



Office Of Transport and Traffic Policy and Planning

The background of the cover is a collage of four circular images. The top-left circle shows a modern high-speed train in a station. The top-right circle shows a night view of a city with many lights. The bottom-left circle shows a traditional wooden boat on turquoise water. The bottom-right circle shows a modern train track with a large, curved roof structure.

# The Study And Design Of The Hat Yai-Padang Bezar Double Tracks Electric Train System Executive Summary Report

**Submitted By**



CHOTICHINDA CONSULTANTS LIMITED



UTILITY DESIGN CONSULTANTS Co., Ltd.



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งานจ้างที่ปรึกษาศึกษาและออกแบบระบบรถไฟฟ้าทางคู่ขับเคลื่อนด้วยพลังงานไฟฟ้า ช่วงหาดใหญ่-ปาดังเบซาร์  
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เรื่อง ขอนำส่งรายงานโครงการศึกษาและออกแบบระบบรถไฟฟ้าทางคู่ขับเคลื่อนด้วยพลังงานไฟฟ้า ช่วงหาดใหญ่-ปาดังเบซาร์

เรียน ผู้อำนวยการสำนักงานนโยบายและแผนการขนส่งและจราจร

อ้างถึง สัญญาจ้างที่ปรึกษาเลขที่ 24/2558 ลงวันที่ 30 มกราคม พ.ศ. 2558

- สิ่งที่ส่งมาด้วย
- 1) รายงานการออกแบบ (Design Report) จำนวน 20 ชุด
  - 2) รายงานฉบับสรุปผู้บริหาร (Executive Summary Report)
    - ภาษาไทย จำนวน 100 ชุด
    - ภาษาอังกฤษ จำนวน 100 ชุด
  - 3) รายงานการศึกษาความเหมาะสมด้านวิศวกรรม เศรษฐกิจ สังคม ภาษาไทย จำนวน 100 ชุด
  - 4) รายการคำนวณ จำนวน 5 ชุด
  - 5) แบบรายละเอียด
    - ต้นฉบับ ขนาด A1 จำนวน 1 ชุด
    - ต้นฉบับ ขนาด A3 จำนวน 1 ชุด
    - สำเนาฉบับสุดท้าย ขนาด A3 จำนวน 30 ชุด
  - 6) แบบแปลนแสดงแนวเขตทางและค่าพิกัด แบบแปลนแสดงที่ดินที่ถูกเขตทาง แบบแปลนแสดงทรัพย์สินที่อยู่ในเขตทาง และบัญชีรายการแปลงที่ดินที่อยู่ในเขตทาง
    - ต้นฉบับ ขนาด A1 จำนวน 1 ชุด
    - ต้นฉบับ ขนาด A3 จำนวน 1 ชุด
    - สำเนาฉบับสุดท้าย ขนาด A3 จำนวน 30 ชุด
  - 7) รายงานบัญชีปริมาณงานและประมาณการค่าก่อสร้าง จำนวน 10 ชุด
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ตามที่สำนักงานนโยบายและแผนการขนส่งและจราจรได้ว่าจ้างกลุ่มบริษัทที่ปรึกษา ซึ่งประกอบด้วย บริษัท โชติจินดา มูเซล คอนซัลแตนท์ จำกัด บริษัท ยูทิลิตี้ ดีไซน์ คอนซัลแตนท์ จำกัด และบริษัท เทสโก้ จำกัด เพื่อดำเนินการโครงการศึกษาและออกแบบระบบรถไฟฟ้าทางคู่ขับเคลื่อนด้วยพลังงานไฟฟ้า ช่วงหาดใหญ่-ปาดังเบซาร์ รายละเอียดตามหนังสืออ้างถึงนั้น

บัดนี้ ที่ปรึกษาได้ดำเนินการศึกษาและจัดทำรายงานซึ่งประกอบไปด้วย

1. รายงานการออกแบบ (Design Report)
2. รายงานฉบับสรุปผู้บริหาร (Executive Summary Report)
3. รายงานการศึกษาความเหมาะสมด้านวิศวกรรม เศรษฐกิจ สังคม
4. รายการคำนวณ
5. แบบรายละเอียด
6. แบบแปลนแสดงแนวเขตทางและค่าพิกัด แบบแปลนแสดงที่ดินที่ถูกเขตทาง แบบแปลนแสดงทรัพย์สินที่อยู่ในเขตทาง และบัญชีรายการแปลงที่ดินที่อยู่ในเขตทาง
7. รายงานบัญชีปริมาณงานและประมาณการค่าก่อสร้าง
8. เอกสารประกวดราคา
9. วิดีทัศน์แสดงผลการศึกษา

พร้อมทั้งบันทึกข้อมูลลงแผ่น DVD และ Portable Hard disk เสร็จเรียบร้อยแล้ว จึงขอส่งรายงานดังกล่าว ดังปรากฏตามสิ่งที่ส่งมาด้วย

จึงเรียนมาเพื่อโปรดพิจารณา

ขอแสดงความนับถือ



(นายปัญญา หาญจงกล)

ผู้จัดการโครงการ

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# Chapter 1

## Introduction

### 1.1 Rationale

On July 29th, 2014, the National Council of Peace and Order has endorsed the Development Strategies on Thailand Transportation Infrastructure 2015-2023 to move forward concrete operations on development strategies related to the infrastructure development of the rail system and trading network development between major regional cities which includes the Hat Yai-Padang Besar Double Tracks Train System already incorporated in the 2015 Transportation Development Project.

On 12 July 2014, the Cabinet has announced its National Policy and under Item 7 : Promotion of Role and Opportunity in the AEC, Item 7: Promotion of Economic Networking on Trading and Investment in the ASEAN Region and other neighboring countries through Transportation and Telecommunication Network; Item 7.4:Promotion of Transportation and Logistics Development in the sub-region and the ASEAN countries; Item 7.5: Linkage of transportation routes and logistics from the production base in the community to the manufacturing base for added value products nationally and among the ASEAN countries; and Item 7.6: Development of special economic zone starting from border trading and transportation network at the major trading gateways to support manufacturing and investment networking across the borders. This includes the development of National Single Window (NSW) and facilitations on trading and transportation across the borders. In the beginning phase, the focus is on 6 major border crossing points: Padang Besar, Sadao, Aranyaprathet, Mae Sot, Ban Klong Luek and Ban Klong Yai to effectively facilitate transportation and logistics with the neighboring countries and accommodate future volume of traffic and transportation from the merging of AEC.

From the set policy, Office of Traffic and Transportation Policy and Planning has moved forward with the Study and Design of the Hat Yai-Padang Besar Double Tracks Electric Train which will extends the existing network at Padang Besar border crossing point between Thailand and Malaysia connecting with the Ipoh-Padang Besar Double l Tracks Electric Train of 329 kilometers presently under construction and expected to be completed in November 2014 and open for service connecting with Hat Yai Depot. This will support transportation of goods and passengers and expansion of future trading between the two countries and moreover, promote travelling by the rail system and support economic and inter-cities growth consistent with the National Policy.

### 1.2 Objectives

- To conduct the Feasibility Study of the Hat Yai-Padang Besar Doublel Tracks Electric Train System by identifying the route and the area along the Project, the necessary infrastructure

and the design to efficiently connect the system and the infrastructure with other transportation modes.

- To conduct the Economic, Social, Financial and Investment Feasibility Study and the Study on the Environment Impact
- To develop the design, project the cost estimates and prepare necessary document for construction bidding.

### 1.3 Scope of the Study

The study covers the following 4 aspects:

- Survey, data collection, study results of other related projects
- Analysis and Feasibility Study of Engineering, Economics, Social Aspect, Financial Aspect and Investment Guideline
- Detailed Design and construction bidding document
- Report on Environmental Impact and Public Participation

### 1.4 The Project Organization

The Study and the Design of the Padang Besar Project includes the Study of the Route, Projection of Passengers and Freight Volume and Train Operation Plan, the Engineering Study, the Investment Costs, the Financial Returns, the Study of the Environment Impact and Public Participation.

#### 1) The Project Route and the Positioning of the Stations

The route starts at Hat Yai Depot (km.928+580) to Padang Besar (km.972+900) of 44.50 kilometers which incorporates the existing train route and 4 stations: Hat Yai Depot, Sala Thoong Song Depot, Klong Ngae Depot, Padang Besar Depot; 3 stopping points: Ban Phru, Klong Rum, Tha Khoy. The land under expropriation along the route starts from km.966+100 to km.967+500 at Thoong Mor sub-district and Padang Besar sub-district, Sadao district, Songkhla province covering an area of 21.98 rais

#### 2) The Projection of Passenger and Freight Volume and the Train Operation Plan

The Projection of Passenger and Freight Volume and the Train Operation Plan can be summed up as follow:

Table 1.4-1 Passenger Volume (persons-trip/day)

| Year | Passenger Volume (person/day) |
|------|-------------------------------|
| 2021 | 4,732                         |
| 2030 | 7,405                         |
| 2040 | 10,857                        |
| 2050 | 15,470                        |

Table 1.4-2 Cargo Volume on Hat Yai-Padang Besar Train Route

| Route          | 2021      | 2030      | 2040      | 2050      |
|----------------|-----------|-----------|-----------|-----------|
| External (BKK) | 978,545   | 1,237,712 | 1,571,919 | 1,969,740 |
| Hat Yai        | 246,096   | 296,524   | 354,111   | 414,361   |
| Padang Besar   | 1,224,641 | 1,534,236 | 1,926,030 | 2,384,101 |

The train operation time and line load has been included in the Infrastructure data analysis for various possible speeds of the train: 140, 120, 100 and 80 km./hour in conjunction with the train route data in order to derive appropriate train operation. The following results have been concluded:

