
1.6 To propose the using of rubber as the construction material for the project	1.6 Consultants to consider this request and propose to the detailed design.
2. Economics, Finance and Investment	
2.1 If developing the project, it will result in better transportation and traveling by railway. And what if can connect the route project to Ranong Airport, it will promote the rail transport and support tourism in Chumphon and Ranong	2.1 Consultants to consider this request and propose to the detailed design.
2.2 Consideration of connecting the railway route from Ranong to Phang Nga and Phuket province	2.2 Consultants to consider this request and propose to the detailed design.
2.3 To Consider indirect benefits to support future construction projects. From the result of freight forecasts of Ranong Deep Sea Port has shown that it will not be feasibility in the long term	2.3 Potential for tourism of Chumphon and Ranong will support the project such as, expenditure of tourists, urban development around the railway station that can make the indirect benefit and rewards the feasibility.
2.4 The details of sources of budget used in project construction and project investment.	2.4 The State Railway of Thailand will be the owner of the project. The source of the project budget may come from the government and the private sector that must consistent of the study of private partnership investment

Table 9.4-1 Suspicious issues and recommendations from the public participation (cont.)

Comments / Suggestions	Improvement of the study results
3. Environmental and Social Impacts	
3.1 To consider the impact and measures for security of community, social impacts, and of the people along the project alignment.	3.1 Measures to prevent and monitor the environmental impacts will be given in IEE report. These issues will study more details on EIA report preparation.
3.2 Because of the most area in Ranong province is protected areas and unspecified certificate of ownership. The project should consider setting the measures to prevent and release the effects of land expropriation.	3.2 The project owner must comply with the expropriation law.
3.3 During construction phase may cause the noise, dust and vibration effects especially sensitive areas.	3.3 Measures to prevent and monitor the environmental impacts where located within 500 meters of the project alignment will be proposed in IEE report. This issue will be studying on EIA report.
3.4 Asking for set up the complaints center about the impact of the project.	3.4 The mitigation plan will be proposed by the project owner. Including the contact number of the agency, the project owner and the contractor. And also setting up the Complaints center to be filed and contacted 24 hours a day.
4. People Participation	
4.1 The project should pay more attention of the opinions of the people fully and around. Especially those who are affected by the expropriation.	4.1 From the result of the study project, it is not possible to identify the properties plan and the owners who are expected to be affected by land expropriation. Detailed design and environmental impact assessment (EIA) reports will give the data which can identify the properties plan and invite the owners to listen to information and comment.
4.2 To consider the activities and public relation of project's information.	4.2 Consultants to consider this request and propose to the next step of study.
5. Others	
5.1 To give detail of project implementation plan.	5.1 When the feasibility study, preliminary design and IEE report has been completed, the next step is to study of detailed design and Environmental Impact Assessment (EIA) reports for one year, and then is to consider and propose the project for approval process about 1-2 year. Finally, when the project has been approved, the construction period will take about 3.5 years and ready for operation.

9.5 Summary of Public Relations

Public relations to disseminate the project information systematically and continuously will support the people concerned. Including of the public to generally knowledgeable, understanding the project. And they are ready to participate in the comments and suggestions that are beneficial to the project in succession. In the study stage, the consultant has conducted the preparation of media relations to distribute information and progress of project study to the public comprise of 3 fact sheets, 3 brochures, 4 project publicity boards, 1 videos and the project website. (www.chumphon-ranongrailway.com) There is also public relations through mass media such as printing media, radio and television, by providing press releases to disseminate the progress of project implementation.



โครงการพัฒนาระบบรางความเร็วสูงตามทางรถไฟเดิม จังหวัดฉะเชิงเทรา และจังหวัดชลบุรี
เส้นทางรถไฟชุมพร-ท่าเรือน้ำลึกระยอง

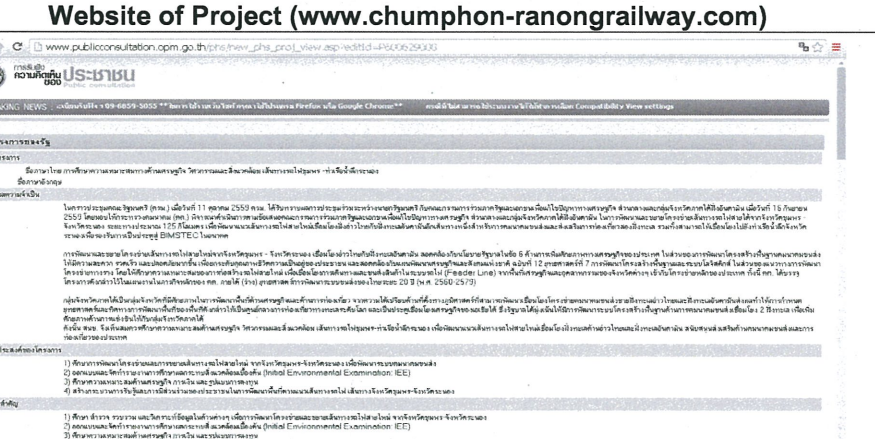
ความจำเป็นโครงการ

การพัฒนาและขยายโครงข่ายระบบรางรถไฟความเร็วสูงตามทางรถไฟเดิม จังหวัดฉะเชิงเทรา และจังหวัดชลบุรี เป็นโครงการพัฒนาระบบรางที่มีความสำคัญและมีความจำเป็นต่อการพัฒนาเศรษฐกิจ สังคม และคุณภาพชีวิตของประชาชนในพื้นที่โครงการฯ โดยเฉพาะอย่างยิ่งในด้านการขนส่งสินค้าและบุคลากร ซึ่งจะช่วยลดต้นทุนการขนส่งและเพิ่มขีดความสามารถในการแข่งขันของภาคอุตสาหกรรมและภาคบริการได้อย่างมีประสิทธิภาพ

วัตถุประสงค์

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- พัฒนาระบบรางความเร็วสูงตามทางรถไฟเดิม
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- พัฒนาระบบรางความเร็วสูงตามทางรถไฟเดิม

Website of Project (www.chumphon-ranongrailway.com)



www.publicconsultation.opm.go.th/preview.php?proj_view.asp&id=4600629000

โครงการพัฒนาระบบรางความเร็วสูงตามทางรถไฟเดิม จังหวัดฉะเชิงเทรา และจังหวัดชลบุรี
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Website of Office of the Prime Minister (www.publicconsultation.opm.go.th)



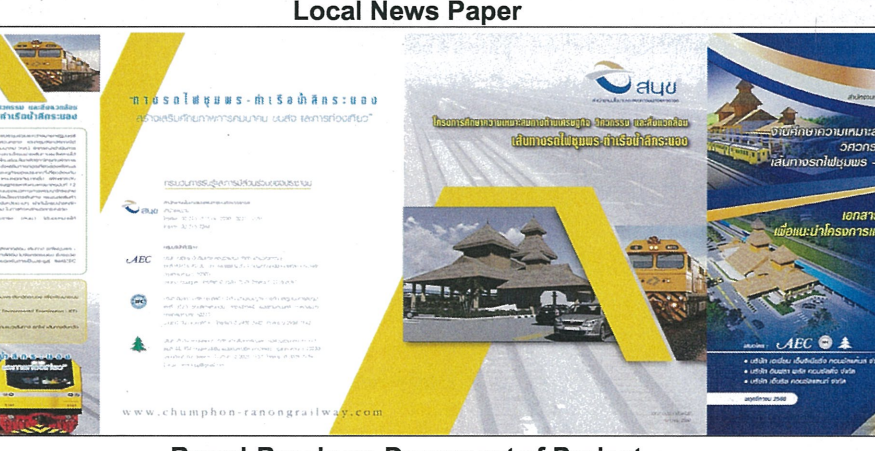
“เส้นทางรถไฟชุมพร-ท่าเรือน้ำลึกระยอง”

เป็นโครงการพัฒนาระบบรางที่มีความสำคัญและมีความจำเป็นต่อการพัฒนาเศรษฐกิจ สังคม และคุณภาพชีวิตของประชาชนในพื้นที่โครงการฯ โดยเฉพาะอย่างยิ่งในด้านการขนส่งสินค้าและบุคลากร ซึ่งจะช่วยลดต้นทุนการขนส่งและเพิ่มขีดความสามารถในการแข่งขันของภาคอุตสาหกรรมและภาคบริการได้อย่างมีประสิทธิภาพ

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- พัฒนาระบบรางความเร็วสูงตามทางรถไฟเดิม

Local News Paper



เส้นทางรถไฟชุมพร-ท่าเรือน้ำลึกระยอง

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Board-Brochure-Document of Project



เส้นทางรถไฟชุมพร-ท่าเรือน้ำลึกระยอง

เป็นโครงการพัฒนาระบบรางที่มีความสำคัญและมีความจำเป็นต่อการพัฒนาเศรษฐกิจ สังคม และคุณภาพชีวิตของประชาชนในพื้นที่โครงการฯ โดยเฉพาะอย่างยิ่งในด้านการขนส่งสินค้าและบุคลากร ซึ่งจะช่วยลดต้นทุนการขนส่งและเพิ่มขีดความสามารถในการแข่งขันของภาคอุตสาหกรรมและภาคบริการได้อย่างมีประสิทธิภาพ

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- พัฒนาระบบรางความเร็วสูงตามทางรถไฟเดิม

Figure 9.5-1 Media Relations

Daily News website (www.dailynews.co.th)

Daily News (newspaper)

Figure 9.5-1 Media Relations (cont.)

Chapter 10

Development Guidelines for Areas Surrounding the Station

Chapter 10

Development Guidelines for Areas Surrounding the Station

10.1 Concepts and Development Guidelines for Surrounding Areas of Railway Station along Chumphon – Ranong Route

The development of the Chumphon - Ranong railway route will be part of linking southern tourism routes between the Gulf of Thailand and the Andaman Sea, resulting in the expansion of tourism in both provinces, as well as the expansion of the city as a whole. The development of this railway line along with the development of urban areas, especially around the railway stations in both major cities, will promote and support spatial development in a way called Transit Oriented Development (TOD), which focus on compact development and incorporate into non-use of personal vehicles and quality urban design.

- ***The development of the area around Chumphon Railway Station***

Chumphon Railway Station will be one of the important stations that are likely to be affected by the development of the Chumphon - Ranong Railway Line because of the location of station is the central source of travel to Chumphon, which is a community center with trade, business services and the services that link tourism activities at the level of the community in Chumphon downtown, provincial and regional. The development of this railway line will affect the increase in the number of passengers and products by train to this station.

The development guidelines of TOD in Chumphon will be different from big city or other major cities of other regions, because the context of Chumphon is not as complicated as the city and density is not very high. Development strategies should focus on supporting the development of secondary roads, pedestrian and bicycles paths and public transport in urban areas that link the railway stations to major cities and the transit station to be able to bring passengers to other tourist attractions in the province, in particular attention should be given to infrastructure for the convenience of tourists who choose to travel by train in the future. The development of the area surrounding Chumphon Railway Station can be implemented in two ways as follows.

- ***Development Guidelines “Infill-Development”***

Development of the area south of the railway station in the area that has been greatly developed, should be implemented in such a way "Infill-Development" or "Re-Development", which is a guideline to develop empty space, wilderness areas or undeveloped areas in urban areas where public utilities and public services are already developed.