Table 1.4-3 Train Operation Time according to Types of Service and Set Speed capacity

| Station/Stopping Points        | Location  | Distance (km) | Operation Time (min, Excluding stopping) |           |           |           | Station Size   |
|--------------------------------|-----------|---------------|------------------------------------------|-----------|-----------|-----------|----------------|
|                                |           |               | 80 Km/hr                                 | 100 Km/hr | 120 Km/hr | 140 Km/hr |                |
| Hat Yai Station                | 928+580   | 0.000         | –                                        | –         | –         | –         | Large station  |
| Ban Phru Stop                  | 935+925   | 7.345         | 6:19                                     | 5:32      | 5:2       | 3:39      | Stop           |
| Thoong Loong Station (Phatong) | 944+887.5 | 8.963         | 7:41                                     | 7:41      | 5:33      | 5:7       | Small station  |
| Klong Ngae Station             | 952+625   | 7.738         | 5:50                                     | 6:11      | 4:25      | 4:31      | Small station  |
| KLong Rum Stop                 | 961+100   | 8.475         | 6:22                                     | 6:35      | 4:45      | 4:24      | Stop           |
| Tha Khoy Stop                  | 967+450   | 7.350         | 5:1                                      | 5:27      | 3:48      | 3:8       | Stop           |
| Padang Besar Station           | 972+900   | 4.450         | 4:20                                     | 4:16      | 3:39      | 2:45      | Medium station |
| Total                          |           | 44.320        | 37:26                                    | 37:10     | 28:56     | 24:44     |                |

The fare rates can be classified as follow

First Class car: 0.86 baht/person/km

Second Class car: 0.42 baht/person/km

Third Class car: 0.18 baht/person/km

The revenues from the passenger fares will be charged 53.48% and 1.83 baht per ton/km for freight transport.

### 3) The Engineering Study

The Hat Yai-Padang Besar Double Tracks Electric Train of 44.5 km. has been designed with double tracks of 1.00 Meter Gauge with ground level single track system of 45 km. running parallel with double tracks system of about 7 km and elevated double tracks of 5 km. Two ground level stations and three stops will be constructed along with one elevated Electric Train station (Khlung Ngae Station) to solve the problematic 31 crossing points. The Consultant Team has designed overpass crossing points and tunnels with a total of 33 crossing points along the existing route with 2 overpass crossings and 31 same level crossings. The solutions can be summed up as follows:



Figure 1.4-1 Six Locations of Overpass U-Turns





Figure 1.4-2 15 Locations of Underpass Box



Figure 1.4-3 10 Locations of Elevated Railway

The design concept of the stations and platforms has been set in harmony with the locations, travel functions and access of the local community along with future business development and connections with other transportation modes. The 3 stations are:

1. Thung Lung Station



Figure 1.4-4 The Scenic landscape of Thung Lung Station

2. Khlong Ngae Station



Figure 1.4-5 The Scenic landscape of Khlong Ngae Station



### 3. Padang Besar 2 Station



Figure 1.4-6 The Scenic landscape of Padang Besar 2 Station

The Design of the Drainage System along the Project route considers appropriate underpass draining pipes to sustain flooding of 100 years record peak and suitable length of the bridge across the river to prevent blocking the current

The Train Operation System consists of Signaling System, Telecom System and Train Operation Control System complied with ECTS Level 1 standard.

The Power Supply System for the train operation will employ Overhead Catenary System: OCS with alternating current of 25 kilowatts and the Electrical Station will be built at Klong Ngae Station.

#### 4) The Project Investment Costs

From the estimates of the construction cost which includes the construction of the train tracks, drainage stations, track crossing points, transit points, fencing along both sides of the train tracks, telecommunication system, electrical system, signaling system, land expropriation and building compensation fees, the Consultants' fees, the total cost will be 13,341.00 Million baht.

**Table 1.4-4**  
**The Estimates of the Construction Costs**

| No.   | Items                                                                                            | Total Investment Capital | Factor F | Construction Cost 2015   | Notes                  |
|-------|--------------------------------------------------------------------------------------------------|--------------------------|----------|--------------------------|------------------------|
| 1     | GENERAL REQUIREMENTS                                                                             | 98,809,189.08            | 1.0000   | 98,809,189.08            | Factor F requirements  |
| 2     | EARTHWORKS                                                                                       | 416,413,133.11           | 1.1606   | 483,289,082.28           | - 10% advanced capital |
| 3     | ROAD AND STATION YARDS                                                                           | 685,059,191.28           | 1.1606   | 801,244,454.10           | - 10% collateral       |
| 4     | STRUCTURES                                                                                       | 2,141,783,197.22         | 1.1479   | 2,458,552,932.08         | - 7% loan interest     |
| 5     | BUILDING                                                                                         | 522,699,547.14           | 1.1781   | 615,792,336.48           | - 7% VAT               |
| 6     | PIPE AND DRAINAGE                                                                                | 117,359,980.00           | 1.1479   | 134,717,521.04           |                        |
| 7     | UTILITIES                                                                                        | 4,157,961.12             | 1.0000   | 4,157,961.12             |                        |
| 8     | TRACK WORKS                                                                                      | 991,124,653.83           | 1.1606   | 1,150,299,273.23         |                        |
| 9     | SIGNALLING AND TELECOMMUNICATIONS                                                                | 554,902,444.55           | 1.1606   | 644,019,777.14           |                        |
| 10    | POWER SUPPLY                                                                                     | 1,143,796,770.00         | 1.1606   | 1,327,490,531.26         |                        |
|       | <b>Total construction costs</b>                                                                  | <b>6,676,106,067.32</b>  |          | <b>7,718,373,057.83</b>  |                        |
| 11    | The Consultants' fees 4%                                                                         |                          |          | 308,734,922.31           |                        |
| 12    | Rolling Stock                                                                                    |                          |          | 5,263,000,000.00         |                        |
| 13    | Land expropriation fees and relocation of resident                                               |                          |          | 50,645,052.94            |                        |
| Total | The construction costs estimates<br>(Thirteen billion three hundred and forty one million baths) |                          |          | <b>13,341,000,000.00</b> |                        |

#### 5) The Study of Economic and Financial Internal Rate of Returns

From the Study, it was found that the Economic Internal Rate of Return: EIRR can be divided into 2 cases: EIRR of the diesel-powered train is 18.24% and EIRR of the electrified train is 18.78%

As for FIRR, FIRR of the diesel-powered train is -2.43% and FIRR of the electrified train is 0.30%

#### 6) The Study of Environmental Impact and Public Participation

The Environmental Impact Study indicated that the Project development could cause major impact such as on topographical condition, ground resources, surface hydrological condition and draining, air quality, noise, vibration, transportation, use of land, relocation and property compensation. However, after the train operation starts, the overall impact would be at a low level and in turn, would yield positive social impact such as offering a new transportation option to reduce energy cost, promoting tourism, creating jobs and income for economic boost.

The Project has delegated information to the local community, those who might be affected and all stakeholders through various media channels. The first seminar was held on 25 March 2015 at Lee Garden Plaza, Hat Yai, Songkhla and the second seminar was held on 10 September 2015 at Lee Garden Plaza, Hat Yai, Songkhla and the third seminar was held at Lee Garden Plaza, Hat Yai, Songkhla. Moreover, small meeting sessions to illicit public opinion were organized: the first group meeting was held from 19-21 May 2015 and 11 June 2015 and the second group meeting was held from 3-5 October 2015



## Chapter 2

# The Conformity of the Project

### 2.1 The Policy Framework

From the analysis of the conformity of the Project to the National Economic and Social Development Plan and to the Development Plan of Specific Aspects or Specific Area, it can be concluded as follow:

#### 2.1.1 The Conformity of the Project to the National Economic and Social Development Plan

The results of the Study revealed that the Project is conformed to the 11th the National Economic and Social Development Plan (2012-2016) as follow:

1. The DoubleTracks Electric Train Project conforms with the Development Plan Strategies on Strengths in Agricultural Sector, Food and Energy Resources which promotes development and efficiency of logistics of the overall supply chain so tracking of the cargo transport can be assessed to reduce loss and damage of produce caused by poor storage and inefficient transport system. Transport system development focuses on temperature control, reverse monitoring system and also allows the manufacturers and special business organizations to work with the State in the development of logistics system and database network of manufacturing and marketing for agricultural produce.

2. The Double Tracks Electric Train Project conforms with the Development Plan Strategies on Economic Restructuring towards Growth and Sustainability. The infrastructure and logistics development aims to:

- Instill continuously various forms of transportation development toward lower transport cost and higher energy efficiency, effective linkage to other transport modes by road, rail, waterways and air, domestically and internationally. This is aimed to increase efficiency and standard in fast transportation and safety and to improve collecting and delivery of goods to lower overall logistics costs of the country.
- Improve logistics management efficiency by producing professional manpower in logistics, developing transport business network of the supply chain, revising related law and regulations, promoting research on logistic innovations, increasing efficiency and facilities on trading and transport across the border such as NSW and border trading points. Focus should be put on improving transport efficiency and roles of the airports and seaports to reduce transport costs and increase long-term competitiveness of the country



- Improve rail transport system by improving the railroad system and roadway crossing points for service safety, building double tracks on major train routes, allocating locomotive engine and track wheels and installing modern signaling system for higher efficiency of passenger and cargo transport. Focus should also be on development of the high speed trains connecting major regional cities and ASEAN countries and most of all a restructuring of the Rail Transport Authority of Thailand.

3. The Double Tracks Electric Train Project conforms with the Development Plan Strategies on Economic Restructuring towards Growth and Sustainability in relation to the financial management by allowing the private sector to be a part of the State in the development of infrastructure and basic public services, revising related law and regulations to allow private investment partnership in the infrastructure and public services with suitable options for each business endeavor in terms of transparency and risk management on both the private and the public sector.

4. The Double Tracks Electric Train Project conforms with the Development Plan Strategies on Connectivity to the countries in the region to attain economic and social stability by developing linkage of logistics and transport system under the ASEAN Economic Cooperation framework especially the Indonesia-Malaysia-Thailand Growth Triangle Development Project, IMT-GT, Thailand-Malaysia Committee on Joint Development Strategy, JDS.

- 4.1 To develop efficient transport and logistics service with an international standard particularly transport by road, rail, dual tracks train, high speed train and water ways/ coastal transport, to improve border customs points, border economic centers, convenient border passes to save transport energy, to develop networking system of transport and logistics business throughout the supply chain in the region to share resource and knowledge transfer. This will lead to regional economic integration and cooperation among the ASEAN countries toward lower investment cost, higher efficiency in transport system, convenience in travel, trading and across the border transport, regional transport and logistics networking. The State will focus on the overall National Economic Strategies in relation to the economic development framework and the transport and logistics development between the national sub-regions and that in the ASEAN countries. By so doing, the State may initiate a project in any economic zone significant to the Strategies by allowing Public Private partnership: PPP
- 4.2 To develop human resource in the transport and logistics business in foreign language skills and logistics management to assist Thai business entrepreneurs in conducting their transport and logistics business throughout the supply chain, domestically and internationally. To improve business skills among the SMEs entrepreneurs so they can conduct their business with the neighboring countries and to be knowledgeable about the infrastructure linkage along the economic zones and exporting channels in the region. This will build up their business skills so they could compete toward international business. Moreover, as a development partner, Thailand also supports academic cooperation with the ASEAN countries in the development of human resource in transport and logistics business.

- 4.3 To connect the economic development zones along the border and to connect the manufacturing system with the inland area by linking transport network with the manufacturing sources, the manufacturing system, the international supply chain and the international gateways according to the international standard. Moreover, to develop economic networking system with large economic development zones in the neighboring countries with Thai borders and inland economic zones by setting up cooperation centers at the borders between Thailand and the neighboring countries.

## 2.1.2 The Conformity of the Project to the National Policy

The Consultants have conducted an analysis on the conformity of the Project to the National Policy in the following aspects:

### 1. The Economic Restructuring Policy

#### 1.1 The Industrial Sector

- 1.1.1 To boost competitiveness among the industrial sector in the country by Increasing production efficiency, effective energy use and lower production cost;
- 1.1.2 To develop new industrial locations by starting new industrial area in the region to accommodate new industrial investment with no pollution and to develop transport route linking between new industrial areas to the deep sea port.

#### 1.2 The Tourism Sector

Development of tourism industry through tourism-oriented infrastructure development and improvement of standards on facilities and safety

#### 1.3 Marketing, Trading and Investment

Moving forward with setting up special economic zones in the highly potential area particularly the border provinces to promote trading, marketing, investment , employment and use of raw materials from the neighboring countries which in turn supporting transport network among the ASEAN countries.

### 2. The Policy of Mass Rail Transport Development and Cargo Transport and Service management

- 2.1 To develop the Transportation Infrastructure to sufficiently connect the national regions, to save energy and lower transport cost and improve life quality, and moreover, to increase competitiveness and generate income and investment to the rural area with

service fees appropriate to the location, the stakeholders and the consumer protection criteria.

- 2.2 To develop continuously various forms of transport facilities to connect with the manufacturing and export bases and to move forward with the long term restructuring plan of the national rail transport system.
  - 2.3 To develop the rail transport system connecting the network with passengers and freight transport management with convenience and safety in the rural areas, urban area and international transport, and to support the expansion of the manufacturing base along the train route such as the development of the doublel tracks train connecting the suburban area with the major cities.
3. The Policy on Security of Life and Society. Reduction of losses from accidents and traffic accidents, promotion of knowledge accessibility on travel and safe transport.
  4. The Policy on International Affairs and Economics
    - 4.1 To move forward with developing good relations with the neighboring countries through co-operations from the State, private, public and the media sector in order to promote good understanding and close relation for better economic, trading, investment , tourism, transportation and other co-operations under the regional co-operation framework.
    - 4.2 To benefit from the ASEAN transportation network and the sub-regions in expanding the economic base in manufacturing and investment with an attention to the development of the provinces and their clusters along the economic corridor and border towns.

In sum, this Project conforms with the National Policy in many aspects mainly the Policy on Economic Restructuring which will promote industrial development, tourism, trading, marketing and investment. The Project also conforms with the Policy on the Development of Mass Rail Transit, Logistics Management and Service, Policy on Security of Life and Society, convenience and safety of travel. Moreover, by expanding the transport network and service, the Project conforms with the Policy on International Affairs and Economics in economic expansion and border towns.

### **2.1.3 The Conformity of the Project with The Special Development Policy or Development Policy in Specific Location.**

Reviews of related plans that could affect the Project Study particularly some major development plans of transportation networks under the Ministry of Transportation have been conducted.

### 1) Road Transport System

Department of Highways is responsible for development and improvement of the highway network system to accommodate transport of people and cargo between cities and regions and to provide efficiency and safety of travel and transport. The related development plans include:

- The Inter-City Motorway Project
- The Expressway Project in Bangkok and its suburb
- The Expansion of 4-Lanes Highway Project (2nd Phase)
- The Construction of Roadway Connecting with the Neighboring Countries

### 2) Waterway and Coastal Transport System

Department of Harbor is responsible for the development of waterway transport system. The related development plans include:

- The construction of public docks
- The construction of embankment to raise the water level
- The development of the 2nd Songkhla Deep Seaport
- The construction of the Deep Seaport at Pak Bara
- The improvement of the Don Sak multi-purpose pier, Suratthani Province
- The development of a pier at Choornporn Province
- The construction of the multi-purpose pier at Klong Yai, Trad Province

### 3) The Rail Transport System

The Railway Authority of Thailand is responsible for the development of the infrastructure and service of the rail transport. The related development plans include.

- The construction of the new train route of Denchai-Chiangrai-Chiang Khong
- The construction of the new train route of Bua Yai-Mookdaharn-Nakhon Phanom
- The improvement of the 5th and 6th Phase of Track rehabilitation
- The acquirement of diesel-powered and electrical locomotive engine and of carriages for commercial use
- The construction of the 2nd Inland Container Depot: ICD and Container Yard: CY
- The improvement of the train tracks and signaling system for safety
- The upgrading of the transport capacity

## 2.2 The Economic and Social Situation

### 2.2.1 Overview of the Operation and Service

This will look into the present situation and the development plans related to the Project, problems and obstacles and solution measures as follow:

#### 2.2.1.1 The present situation and the development plans related to the Project

The Double Tracks Train Project requires related support factors concerning future passenger activities as follow:

- 1) Trading Business: As the travelling of passengers by train will result on trading business around the station, there must be provisions of business activities for train passengers' needs at and around the stations.
- 2) Industrial Aspect: The Dual Tracks Train can accommodate weight and volume of industrial cargo but with limitation on loading time and accessibility.
- 3) Tourism: In the southern region, there are several locations suitable for setting up train stations to promote tourism and as a transportation option for tourists so they could decide on their travel plan effectively.

#### 2.2.1.2 Problems/Obstacles and Solution Measures

From the Study of Continuous Development Project of Various Transport Modes and Logistics, it was found that the rail transport is deemed high on safety, facilities and service flexibility with some aspects of transport modes that need improvement such as slowness of service and cargo transport time, lack of convenience for service, low accessibility and connection, insufficient capacity to support transport and travel needs.

From the Study, it was found that the rail transport can accommodate up to 85.5 tons-km/liter which will save energy and reduce oil import but the service has not been popular because of its slow service and transport time as the train runs with the highest speed of 60 km/hour for passenger trains and 35 km/hour for freight train (RAT 2009). Moreover, loss of time during train track shifting resulting in unpunctual timetable. The construction of the Double Tracks Train will solve this problem by reducing travel time with no need for track shifting.

Moreover, the rail transport still lacks convenience in service, accessibility and connectivity since most train stations are not located in the economic zones and other forms of transport will be needed for train connection. As in the 11th National Economic and Social Development Plan, the development of the rail transport efficiency has included Multimodal Transportation such as transportation by road, waterway and air so connections with the major train stations can be made for both convenience and

efficiency. The Hat Yai-Padang Bezar Double Tracks Electric Train will therefore provide both convenience, travel time saving and higher efficiency for the rail transport.

## 2.2.2 The Economic and Social Situation

The indicating factors toward the economic and social situation and the potentials of the location which will be used as crucial data in the projection of passenger volume along the route include the following:

- **Songkhla Gross Provincial Product:** GPP In 2013, the fixed gross rate stood at 144,758 m. baht(1.57% and 19.60% of GDP and GRP respectively) and mostly (46.34%) came from the service industry, secondly from manufacturing and agriculture (41.04% and 12.61% respectively). Songkhla GPP in 2013 has risen to 25,131 m. baht or 21.00% from 2004 with an average growth of 2.14% per year.
- **Population** The population of Songkhla is found at 1,401,303 (2.15% of the national population number or 15.21% of the population in the South) with 497,127 households of an average of 2.81 persons per household. The changing rate of the population and households from 2004-2014 was 0.90% and 3.32% per year.
- **Personal Income** The population of Songkhla has an average income of 146,030 baht/year and from 2004-2014, was found to be increasing at a rate of 4.63%/year.
- **•Employment** The employment rate in Songkhla was found at 855,749m people (61.06% of the Songkhla population). From the employment records (The National Statistics Bureau 2014), it was found that during 2004-2014, the ratio between employment and the population has been fluctuated at a changing rate of 1.79%/year
- **Industrial sector** Songkhla has been a location for the industry especially for the manufacturing factories linked with agricultural produce for export such as seafood canning industry, frozen seafood and refrigeration facilities, rubber-processed products such as rubber gloves, furniture (rubber wood), rubber sheets, rubber sticks and factories treating rubber wood, producing compressed wood product, etc. Most factories are located in Hat Yai and Songkhla, respectively
- **Agriculture** Agriculture has been a major sector in the South with most of the population involved in agriculture and the agricultural produce has been the food source of the people for the region and the country. After consumption, whatever is left has been used as raw materials for agriculturally processed products which have created both Value Added products and employment. Moreover, this has created the national income from exporting and decreased imbalance in international trading. Two major agricultural produce are rubber and palm oil.
- **Vehicle Ownership** In 2014, there were a total of 816,024 registered vehicles, 2.27% of the total number of registration in the country and 17.15% of that in the South and 96.98% of



which are sedan, while 2.29% and 0.72% are trucks and buses respectively. The registration number during 2004-2014 has been increasing continuously at a rate of 4.75/year.