- ***Development Guidelines “Suburban Center Neighborhood”***

Development of Chumphon Railway Station in the future, if the city has expanded even more, the establishment of stations in existing area may have restrictions and may cause traffic problems within the city, so maybe consider

adding a new station to the suburbs to accommodate the expansion of the new suburban community center in Chumphon, focusing on the convenience of traveling to other tourist attractions in the province and linking with surrounding communities such as Pak Nam Chumphon Municipality Community. The development of a new suburban transport community center should focus on being a suburban community center such as market, shop, office, school facility, infrastructure including other public services for accommodate the expansion of Chumphon in the future. The appropriate location should be an area that can link to the outer city and travel to the city or travel to other tourist attractions in the province conveniently.

- **Development of the area around Ranong Railway Station**

Due to Ranong City has a mountainous terrain stretching from the north to south on the east side, resulting in the settlement of Ranong community is characterized by the concentration of the community periodically in a longitudinal alignment along Highway 4 on the coastal plain. These communities include: Ranong Town Community, Bang Rin Sub-district Community, Ngao Sub-district Community and Rajchakrud Sub-district Community, which is the location of Ranong Airport, although communities of Bang Rin, Ngao and Rajchakrud, are not included in Ranong Township, but may be designated as an area to accommodate the expansion of Ranong in the future. For the development guidelines of TOD in Ranong City must be integrated with the development of public transportation system of the city, which may be any system. There are two possibilities as follows.

- **Development Guidelines “Infill-Development”**

Developmental guidelines in form of Infill-Development or Redevelopment are suitable for the urban areas in Ranong, which has been very densely developed before, especially in the area surrounding the current bus terminal, which is the area where the Chumphon - Ranong route passes near the city center the most. These areas is characterized by a community, such as residential areas, schools, and recreation facilities. In addition, the area has open spaces that can be developed to fill the intensity of activities and high density in the future properly.

- **Development Guidelines to New Suburban Community Center**

Another possible alternative is the development of a new railway station in the suburban community, especially in the community area south of Ranong such as Bang Rin Sub-district Community or Ngao Sub-district Community, due to these communities are not far from Ranong Town, therefore, it is highly possible to be a space for accommodating the expansion of the city in the future such as the site of the government center and Ranong Airport. The development guidelines of the area around the railway station in form of the suburban community center should focus on the connection between Ranong and other tourist attractions and surrounding communities, there is a mix of residential areas, department stores, commercial areas and task sources in the moderate density especially in the future, if there are policies to expand the Southern Railway along the Andaman coast. The development of the railway station and the development of the surrounding area in form of this suburban community center will provide an opportunity for Ranong to become a gateway to a new style of tourism by rail of the southern provinces along the Andaman coast.

For the station along the route, by studying the context and condition of the area around the nine stations along the Chumphon - Ranong Railway route can conclude the classification of development areas around the station, as shown in **Table 10.1-1** and summarized as follows.

- (1) Development of the area around the station at the Urban Center level, including *Ranong Station*
- (2) Development of the area around the station at the Suburban Center level, including *Khun Krating Station* and *Ranong Port Station*
- (3) Development of the area around the station at the Transit Town Center level, including *Kra Buri Station*
- (4) Development of the area around the station at the Transit Neighborhood level, including *Ban Na station* (1) *Ban Na Station* (2) *Pak Chan Station*, *Bang Yai Station* and *La-un Station*

**Table 10.1-1 Summary of Proposals for Development Guidelines
for Areas Surrounding the Station**

Details	Urban Center	Suburban Center	Transit Town Center	Transit Neighborhood
Station	Ranong town, Chumphon town (old or new station)	Khun Krating, Ranong Port	Kra Buri	Ban Na (1), Ban Na (2), Pak Chan, Bang Yai, La-un
Characteristics of development around the station	Provincial Economic and Cultural Center	Provincial Economic and Cultural Center	Economic centers and activities of the community and surrounding areas	Residential development and community service store system
Transportation system	All systems	Transportation system linking the main city community center / Intercity transport	Intercity Transport / Local Transportation	Community Transportation
Land use	The mix of residences, task sources, shops & services and Government office	The mix of residences, task sources, shops & services	The mix of residences, task sources, shops & services	Focus on residences and also has a system of shops & services to support
Building Development Model	High rise buildings between 2-5 floors	High rise buildings between 2-4 floors	Low-rise buildings between 1-3 floors	Low-rise buildings between 1-2 floors
Density	High - Medium	Medium	Medium - Low	Low

10.2 Tourist Attraction Nearby Railway Station along Chumphon - Ranong Route and Connection with the Nearby Highway Network

There are many tourist attraction near the railway station along Chumphon – Ranong route. The details of the highway network linking the railway station to the nearby tourist attraction can be summarized in **Table 10.2-1**.

Table 10.2-1 Tourist Attraction nearby the Railway Station along Chumphon - Ranong Route and the Nature of the Highway Network Linking Tourist Attraction

Station	Nearby Attractions	Category of tourism	The nature of the road linking the station to the tourist attraction
1) Khun Krating Railway Station	NA	-	-
2) Ban Na Railway Station (1)	NA	-	-
3) Ban Na Railway Station (2)	NA	-	-
4) Pak Chan Railway Station	Chum Saeng Waterfall	Natural attractions	Entrance to Road 1003 is a paved road, 7 meters wide, good surface condition and when entering the local road, which is a paved road, alternating with rocky road, 5 meters wide but when entering the waterfall along the Road 3117 is a two-lane paved road, the route will be more complete.
5) Kra Buri Railway Station	Bok Krai Waterfall	Ecological and natural attractions (Thung Raya – Na Sak Wildlife Sanctuary)	Entrance to Road 1008 is a paved road, 8 meters wide, winding path, completely surface condition.
	Phra Khayang Cave	Religious and cultural attractions	The entrance is a 5 meter wide concrete road, easy access.
6) Bang Yai Railway Station	Suwansiri Waterfall	Natural attractions	The entrance is a concrete road, 3.5 meters wide, quite narrow. The Path passes through the community, completely surface condition.
	Khlong Bang Yai Forest Park	Natural attractions	
7) La-un Railway Station	Khao Fa Chi View Point	Natural attractions	The entrance is a paved road, 4 meters wide, quite narrow, steep and winding roads, big car cannot be up, completely surface condition.
	World War II Museum (Steam engine)	Historical and cultural attractions	The entrance is a paved road, 7 meters wide, completely surface condition and easy access.