- **Tourism** Songkhla has been the center of tourism in the South. In 2013, there were 5,763,439 visitors or 2.65% and 15.31% of the total number of visitors in the country and the South respectively. The number of visitors during 2009-2013 had been fluctuated due to the social unrest along the southern border. However, the changing rate during that time was found at 21.96%
- **Border Trading between Thailand and Malaysia** Border trading between Thailand and Malaysia (mainly export and import) was 38% of the total value. In 2014, the total value was found at 507,655.46 m baht with 274,992.19 m baht in export and 232,663.27m. baht in import and Thailand was found with 42,328.92 m baht of an imbalance of trading value.

Most export products at Thailand-Malaysia border in 2014 were natural rubber, computer parts and accessories, rubber products and processed wood products, etc. with a total value of 33.21%, 9.40% and 5.39% of the total export respectively at a changing rate during 201-2014 of -23.91%, -4.61%,-14.10% and 6.16% respectively.

Most import products at Thailand-Malaysia border in 2014 were data recording accessories, magnetic tapes and plates for computer, computers and accessories, etc. with a value of 10.13%, 9.69% 8.72% and 7.92% of the total value of export products at a changing rate during 2011-2014 of 0.12%, 9.58%, 0.25% and 1.95% respectively.

## 1) Collection of Travel and Freight Transport Data

### ▪ Domestic Passenger Transport

It was found that the number of domestic passenger travel by public transportation during 2009-2013 has decreased from 501.67 m people in 2009 to 474.05 people in 2013 at a reduction rate of 1.41% /year. This has shown that some of the passengers have changed to travel by their personal vehicles. This has corresponded with the increase of personal vehicle registration during 2009-2013 of 6.29%/year. When considering each type of transportation, it was found that the number of passengers traveling between cities by public buses has significantly decreased from 427.31 m. people in 2009 to 395.51 m. people in 2013 as shown in **Table 2.2-1** and **Table 2.2-2** below.

**Table 2.2-1**  
**The Number of Domestic Passengers during 2009-2013 (m. people)**

| Travel Mode  | 2009          | 2010          | 2011          | 2012          | 2013          | Changing Rate (%) |
|--------------|---------------|---------------|---------------|---------------|---------------|-------------------|
| Public buses | 427.31        | 442.30        | 413.97        | 399.90        | 395.51        | -1.91%            |
| Trains       | 47.94         | 44.54         | 44.05         | 41.76         | 37.34         | -6.05%            |
| Air (planes) | 26.42         | 26.94         | 31.18         | 36.33         | 41.20         | 11.75%            |
| <b>Total</b> | <b>501.67</b> | <b>513.77</b> | <b>489.21</b> | <b>477.99</b> | <b>474.05</b> | <b>-1.41%</b>     |

Source: Department of Road Transport, Ministry of Transportation

**Table 2.2-2**  
**Records of Vehicle Registration during 2009-2013 (thousand vehicles)**

| Year                     | Number of registered vehicles (thousand vehicles) |
|--------------------------|---------------------------------------------------|
| 2009                     | 26,258                                            |
| 2010                     | 27,530                                            |
| 2011                     | 29,205                                            |
| 2012                     | 31,440                                            |
| 2013                     | 33,520                                            |
| <b>Changing Rate (%)</b> | <b>6.29%</b>                                      |

Source: Department of Road Transport

## 2) Domestic Cargo Transport

The records from Ministry of Transportation during 2009-2013 have shown that the cargo transport by road was the highest. In 2013, the volume of cargo transport via road was 423 m. tons/year or 80.36% of the total cargo transport while waterway transport and coastal transport were 8.99% and 8.39% respectively.

As for the annual growth rate from 2009 to 2013, it was found that coastal transport has increased the most followed by domestic waterway transport, air transport and rail transport respectively. While the rate of road transport has increased the most, the volume of cargo has not increased accordingly. This has shown that cargo transporters have chosen other transport modes besides roadway. The road transport rate has decreased from 83% in 2009 to 80% in 2013 as shown in **Table 2.2-3**.

**Table 2.2-3**  
**Records of Domestic Cargo Transport during 2009-2013**

| Transport Modes   | 2009           | 2010           | 2011           | 2012           | 2013           | Changing Rate(%) |
|-------------------|----------------|----------------|----------------|----------------|----------------|------------------|
| Road              | 423,677        | 420,449        | 406,538        | 425,804        | 423,984        | 0.02%            |
| Train             | 11,517         | 11,288         | 10,667         | 11,849         | 11,817         | 0.64%            |
| Domestic Waterway | 41,561         | 48,185         | 46,932         | 47,423         | 47,422         | 3.35%            |
| Coastal           | 35,692         | 36,731         | 41,273         | 34,968         | 44,261         | 5.53%            |
| Air               | 104            | 121            | 131            | 130            | 122            | 4.07%            |
| <b>Total</b>      | <b>512,551</b> | <b>516,774</b> | <b>505,541</b> | <b>520,174</b> | <b>527,606</b> | <b>0.73%</b>     |

Source: Ministry of Transportation

## 2.3 The Conformity of the Project with other Related Projects

### 2.3.1 Overview of the Conformity

#### 1) The Development Project of Multi-Modal Transportation and Logistics Toward Activation Plan

To promote multi-modal transportation aimed at lowering domestic logistics costs, it is deemed suitable to move forward first with rail and waterway transport development with road transport as Feeder connecting ICD points with the manufacturing and consumption locations. This is because road transport can access any location on a Door-to-Door service basis as follow:

1.1) Road Transport Network Project should develop the motorway system connecting cities as follow:

- Pattaya-Map Ta Phut
- Bang Pa-In – Nakhon Ratchasima
- Bang Yai- Ban Pong-Kanjanaburi
- Ban Pong-Pak Thor-Cha-am
- Cha-am-Prajuap Khirikhan-Choomporn
- Bang Pa-In- Ang Thong
- An extension of The Motorway between Bangkok-Chonburi-Pattaya into 8 traffic lanes

1.2) Rail Transport Network Project should focus on the development of the dual tracks train system in the South as follow:

- Nakhon Pathom-Nong Pla Dook-Hua Hin
- Prajuapkhirikhan-Choomporn
- Hua Hin=Prajuap Khirikhan
- Choomporn-Suratthani
- Suratthani-Padang Bezar
- Hat Yai- Sungaikolok

- Thoongsong-Katang

1.3) Coastal Transport Network should focus on the development of public docks to support coastal transport particularly the development of the second Songkhla Deep Seaport in Suratthani, the Deep Seaport at Pak Bara and promotion of private investment in the coastal transport service connecting with Laem Chabang Seaport.

1.4) The Multi-Modal Transportation Linkage. The linkage points recommended to be developed are:

- Nakhon Ratchasima: CY at Koot Chik Train Station
- Khon Kaen: CY at Tha Phra Train Station
- Nakhon Sawan, Kamnan Song Rice Station
- Phra Nakhon Sri Ayutthaya and Ang Thong
- Choomporn: CY at Wisai Train Station
- Suratthani: CY at Ban Thoong Pho Depot
- Cargo transport border stations: Mae Sot district, Tak Province, Muang District, Nong Khai Province, Muang District, Mookdaharn Province, Chiang Khong District, Chiangrai Province

## 2.3.2 The Conformity of the Project with other Related Projects

### 1) The Development Plan of the Double Tracks Train across the Country

Recommendations are made on the available capacity of the existing train routes and the frequency of use to be applied on the basis of decentralization development. These have been approved by the Economics Committee. The details of the projects are found in **Table 2.3-1**

**Table 2.3-1**  
**The Development Plan of the Double Tracks Train System**

| Phase                            | Train Routes                        | Distance (km.) |
|----------------------------------|-------------------------------------|----------------|
| <b>1st Phase<br/>(2010-2014)</b> | Lopburi-Nakhon Swan-Pak NamPho      | 118            |
|                                  | Map kabao-Thanon Jira Depot         | 132            |
|                                  | Thanon Jira Depot-Khon Kaen         | 184            |
|                                  | Nakhon Pathom-Nong Pla Dook-Hua Hin | 165            |
|                                  | Prajuap Khirikhan-Choomporn         | 166            |
| <b>2nd Phase<br/>(2015-2519)</b> | Thanon Jira Depot-Ubon Ratchathani  | 309            |
|                                  | Khon Kaen-Nong Khai                 | 172            |
|                                  | Pak Nam Pho- Tapan Hin              | 69             |
|                                  | Hua Hin- Prajuap Khirikhan          | 89             |
|                                  | Choomporn-Suratthani                | 166            |
|                                  | Kang Khoi-Bua Yai                   | 220            |
| <b>3rd Phase<br/>(2520-2524)</b> | Tapan Hin-Chiang Mai                | 427            |
|                                  | Suratthani-Padang Bezar             | 339            |
|                                  | Suratthani-Padang Bezar             | 76             |
|                                  | Hat Yai-Sugnaikolok                 | 214            |
|                                  | Thoongsong-Kantang                  | 93             |
|                                  | Kabinburi-Klong Luek                | 98             |

From the 1st Development Phase of the Double Tracks Train System, it was found that the Project has been under the consideration process of the Office of Policy and Planning of Natural Resources and Environment. Therefore, necessary modifications of investment plans should be made for better conformity with the State Policy.

However, an immediate development project of the Double Tracks Train System should be moved forward with the present northern, north-eastern and southern routes to solve the bottle-neck problems on the southern route of 767 km. including Lopburi-pak Nam Pho, Map Kabao-Thanon Jira Depot, Thanon Jira depot-Khon Kaen, Nakhon Pathom-Nong Pladook-Hua Hin and Prajuap Khirikhan-Choomporn. The projects include:

- construction of new reinforced shoulder and effective drainage system
- installing 100 pd. tracks on reinforced concrete planks
- building cross-over bridge
- installing fences along the train routes
- installing/improving automatic barring equipment
- installing the signaling system
- improving train stations
- building new repair shops

## 2) The Study and the Design of the Nakhon Pathom-Hua Hin Double Tracks Train System by SRT

This Development Project of the Double Tracks Train System covers 170 km. with a construction of a new train route running parallel with the existing one with the width of the tracks at 60 m. The route starts at km.47+700 at Nakhon Pathom station heading west to Nong Pladook Depot covering 16.5 km. before turning left and running southward passing Ratchaburi and Phetburi and ends at km.217+700 , 4 km past Hua Hin station. At the station from km.211+589.900 to km 215+872.900 covering 4.290 km., the 1.00 meter gauge tracks are elevated and surfaced with ballast. The UIC54 tracks are placed on Mono Block Sleepers. Automatic signaling and telecom system are installed at the Nakhon Pathom-Hua Hin section. When the Dual Tracks Train of Nakhon Pathom-Nong Pladdok Depot-Hua Hin is ready for operation in 2015, the capacity of the cargo transport will increase from 1m. tons/year to 1.5 m tons/year, and the number of passengers will increase from 6m people/year to 12 m people/year with an increase of 200 trains/day. This will provide convenience and reduce travelling time from Bangkok to Hua Hin from 3 hours to 2 hours.

## 3) The Study and Design of the Prajuap Khirikhan- Choomporn Double Tracks Train System

The Development Project is aimed at increasing the train capacity, efficiency and safety of travel to accommodate an increasing demand of transportation for passengers an cargo. The Dual Tracks Train system will reduce travel time by avoiding track shifting and offer punctual operation timetable for higher service satisfaction. This will draw more cargo transport business and reduce transport cost by saving energy. The Dual Tracks Train covers 167 km. with 1.00 Meter Gauge tracks and 21 stations (including Prajuap Khirikhan station and Choomporn station), 5 additional stopping points and dismantling 14 stations. The train route runs through two provinces and six districts. The Project will benefit the local population in terms of travel convenience and the local industry in terms of cargo transport convenience. This will cut logistics costs and increase competitiveness of the country beneficial to the economic and social system and worthy of the investment.

## 4) The Feasibility Study and Preliminary Design of the Freight Train System Connecting between The Ports along the Gulf of Thailand with those on the Andaman Coastline

The construction of the train system for cargo transport connecting between the ports along the Gulf of Thailand with the Andaman coastline will boost the economic development of the South of Thailand as a land bridge serving as the Gateway of exporting products from other regions of Thailand or even from the south of China outward to the Andaman Sea onward to Europe, Africa, the Middle East and South Asia without passing through the Melaka Strait. This will allow new cargo transportation route, exports and imports, transshipment through Thailand creating our

country's competitiveness with our neighboring country which has been developing its deep seaport on the west (the Andaman Coast) and also on the east (The Gulf of Thailand Coast).

Tran-shipment of cargo through the Land bridge mode will replace transshipment of cargo through the Melaka Strait via the ports in Singapore or Malaysia to the new tran-shipment route at Pak Bara Deep Seaport and Songkhla Deep Seaport via Land bridge mode connecting between the two ports. This route will serve an increase of cargo transport between Europe and Asia.

The location of the Project is shown in Figure 2.3-1

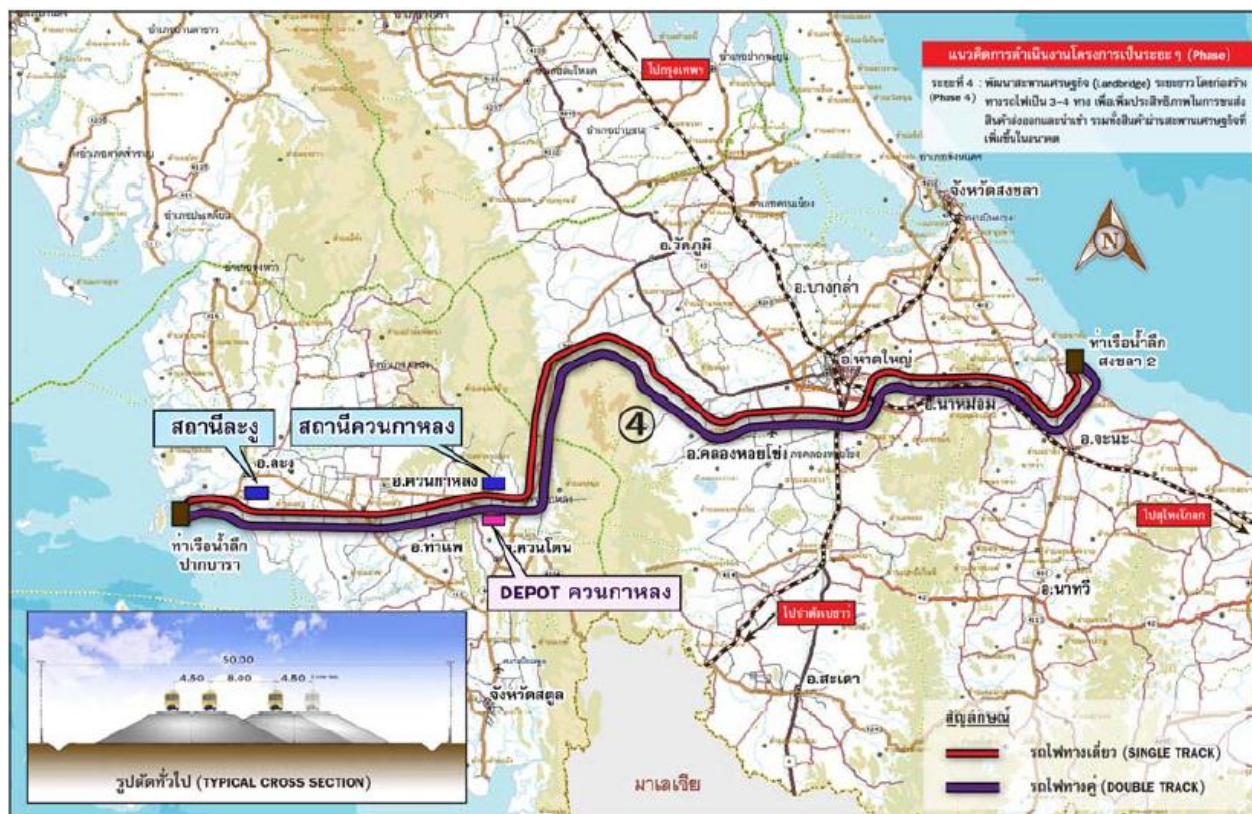


Figure 2.3-1 The Location of the Cargo Transport Train Connecting between The Gulf of Thailand Coast and The Andaman Coast





## Chapter 3

# The Feasibility of the Project

### 3.1 The Feasibility of the Project Locations

#### 3.1.1 The Availability of the Location Preparation

The train route of this Project will use the existing carriageway of 80 m. width and will expropriate additional land along the new route for radius curving adjustment to obtain the designed speed.

In the preparation of the construction of the Project site already SRT's property, SRT can proceed by informing the renters or land users to leave the premise as agreed in the lease and with compensations on building dismantling as specified in the SRT land expropriation regulations. While most of the additional site for expropriation is farm land, a Decree of Land Expropriation must be stipulated with reference to Act of Land Expropriation 1987 and Guidelines on Land Expropriation Compensations 2013.

The additional land for expropriation starts from km.966+100 to km. 967+500 located at Thoong Mor Sub-district and Padang Besar Sub-District, Sadao District, Songkhla Province covering 9 plots of 35,166.41 square meter or 21.98 rais.

#### 3.1.2 The Availability of the Facilities at the Project Location

As most of the Project location is found on the existing train line cutting across Highway 4 and several large communities, the facilities such as entrance to the station, etc. are already available including public utilities needed for the station and other buildings, electrical system, pipe water system and sanitary system. These can be easily accessed and linked to the Project location along the highway. As for the design of the Station compound, the Consultants have considered future needs of public utilities and included necessary details such as the electrical system for the train operation, the road network, etc.

The basic public utilities needed for the Double Tracks Electric Train system and the stations include the following:

- 1) The road and lighting system on Highway 4 is found near the station and can be extended into the station compound with additional modifications of street lights, direction signage to facilitate passengers' entrance and exit to the station daytime and nighttime. The station network are:

## 1. Sala Thung Lung Station

- Location
  - km. 944+900
  - Located at the present Thung Lung Station no longer used
  - Existing station located in the center of Thung Lung marketplace, Ban Thung Lung, Patong Sub-district, Hat Yai District, Songkhla Province. The location is between the SRT property and Hat Yai Highway-Sadao-Dan Nok or Kanjanawanit Road.
  - Around the station area, there are residential communities, schools, temples, houses and markets. Currently, the station building no longer exists. Only the station signage and the platform can be found with the area turned into public park and garden.
- Physical Features Overview
  - North: ground level through path, school ground, Thung Lung community connected with Ban Phru Sub-District; the train route heading to Hat Yai
  - South: Thung Lung community and some unoccupied area, connected with Kha Mee Kiat Sub-District; the route heading to Padang Besar.
  - East: mostly rubber plantation and some residential community
  - West: the entrance roadway and Thung Lung rotary entering from the main road to Hat Yai-Sadao-Dan Nok Highway or Kanjanawanit Road; existing station and platform turned into public park and garden.