Table 10.2-1 Tourist Attraction nearby the Railway Station along Chumphon - Ranong Route and the Nature of the Highway Network Linking Tourist Attraction (Cont'd)

Station	Nearby Attractions	Category of tourism	The nature of the road linking the station to the tourist attraction
8) Ranong Railway Station	Raksa Warin Hot Spring	Cultural attractions	The entrance is a paved road, 6 meters wide, completely surface condition and easy access.
	Chan Dumri Beach	Natural attractions	Road 4004 is a paved road, 8 meters wide, completely surface condition and easy access. However, the entrance to the beach is a paved road, 4 meters wide, quite narrow, deteriorated pavement and located in a private area.
	Ranong Governor's Grave	Historical and cultural attractions	Pass through Pha Dad Alley, concrete road 2-4 lanes, easy access path or take the Kamlang Sup road and Rueangrat Road, which are paved road with 2-4 lanes, completely surface condition.
	Ranong King's Cemetery	Historical and cultural attractions	Road 4004 is a paved road with 2 lanes, completely surface condition and easy access.
	RattanaRUNSUN Palace	Historical and cultural attractions	Kamlang Sup road is a paved road with 2-4 lanes in urban community area, completely surface condition.
	Grass Mountain	Ecological and natural attractions	Completely path condition, the entrance is concrete road, 8 meters wide
	Ngao Waterfall	Natural attractions	The entrance is paved road, 6 meters wide, completely path condition and easy access.
	Porn Rung Hot Spring	Natural attractions	The entrance is paved road, 6 meters wide, completely path condition and easy access.
	Hat Som Paen Temple	Religious and cultural attractions	Road 4005 is a paved road, 6 meters wide, winding path, completely surface condition.
	Hat Som Paen Reservoir	Natural attractions	The entrance is a paved road, 6 meters wide, winding path and some are bumpy path, easy access.
	Ranong Canyon	Natural attractions	The entrance is a paved road, 6 meters wide, steep and winding roads, big car has difficulty accessing, completely surface condition.

10.3 Economic Impact from Tourism in Chumphon Province and Ranong Province

Tourism plays an important role to the economy and the development of competitiveness is promoting income distribution at all levels through the tourists spending, which stimulates the local economy and employment and generate income in the domestic circulation. The value of the money from tourism will be distributed to various agencies in a variety of economic systems. Ultimately, these revenues will fall to the hands of people in the country from the so-called process. "Tourism Multiplier Effect", which shows that the proportion of revenue from tourism is repeatedly rotated in the economy. The more income means that everyone in the country also benefit from the expansion of tourism, therefore the tourism is a service industry that is vital to the economic and social development of the country. Based on the study of economic valuation of tourism in the southern area of the Thailand Research Fund (TRF) found that the restaurant has the highest value of Tourism Multiplier, followed by the souvenirs business and the business of accommodation, respectively, which tourism multiplier, the higher the value, the higher the economic benefits of the area. The tourism sector is a labor-intensive industry, which will result in more job creation and revenue generation to the area also, therefore, tourism promotion is to help develop the country's economy even better.

The tourism situation of Chumphon and Ranong Provinces in the year 2012-2016 can be summarized as follows.

- The number of visitors in Chumphon and Ranong Provinces has the growth rate increased by 8.64% and 5.78% per year, respectively. By 2016, Chumphon and Ranong Provinces had 1,357,428 and 923,243 visitors, respectively, which the number of visitors is in the rank of 48th and 54th of the country, respectively, and is in the rank of 10th and 11th of the southern region, respectively.
- The average day of visitor arrival in Chumphon and Ranong Provinces has the growth rate decreased by 0.94% and 1.65% per year, respectively. By 2016, Chumphon and Ranong Provinces had the average day of visitor arrival of 2.49 and 2.47 days, respectively.
- Revenue from tourism of visitors in Chumphon and Ranong Provinces has the growth rate increased by 9.85% and 9.17% per year, respectively. By 2016, Chumphon and Ranong Provinces had revenue from tourism 6,240 and 3,978 million baht, respectively.
- Expenses for tourism in Chumphon and Ranong Provinces has the growth rate increased by 2.09% and 4.19% per year, respectively. By 2016, Chumphon and Ranong Provinces had an expenditure incurred by the average visitor of 2,073 and 1,928 baht per person per day, respectively. The expenses for tourism in Chumphon was mainly from food and beverage (25%), followed by accommodation (22%) and Souvenir (19%), respectively. For Ranong, most of the expenses came from accommodation (27%), followed by food and beverages (24%) and souvenir (16%), respectively.

Chapter 11

Conclusion and Recommendation

Chapter 11

Conclusion and Recommendation

11.1 Conclusion

As Ranong Province has no railway for transportation, there is only a road network which the route is slope and has a lot of curves due to the mountain terrain. Travelling is very inconvenient especially for freight transportation. Therefore, the construction of the new railway from Chumphon Province to Ranong Province shall connect both passengers and freight through Ranong Deep Sea Port. This study could be concluded as follows:

- In terms of the consistency between the project and the national's development policies and strategies, the project shall enhance a link between the two coasts (the Andaman Sea and the Gulf of Thailand), which shall promote tourism between the two coasts. In addition, the project shall also connect transportation between production bases to Ranong Port, which shall be the trading gateway linking the Andaman Sea to BIMSTEC countries (Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation) comprising Bangladesh, Sri Lanka, India, Thailand, Myanmar, Nepal and Bhutan through rail transportation mode that is energy efficient and environmentally friendly.
- The Chumphon to Ranong Deep Sea Port Railway Project shall be 1 m. gauge single track, pass 4 districts namely Muang District of Chumphon Province, Kra Buri District, La-un District, and Muang District of Ranong Province, having a total length of 109 km (including the main line from Chumphon to Ranong Port 103 km, the spur line to Ranong Town 5 km and the chord line linking the existing southern railway to the main line 1 km). There shall be 9 stations consisting of 1 inland container depot namely Ranong Port Station and 8 passenger stations namely Khun Krating Station, Ban Na-1 Station, Ban Na-2 Station, Pak Chan Station, Kra Buri Station, Bang Yai Station, La-un Station and Ranong Station. The railway structures shall be composed of embankment structure, bridge structure and tunnel structure within the right-of-way of 50 m. The construction budget shall be 27,000 million Baht.
- **Table 11.1-1** shows the forecasted potential passenger and freight volumes through Ranong Port at the future years.

Table 11.1-1 Forecasted Passenger and Freight Volumes in Years 2025-2054

Forecast	Years			
	2025	2034	2044	2054
Passenger Volume (Person per day)	5,724	7,331	9,331	11,710
Export and Import Container Volume (Cabinets per Year)	33,116	45,257	60,770	85,502

- Though the economic analysis of the project shows that the project is not economically feasible for 30 years if the project is constructed and operated in year 2025 as an economic internal rate of return (EIRR) is 8.55% However, if the project is postponed for 9 years, after the opening year (2034), the economic internal rate of return (EIRR) shall exceed 12.19%.

11.2 Additional Comments and Recommendations

11.2.1 Recommendations on Traffic and Transportation

Passenger Transportation. Upon consideration of passenger volumes, it is found that there shall be small passenger volumes. This may be due to the socio-economic factors in Ranong and Chumphon Provinces which caused not much travel. The major factor contributing to the increase in travel volume is tourism, so the Consultant recommended the guidelines for further action as follows:

- 1) Development and extension of the new railway from Chumphon Province to Ranong Province shall be a part of infrastructure and facilities development to support the tourism growth which is consistent with the Strategy 2 of the National Tourism Development Plan No. 2. Besides this, it is consistent with Strategy 1: Development of the quality of tourist attractions, goods and services to be sustainable and balance, Strategy 3: Development of tourism personnel and enhancement of public participation for tourism development, Strategy 4: Balance Thai tourism through niche marketing, promoting Thai style living and the confidence of tourists and Strategy 5: The integration of tourism management and international cooperation, which must be implemented together.
- 2) In order to have the utmost benefit to the project, it is necessary to emphasize on the development of areas around stations. The recommendations are as follows:
 - In case of stations in the main town or stations at center town level, a vacant area should be developed to maximize efficiency in accordance with Infill Development or Redevelopment Guidelines. However, the development theory of mixed uses, compact, environmentally friendly and the rail network linking with other public transport systems should be considered.
 - In case of station area development at a new suburban community center, the land use plan to accommodate city expansion in the future and the development of areas around stations should be considered.
 - In case of stations at small community level or residential level, public transportation linking stations to surrounding communities and tourist attractions should be provided.

Freight transportation. Upon consideration of the role and potential of Ranong Port, it is found that there are also opportunities and necessities for transportation through Ranong Port as an option to transport goods to BIMSTEC countries. The development of railway shall be only a part of the promotion of transportation through Ranong Port. There are also many important factors to be considered simultaneously such as:

- 1) Freight transportation through Ranong Port shall have competition among transport operators between the existing routes and the new routes. Therefore, those who are involved in the transportation at Ranong Port need to have a customer base that needs to transport goods to the BIMSTEC countries and must have effective management. That is, there must be a good network of logistics and marketing to

provide cost and management to meet the customers who will use the services continuously and attract customers to switch to transport through Ranong Port.

- 2) Problems of rail transport services. Although the rail transportation cost is cheaper, the weakness of rail freight is irregularity and unpunctuality. The train also has problems with insufficient locomotives and freight cars. If the freight transportation cannot be done in time, it will cause damage to the owner resulting in lack of confidence in rail transport.
- 3) Problem of the Strait of Malacca. If in the future, the vessel volumes passing through the Malacca Strait increase drastically, the Straits of Malacca cannot serve the fleet in time and safe navigation, fleet will avoid using the Sunda and Lombok Strait routes. This will make the route longer. In addition, the Malacca Strait countries may increase the ocean freight to maintain a balance of service. As a result, the cost of ocean freight between the Indian Ocean and the Pacific Ocean will be increased.

11.2.2 Recommendations on Engineering

- 1) The government should have a clear policy in developing the transportation route linking to travel attractions tangibly to facilitate the comfort in traveling to various tourist attractions of both Thai and foreign tourists.
- 2) The government should expedite the extension of traffic lanes to 4 traffic lanes on the main route, especially on Highway Route No. 4 (Phetkasem Road), the whole route from Chumphon, Phang Nga and Phuket Provinces as Highway Route No. 4 is the main route linking to the distributor roads to travel attractions and nearby provinces, e.g. Phang Nga and Phuket etc.
- 3) In promoting freight transportation through Ranong Port, the government should have a clear policy in developing the port to be large enough and cost effective for freight transportation, encouraging the port to be an international port tangibly and encouraging the project to dredge watercourses to be 12-18 m deep.

11.2.3 Recommendations on Environment and Social

After completion of the feasibility study on economic, engineering and environment and the preliminary design of the project, the next process is the project owner has to prepare the environmental impact assessment report according to the Notification of the Ministry of Natural Resources and Environment (June 2012) on the type and size of the project that has to prepare the Environmental Impact Assessment Report. This project is under No. 21 of the rail transit system and No. 33 of the projects of the areas that are in Watershed Classification 1 according to the Cabinet's resolution to submit EIA report to agencies concerned for consideration and approval prior to further construction (**Figure 11.2-1**). The Consultant has the following recommendations on preparation of the Environmental Impact Assessment Report:

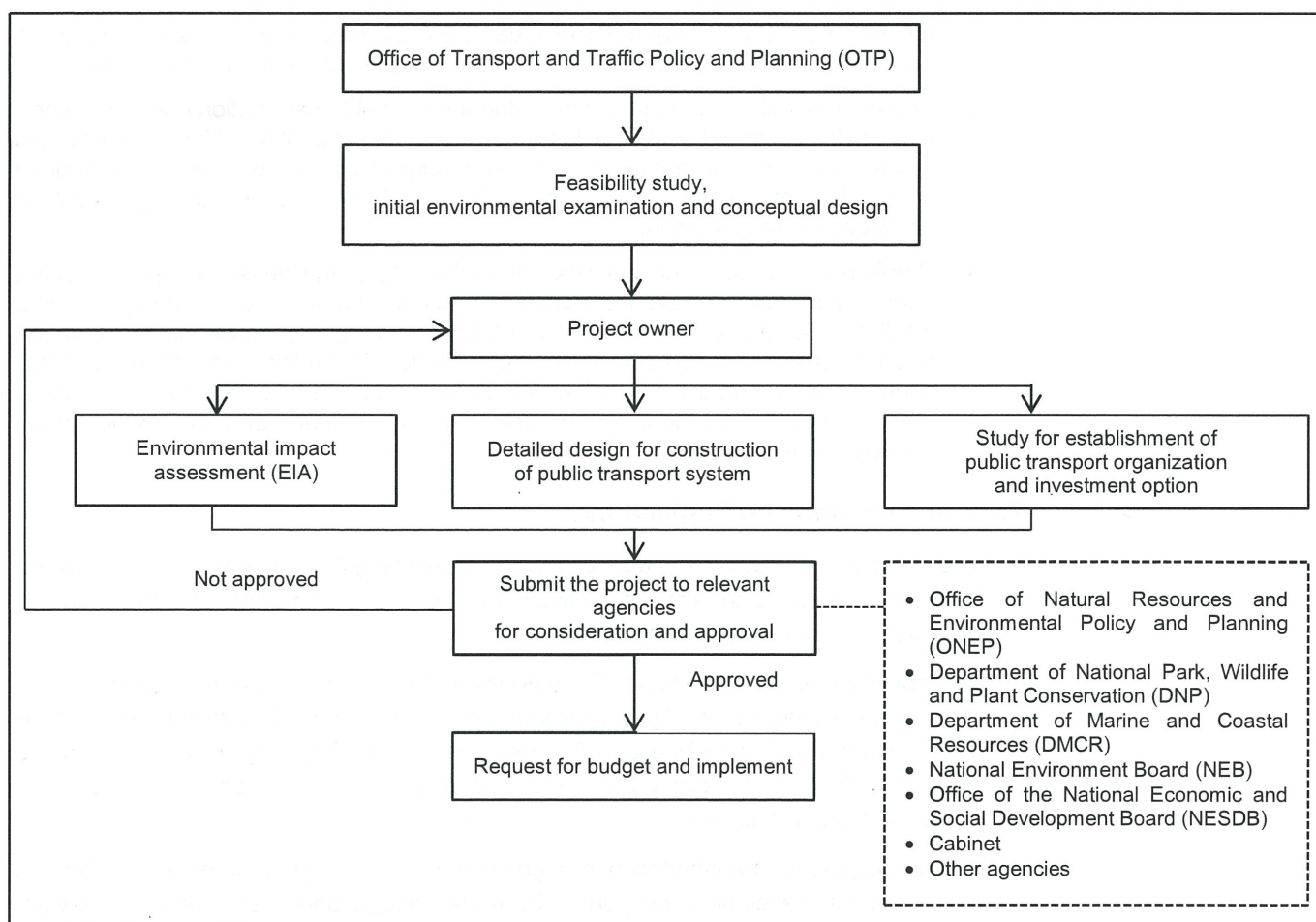


Figure 11.2-1 Next Process of Environmental Execution of the Project

- 1) Provide environmental information to support the consideration of detailed design to avoid environmental problems that will follow later. In the event that the environmental impacts shall occur, measures to protect and mitigate the environmental impacts, especially for the project which shall pass Watershed Classification 1, Ramsar Site, national park, mangrove forest and communities should be prepared.
- 2) Follow the rules and regulations of agencies responsible for conservation areas strictly, e.g. application for research in conservation area, application for use of conservation area and the request for a waiver of the Cabinet's resolution relating to the use of Watershed Classification 1 area.
- 3) Examine the constraints and guidelines for the implementation of the project of other agencies, e.g. Department of Highways, Department of Rural Roads, Department of Marine, Port Authority of Thailand, Royal Forest Department, Department of Marine and Coastal Resources, Department of National Park, Wildlife and Plant Conservation and Office of Natural Resources and Environmental Policy and Planning (e.g. Natural Resources and Environmental Management Coordination Division and Natural and Cultural Environmental Conservation Division) etc.
- 4) Execute public relations and public participation covering every stakeholder especially people who are affected from land expropriation and property

compensation including agencies responsible for permitting the use of land for construction of the project etc.

- 5) Collect documents and evidences during the feasibility study and public participation activities to support the preparation of EIA report e.g. a summary of discussion with agencies concerned, concerns/recommendations, meeting attendant signatures, pictures or animation etc.).