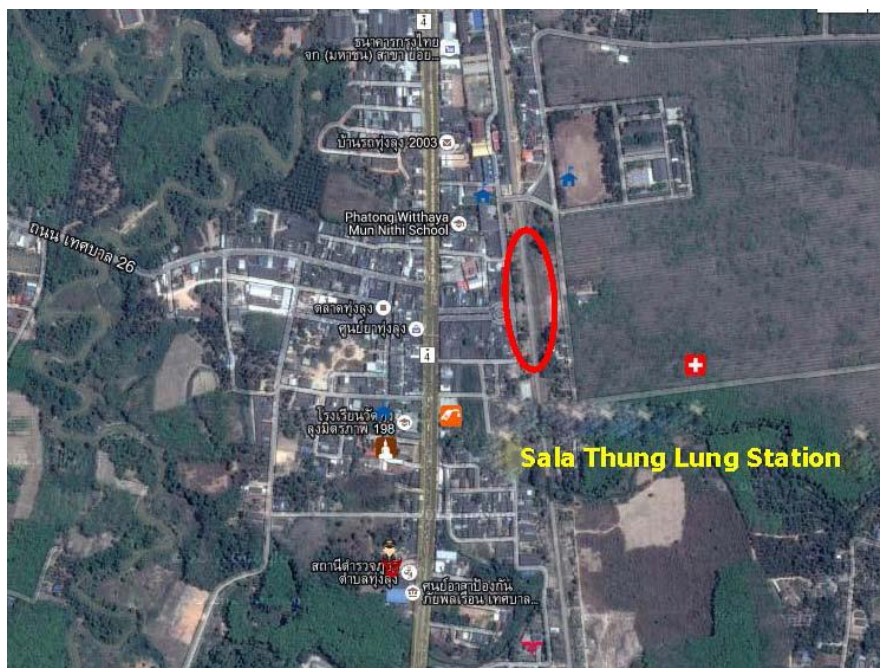


Figure 3.1-1 The Present Location of Thung Lung Station

## 2. Khlong Ngae Station

- Location
  - Km.952+600
  - Located at the current station, the only station along the Hat Yai-Padang Besar route still in operation.
  - The station located in the center of Khlong Nage community between the train route and Hat Yai-Sadao-Dan Nok Highway or Kanjanawarit Road.
  - Around the station area, there are residential communities, schools, houses. The location is found between the main road and the commuting road within the community along the train tracks and Khlong Ngae market.
- Overview Physical Features
  - North: ground level through path, school ground, Khlong Ngae community connected with Thung Lung sub-district; the train route heading to Hat Yai
  - South: Khlong Ngae community with unoccupied area along the train route with a ground level through path crossing with Tha Pho road; the train route heading padang besar
  - East: residential community, business buildings, Khlong Ngae market and Hat Yai-Sadao-Dan Nok Highway or Kanjanawarit road; entrance and exit to the station
  - West: residential community along the train tracks flanked with commuting roads in the community

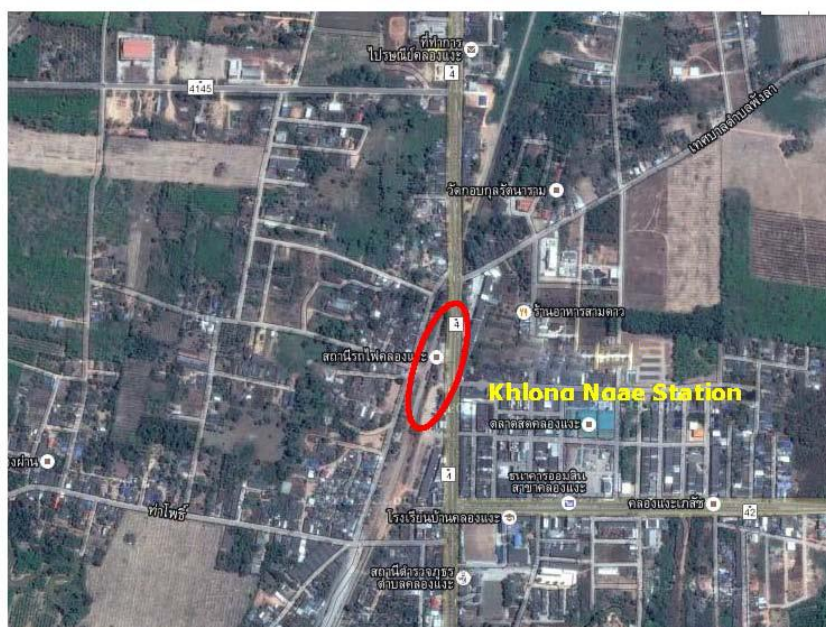


Figure 3.1-2 The Location of the Present Khlong Ngae Station

### 3. Padang Besar Station

- Location
  - km.972+900
  - Located on the SRT property; some area turned into Padang Besar public park.
  - The train route stops before Padang Besar Station 500 m. before Malaysia (the borderline).
  - The site of Padang Besar Station 2 has been under construction (within Thai border) to replace the previous station as there had not been any station but only a train stopping point here at Highway 973+000.
  - The station is found within the public park area, community and Padang Besar market, Thai-Malaysian border near Padang Besar Customs, Sadao Immigration Check Point.
- Physical Features Overview
  - North: ground level through path, Khlong Ngae community, connected to Thung Lung Sub-District; the route heading to Hat Yai.
  - South: Connected with SRT's Unloading Yard/Container Yard, Thai-Malaysian border, residential community and marketplace; the train route heading to Padang Besar.
  - East: Public park area surrounded with drainage canal, some encroaching from houses and residential community, business buildings along Highway 4054 (Sadao-Padang Besar), the main road heading to Sadao border crossing point.
  - West: Public park area flanked with Pong Phol Road, the entrance-exit to the station, residential community along the train line.



Figure 3.1-3 The Location of Padang Besar 2 Station (On the Thai border)



- 2) The Drainage and Flood Prevention System There is no rainwater draining or flood prevention system around the station and the surrounding buildings and none around Thung Lung Station, Khlong Ngae Station and Padang Besar 2 Station, Such a system is needed to reduce the impact from heavy rain. The design must include rainwater absorption and draining from the site to prevent flooding.
- 3) The Sewage and Water Treatment System Along Highway 4, there is found the existing sewage pipe to drain sewage and excess water from the buildings at the station but a new effective design according to the specified standard to reduce environmental impact to the surrounding community.
- 4) The Electrical System Along Highway 4, there are electrical power stations but more sub-stations will be needed to supply the high voltage electrical lines for the operation of the electric train and other related activities at the station and surrounding buildings.
- 5) The Telephone and Telecommunication System At the site, there is optic fiber cable along Highway 4 but for the train operation, both telephone and mobile cellular network must be installed to meet the demand of the passengers.

## 3.2 The Service Facilities

### 3.2.1 The Service Facilities related to the Project

The Hat Yai- Padang Besar Double Tracks Electric Train System provides the following basic service facilities:

- 1) The train route
- 2) The train tracks
- 3) The track system
- 4) The station and the platform
- 5) Split level track crossing points

These basic service facilities will be provided to the passengers of the train particularly around the station. The design will consider the convenience and time of the passengers' connections to other travel modes or destinations in the following areas:

- The parking area for the train passengers who will use the high speed train to travel to other cities.
- The parking area for mass transit buses that will bring the passengers to the station such as local buses, medium-sized truckspicking up cargo from the train.
- The business area providing business activities to the passengers at the station and making a full use of the station such as banks, food court, shopping arcade and post office.

### 3.3 The Steps and Operation Periods

The Hat Yai-Padang Besar Double Tracks Electric Train Project covering a distance of 44.5 km. consists of the following operations:

- The construction of the ground level single track of 45 km.
- The construction of the ground level double tracks of 7 km.
- The construction of the elevated double tracks of 5 km.
- The construction of 2 ground level stations and 3 stops
- The construction of one elevated station (Khleng Ngae Station)
- The construction and improvement of the track crossing points, signaling system and telecommunication system

The construction plan will consider the safety and impact of the construction steps that may occur to the train operation and other train systems. The construction steps can be divided into 6 steps as shown in **Table 3.3-1**.

- 1) The preparation steps which will take approximately 3 months include the following
  1. The preparation for the construction of the Project office, on-site office, and construction workers' lodging
  2. The detailed survey of the Project route to be used in the construction and the calculation of the actual workload
  3. Obtaining permit for the construction materials, procurement and import of materials such as the tracks, etc
- 2) The civil and structure work which will take approximately 21 months include the following:
  1. The construction of the carriageway and sub-ballast.
  2. The drainage system: RC Pipe Culvert and Box Culvert.
  3. The construction of the bridge crossing the water channel.
  4. The Construction of the Station ,Entrance and architectural design of the station.
  5. The Construction of the underpass level crossing points .
- 3) The track system work which will take approximately 24 months include 2 areas of work:
  1. Track Materials Supply. As the track materials such as tracks, switchers, locks, have to be imported from overseas and take time in the manufacturing process while the reinforced sleepers can be manufactured in Thailand. However, the ordering and testing steps would take about 14 months.



2. Lay Plain Track work includes setting the route, adjusting the sleepers, installing the tracks and switchers. Importing process will generally take about 3 months and after that, assembling of the tracks will take place as the tracks will be shipped in shorter pieces of 25 meters long. The assembling will take place at the shop before the tracks are transported to the location. This process will take about 6 months and the installing of the tracks has to wait for the completion of the earth work. The track installing process will then take about 18 months.
3. The Electrical and Transmission System Work will take about 15 months.
4. The Signaling and Telecommunication Work will take approximately 15 months including the following:
  - The moving of the existing signaling system, the telegram poles and the fiber optic cable, and the installment of the signaling system at the temporary crossing point during the construction period which will take about 15 months.
5. The Testing of the Train Operation will take about 2 months.