11.2.4 Recommendations on Tourism Management of Ranong Province

Though the study results show that year 2034 is feasible to construct the project, Ranong Province is a province with a wide range of tourist attractions such as natural tourism, historical tourism and cultural tourism. If the government sector, travel agents and local communities jointly determine the guidelines for tourism management to be implemented seriously and successfully, it will attract both domestic and international tourists to visit tourist attractions of Ranong Province and some may want to come back again if they are impressed. These executions not only generate revenues for Ranong Province and local communities, it is also encouraging the government sector to accelerate infrastructure development and rail system development to facilitate traveling of passengers and tourists. The OTP and the Consultant have organized a workshop on tourism related issues in Ranong Province on Friday, February 2, 2018 at 13.00-16.00 hrs. at Tinidee Hotel @ Ranong (**Figure 11.2-2**) participated by representatives from government agencies, private organizations and tourism entrepreneurs etc. The key information exchanged, brainstorm and recommendations on tourism management in Ranong Province in the future can be summarized as follows:



Figure 11.2-2 Workshop with Ranong Tourism Representatives
on Friday, 2 February, 2018 at Tinidee Hotel @ Ranong

- 1) Ranong Province is a province with a long history since the Ayutthaya period. It was a small town under the supervision of Chumphon Town. The word "Ranong" is distorted from Rae Nong due to a lot of mineral in the province. It was the residence of the Hokkien Chinese in the early Rattanakosin. It was also an important route of the Japanese military in World War II. So there are many historical and cultural attractions such as the passage of the reign of King Rama V, the old railway during World War II, Khao Fachi, the cemetery of the ruler of Ranong, Rattana Rangsan Palace etc.
- 2) The abundance of natural attractions to accommodate eco-tourism, adventure travel and health tourism, such as mountains covered with natural forests, a variety of waterfalls and natural hot springs, the most fertile mangrove forest in Thailand and an internationally important wetland (Ramsar Site), Phu Khao Ya (grass hill), Khao Fachi View Point and beautiful snorkeling sites at Koh Phayam, Bat Island and Japan Island etc.
- 3) Various local and unique dishes of Ranong, such as Tub Lee Steamed Dumplings, Hokkien food, fresh coffee growing and selling (Kong Coffee), cashew nut, including the sale of seafood products, local products and processed products such as sea crab, soft shell crab, shrimp (Kraburi River), dried shrimp, shrimp paste, vegetables etc.

After the Cabinet has a policy to encourage domestic tourism, the Tourism Authority of Thailand (TAT) has launched the "Amazing Thailand Go Local" program comprising 55 secondary provinces such as Udon Thani, Mahasarakham, Lopburi, Nakhon Nayok, Suphan Buri, Prachinburi, etc. The southern secondary provinces include Nakhon Si Thammarat, Phatthalung, Trang, Satun, Chumphon, **Ranong**, Narathiwat, Yala and Pattani. So if the relevant authorities of Ranong Province can determine a master plan / roadmap for tourism with cooperation from enterprises and the public sector, Ranong Province may be able to be upgraded from the "secondary city" to the "main city" of tourism of the south and of Thailand, where both domestic and foreign tourists must find opportunities to visit. Followings are the overall suggestions:

- 1) The government sector involved in tourism development should promote and encourage the communities to aware and participate in tourism development of Ranong Province starting from drafting the policy and master plan for Ranong tourism. It can be divided into 3 phases, i.e. short, medium and long term. Operational procedures should be defined by having government agencies as mentors or followers to assess the effect of the operation at all stages and also to mitigate the negative impact that may occur in the future. Local authorities and the private sector/entrepreneurs concerned should cooperate with communities to develop tourism and to establish tourism potential for communities.
- 2) Public relations and marketing are key factors that will contribute to various modes of tourism development through various forms of public relations. The communities should be recommended to select the precise media especially the public relations media that the communities can manage themselves, such as brochures, tourist service center of communities and signs in the communities (Thai/English/Chinese). The media that need to coordinate with government agencies or local government organizations has a high cost, such as signs to the communities, event coordination, exhibition introducing tourist activities, festivals and occasions, travel guide website, print media related to tourism and radio etc.

3) Factors to attract tourists to Ranong Province are natural and historical attractions, a variety of lifestyles, culture and food, then the government should provide facilities and develop infrastructure for access to these sites of Ranong Province by:

- Prepare map or layout of province-district tourist attractions and public relations board (Thai and foreign language) and provide tourist service center with personnel to facilitate and give information to domestic and foreign tourists including the disabled.
- Develop transportation routes either by car, train or air, nature trails, bicycle path and pedestrians to be appropriate to travel to tourist attractions.
- Improve sanitation and garbage management, other facilities such as hygienic restrooms. Provide a garbage bin that separates the garbage type and provide appropriate and sufficient parking and provide ramps and auxiliary equipment to facilitate the disabled.

In order to obtain the appropriate and adequate information to formulate a master plan for tourism management of Ranong Province to be sustainable and with the participation of the people, the Consultant proposed the framework for further stage as follows.

Information	Tool	Knowledge	Expected Result
1. Attractiveness 2. Facilities 3. Accessibility 4. Environment	1. Related Documents 2. Explore and Observation with Local Community 3. Travel / Tourist Questionnaire	Tourist attraction Factors	Tourism Management Master Plan with Participation of People
1. Travel Resources 2. Situation, Problems and Management 3. Guidelines for the Development of tourism Management Capabilities	1. Tourism Resources Check with Local Communities 2. In-depth interview with community leaders / entrepreneurs / villagers / top executives	Tourism Management	

11.3 Guidelines for Implementation

Based on the economic analysis of the project which shows that the project shall be cost effective upon opening for operation in year 2034, the procedures and processes that the relevant agencies need to do are as follows:

- Propose the project to the Ministry of Transport to consider and approve and then the Ministry of Transport proposes the project the Cabinet for approval in principle.
- Perform the detailed design and prepare the environmental impact assessment report to submit to Office of Natural Resources and Environmental Policy and Planning (ONEP) for approval.
- Construction of the project consists of land expropriation and compensation for buildings, the selection of supervision consultants as well as construction work.