Table 3.3-1  
The Construction Plan

| Order | Work                                                                  | Period (month) |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------|-----------------------------------------------------------------------|----------------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|       |                                                                       | 1              | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| 1     | Preparation work                                                      |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 2     | Civil Works                                                           |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 2.1   | Carriageway and drainage work                                         |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 2.2   | Bridge construction                                                   |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 2.3   | Construction of the station and entrance/exit                         |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 2.4   | Construction of the overpass and underpass                            |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 3     | Track system work                                                     |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 3.1   | Preparation of track materials                                        |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 3.2   | Track installment                                                     |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 4     | Electrical system and electrical transmission for the train operation |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 5     | Signaling system                                                      |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 6     | Testine of the train operation                                        |                |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

### 3.4 The Technical Feasibility

#### 3.4.1 The Feasibility of the Capacity to Service and Accommodate the Volume of Passengers and Cargo

##### 3.4.1.1 The Specification of the Location of the Stations

Along the Hat Yai-Padang Besar Train route, there will be 4 stations and 3 stopping points. The Project design of the stations

has been adjusted to be suitable with the train operation concept and future travel modes. The old stations such as Sala Thung Lung Station, which is no longer used will be rebuilt and modernized while the current one such as Khlong Ngae Station, will be renovated to harmonize with the new image of the Project. More stops will be added to provide a full service cycle such as Ban Phru Stop, Khlong Rum Stop, Tha Khoy Stop.

On the feasibility of the location of the station compound, the design has paid attention to the full use of land and facilities to support related activities and accessibility to the station. The preparation of the location considers future development with reference to the City Planning and problems that may arise from land expropriation.

However, the modifications of the roles of the stations and the development guidelines of the station compound can be described as follow:

The location of the stations: 4 stations and 3 stops:

- **Hat Yai Junction** Located at the current Hat Yai Depot and working as the departure point; the design already included in the renovation of Hat Yai Depot under the Suratthani-Hat Yai-Songkhla Double Tracks Train
- **Ban Pru Stopping Point** Located within the train area at Ban Phru Sub-district, Hat Yi District, Songkhla Province
- **Sala Thung Lung Junction** Located at Sala Thung Lung Station, Patong Sub-district, Hat Yai District, Songkhla Province
- **Khlong Ngae Junction** Located at the current Khlong Ngae Station
- **Khlong Ram Stopping Point** Located within the train line at Ban Khlong Ram, Thung Mor Sub-district, Sadao District, Songkhla Province
- **Ban Tha Khoy Stopping point** Located within the train line at Ban Tha Khoy, Padang Besar Sub-district, Sadao District, Songkhla Province
- **Padang Besar 2 Junction** Located within the train area near Padang Besar Station 2 on the Thai border, Padang Besar Sub-district, Sadao District, Songkhla Province. At present, this area has been turned into public park and some occupied as residence and business shops.

The modifications of the roles of the stations and development guidelines of the Project can be summed up as follow:

**Table 3.4-1**

**Summary of the Modifications of the Roles of the Stations and Development Guidelines of the Station Compound**

| Station/Stopping Point | Modifications of Roles                 |         | Development                    |                                  |
|------------------------|----------------------------------------|---------|--------------------------------|----------------------------------|
|                        | Present                                | Future  | Present building               | New building                     |
| Hat Yai                | Station                                | Station | Still in operation             | Suratthani-Hat Yai Depot Project |
| Ban Phru               | Non-existing                           | Stop    | None                           | New waiting building             |
| Sala Thung Lung        | Station area still remaining           | Station | None                           | New building (Type:S)            |
| Khlong Ngae            | Station                                | Station | Still in operation             | New building (Type:S)            |
| Khlong Ram             | Non-existing                           | Stop    | None                           | New waiting building             |
| Ban Tha Khoy           | Non-existing                           | Stop    | None                           | New waiting building             |
| Padang Besar 2         | Under construction to be a sub-station | Station | New station (not in operation) | New building (Type:M)            |

### 3.4.1.2 Projection of the Passenger and Freight Volume

#### 1) Steps and Procedures

##### • The Study Framework

In conducting the Analysis and the Projection of the Volume of Passengers and Freight, the Consultants will refer to the National Area Model (NAM) which has been designed for the development and maintenance of database and information and has been used as a model to develop multi-modal transportation and logistics (TDL) under Office of Transportation. This model can be applied in the analysis of the volume of the multi-modal transportation such as by car, train, air and waterway.

The operation procedures of the model takes 4 steps: Travel Initiation Model, Travel Distribution Model, Selection of Travel Mode Model and Types of Travel Model. The National Area Model (NAM) consists of 2 models:

- Passenger Model
- Freight Model

##### • The Division of the Area of the Study

In the Study, the Consultants have divided the study area in Songkhla into sub-districts to reflect precise travel behavior as shown in **Figure 3.4-1**. Besides the sub-district divisions of the area, the study also looks into the location along Thai border: 12 border crossing points and 38 Logistic Nodes.

## 2) Transport Network Model

Transport Network Model will be developed from the Database and related maps along with the collected data from related offices. The data on the road network will be used in the study of traffic and stored in the computer as “Node” and “Link”. “Node” will be coded with number references while “Link” will be considered as the route connecting from one Node to the other. The details on the road and public transportation network will only apply these “Links” in the selection of the travel mode. Besides, there will be “Centroid” of each sub-division of the location used as the starting and ending point of each travel between those sub-division locations. The details of the Transportation Network are:

- The Road Network: The data in drawing the Road Network Model include distance, the capacity of the road, the types of the road, etc.
- The Public Transportation Model looks into 3 main travel modes: train, water and coastal, and air. The data used in the Model include route/line, travel mode, service company, fare tables, location of the station, capacity, speed.

The details of the present Transportation Network will be brought into consideration which include the transportation network by road, train, air, water and coastal channel and also the linkage with other transportation locations such as cargo transport stations, seaports, airports, train stations, etc. as shown in **Figure 3.4-2**