In order to develop the project successfully as planned and forecasted, the Consultant has prepared the project implementation plan as a guideline as shown in **Figure 11.3-1**. Based on the plan, the Consultant recommends starting the review of the feasibility study, detailed design and preparation of EIA report in year 2025 and the land expropriation works should be completed prior to the construction which should start in year 2030 to open for operation in year 2034.

However, the above processes usually take a long time and it may be even longer if these processes encounter a problem. Therefore, the preparation of the project implementation in advance is necessary due to the following policies of the government:

- The Government's policy to promote the development of rail systems to contribute to the economy and tourism of the country, because Chumphon and Ranong Provinces have many tourist attractions that are beautiful and attract tourists. It also complies with the government policies that support secondary tourism. The policy has been submitted to the State Railway of Thailand to accelerate the construction of railway on the main line, double-track railways, and railway to the secondary city to connect tourism sectors. In addition, at present Phuket Province accommodates a large number of tourists. If it increases, it will cause problems. It is therefore necessary to develop new tourist sites in order to promote and link tourism to these areas, especially on the Andaman coast. It may need to develop a circular or continuous route to promote tourism and travel. It is important to coordinate with the private sector to develop joint tourism packages.
- On January 15, 2018, the Ministry of Tourism and Sports discussed with the Ministry of Transport in the development of transportation network linking tourism by focusing on the development of infrastructure to support tourism including the development of the main city-secondary city link to facilitate and secure travel either by land, water and air transportation, as well as rail travel, which is a unique travel. Also, a joint statement was signed between the two ministries on the establishment of a joint committee for the development of transport links. Therefore, the New railway from Chumphon-Ranong Deep Sea Port Project is a project that needs to be developed together to achieve that goal.
- Besides the construction procedures and processes which take times to complete, it is important and necessary to execute simultaneously the development of excursion train which needs the local and provincial authorities and people to motivate and coordinate with the Ministry of Tourism and Sports and the Ministry of Transport in formulating an integrated development plan.

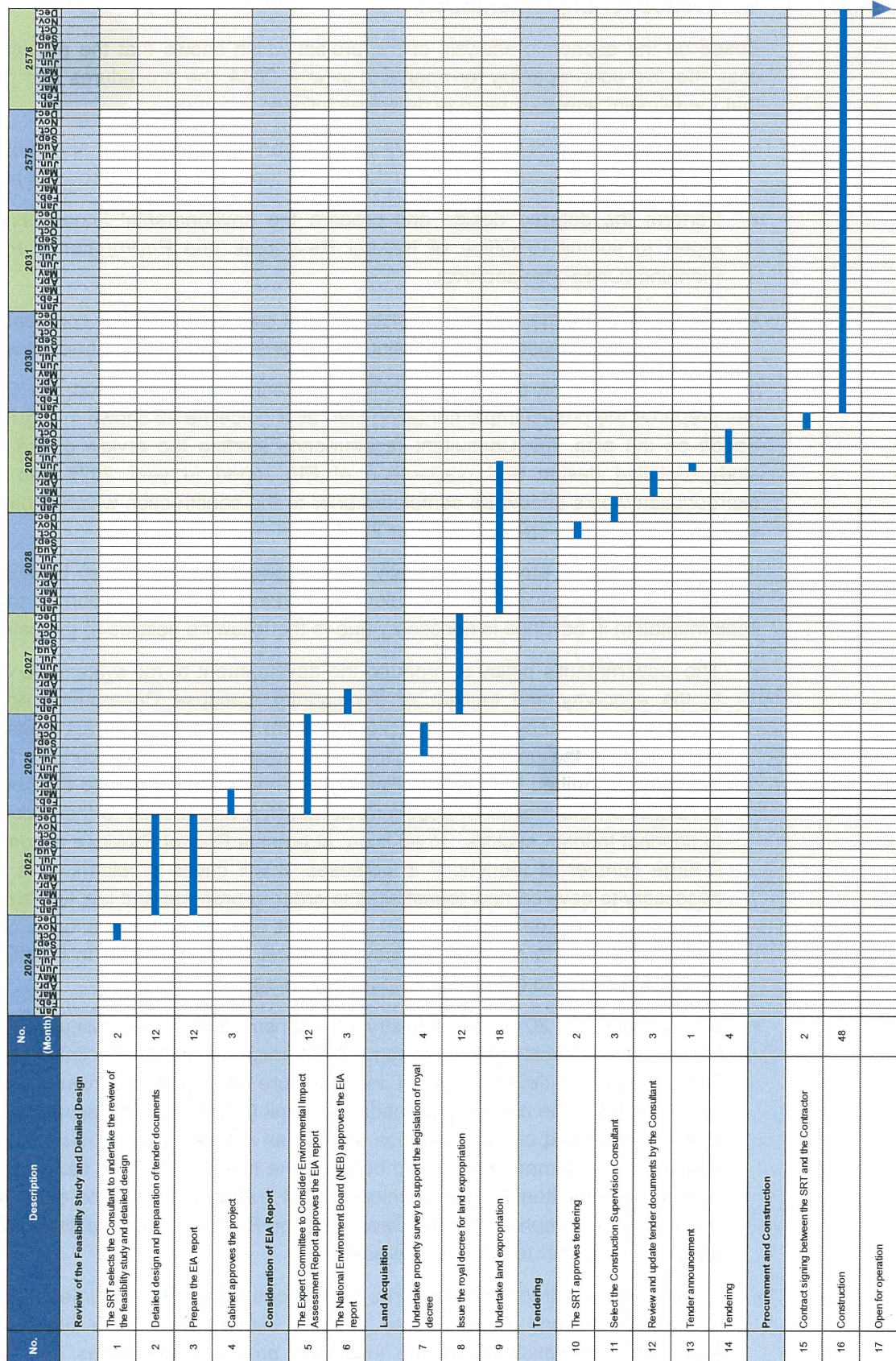


Figure 11.3-1 Project Implementation Plan (Guideline)