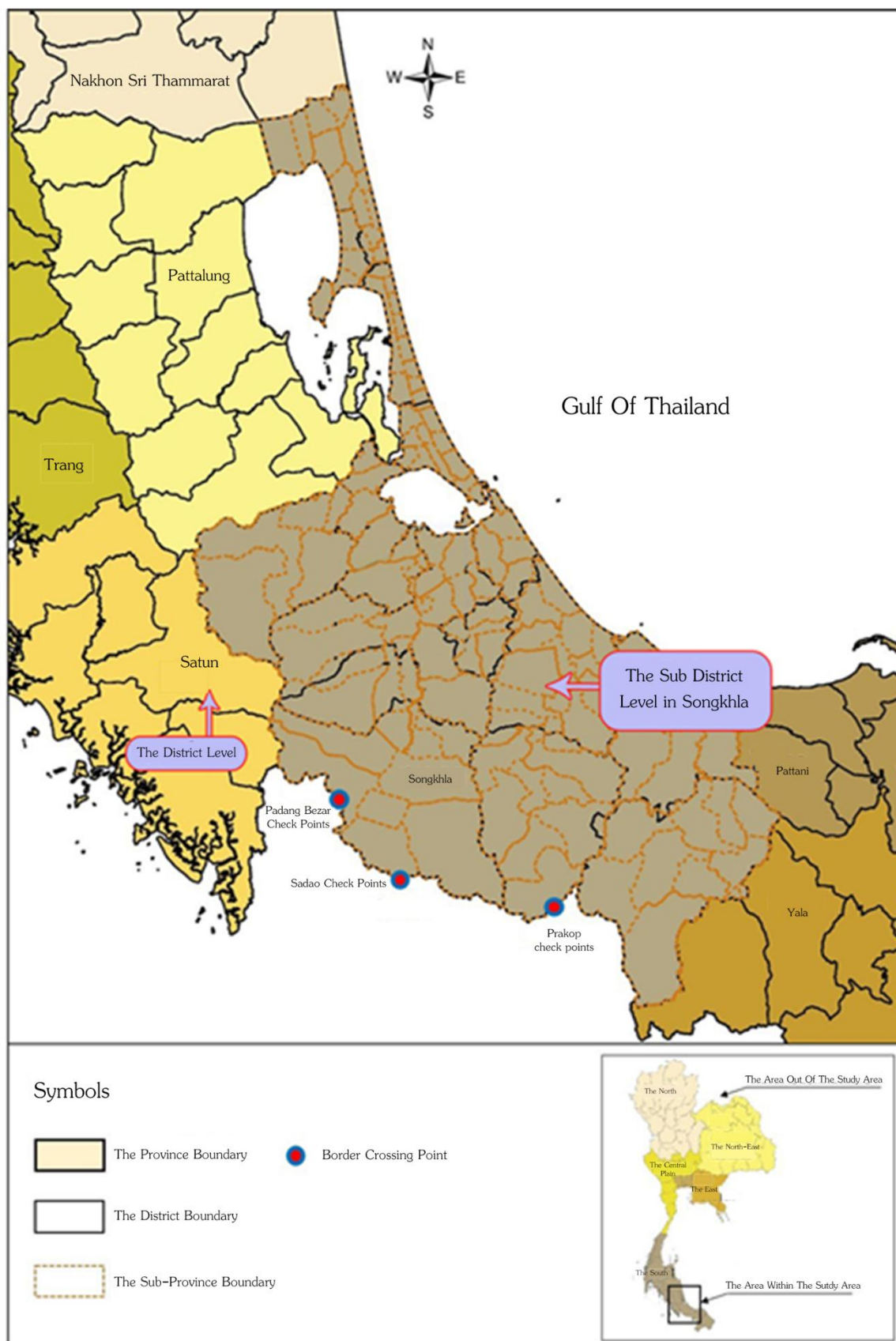


Figure 3.4-1 The Sub-Divisions of the Study Area

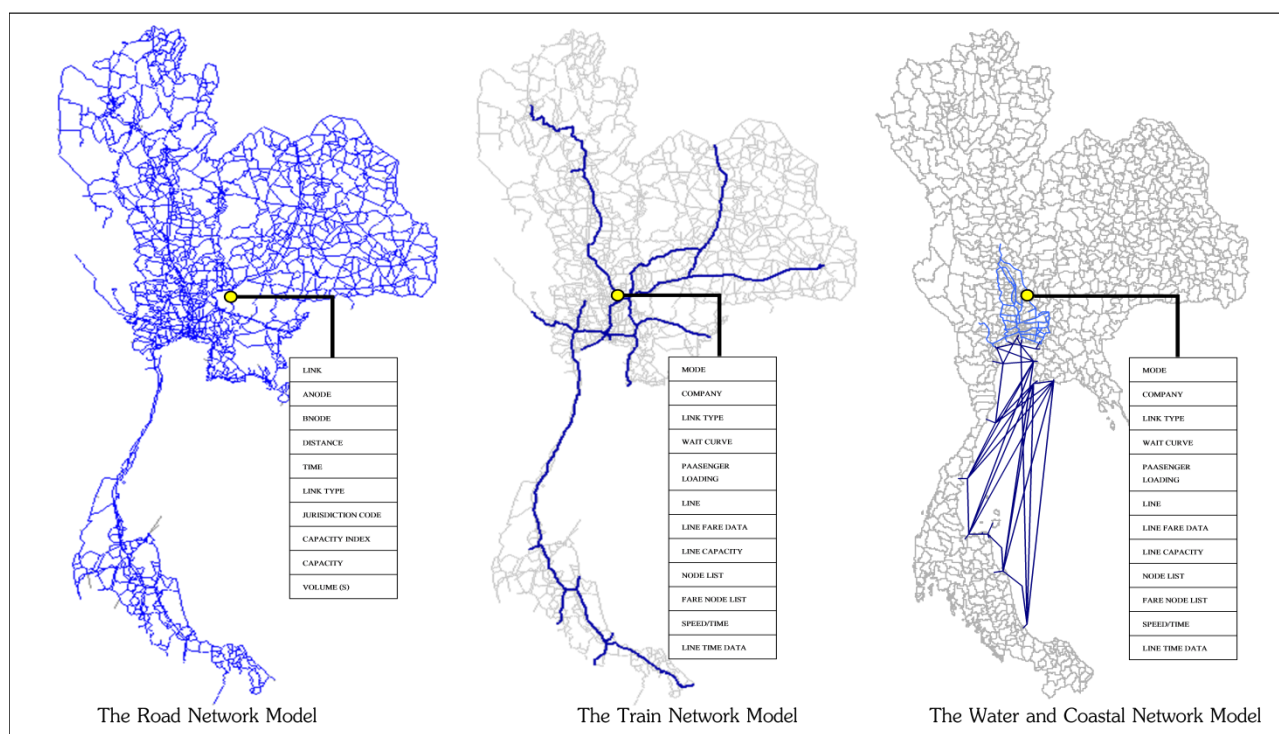


Figure 3.4-2 The Multi-Modal Transportation Model

### 3) The Location of the Stations

In the Projection of the Passenger and Freight Volume, the specification of the location of the boarding and de-boarding stations must be clearly made. On the Hat Yai-Padang Besar Train route of a total 44.5 km., the stations and the stops are specified as follow:

- Hat Yai Depot
- Ban Phru Stopping Point
- Sala Thung Lung Station (Patong)
- Khlong Ngae Station
- Khlong Ram Stoppint Point
- Tha Khoy Stopping Point
- Padang Besar Station

### 4) The Modification of the Models

The Consultants have compared the Passenger Travel Model with the collected data and additional survey data by adjusting several variables in the Model to draw out realistic collaborations before its application to the Projection as shown in **Figure 3.4-3** It was found that  $R^2$  was quite high. In sum, the validity of this Model is acceptable and the Model can be used in the Projection of Travel and Transport Volume.



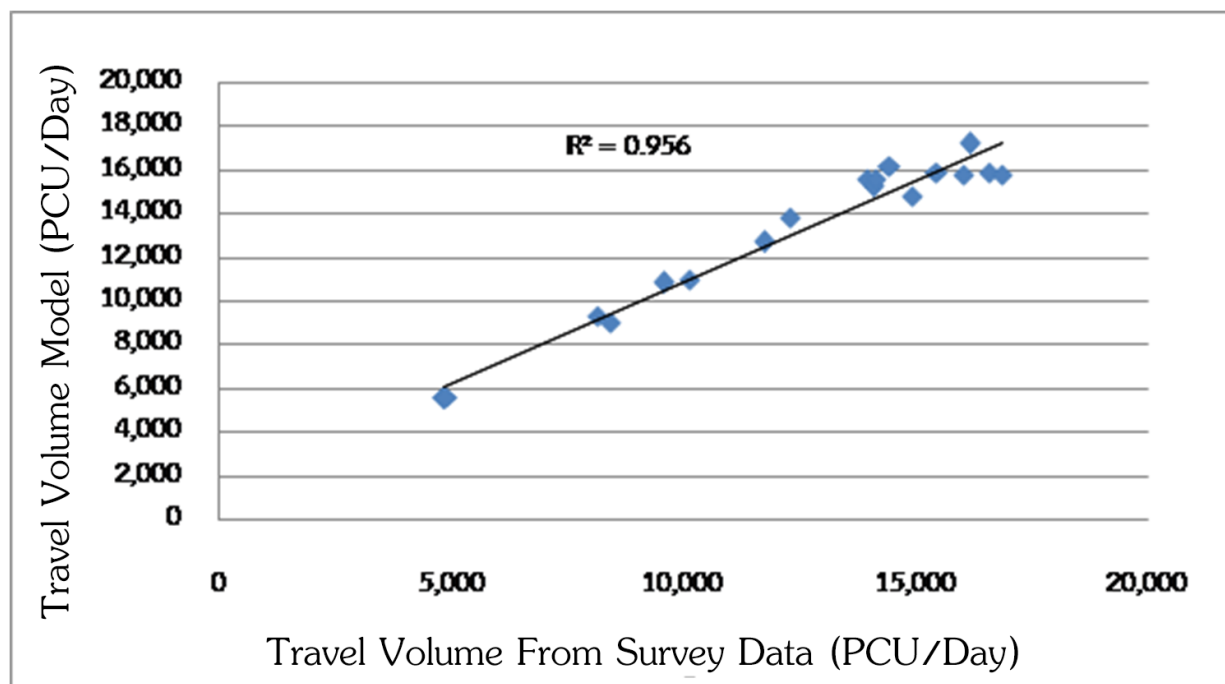


Figure 3.4-3 The Results of the Model Comparison

#### 5) The Projection of the Passenger Volume

##### ▪ The Analysis of the Present Transportation Volume

At present, transportation on the Study location can be grouped into 4 types: personal cars, public buses, trains and airplanes. The volume of each type is shown in Table 3.4-2. It was found that there were approximately 220,795 people travelling on the Study location, of which 156,062 people or 70.68% travel in the personal cars, 51,694 people or 23.41% by public buses and 8,157 people or 3.86% by plane and 2.05% by train.

Table 3.4-2  
The Present Types of Transportation

| Type of Transportation | Transportation Volume (People/day) | %              |
|------------------------|------------------------------------|----------------|
| Personal cars          | 156,062                            | 70.68%         |
| Public buses           | 51,694                             | 23.41%         |
| Trains                 | 4,522                              | 2.05%          |
| Airplanes              | 8,517                              | 3.86%          |
| <b>Total</b>           | <b>220,795</b>                     | <b>100.00%</b> |

Source: The Consultants

However, when considering the distribution of transportation between different locations, it was found that most transportation between Hat Yai and the upper north of the South was 35,289 people or 15.98% of the total volume, between Hat Yai and Songkhla province was 28,838 people or 13.06%, and 22,038 people or 9.98% was between Sadao and Hat Yai.

Moreover, when looking at the distribution of transportation between the major border check points in Songkhla and other areas, it was found that:

- Travel in and out at Sadao Border check point was 17,238 people /day with most of the number, 7,160 people or 41.54%, travel between Sadao District and Sadao border check point while 4,449 people or 25.81% travel between Hat Yai and Sadao, and 2,337 people or 13.56% between Songkhla and Sadao border check point.
- Travel in and out of Padang Bezar border check point was 2,427 people /day, 1,504 people or 61.98% of which travel between Hat Yai and Padang Bezar border check point, and 360 people or 14.85% between Songkhla and Padang Bezar border check point, and 326 people or 13.42% between Bangkok and its vicinity and Padang Bezar border check point.

#### ■ The Projection of Future Travel Volume at the Study Location

From the Projection a shown in **Table 3.4-3**, it was found that in 2021, the total travel volume would be 264,673 people/day, with an increase to 334,219 people/day, 423,597 people/day and 490,612 people/day in 2030, 2040 and 2050 respectively, or at an increase of 2.3%/year.

**Table 3.4-3**  
Travel Volume According to Types of Transportation

| Types of Transportation | 2021                            |            | 2030                            |            | 2040                            |            | 2050                            |            |
|-------------------------|---------------------------------|------------|---------------------------------|------------|---------------------------------|------------|---------------------------------|------------|
|                         | Travel volume (people-trip/day) | %          | Travel volume (people-trip/day) | %          | Travel volume (people-trip/day) | %          | Travel volume (people-trip/day) | %          |
| Personal cars           | 185,026                         | 69.91      | 232,236                         | 69.49      | 291,803                         | 68.89      | 337,782                         | 68.85      |
| Public buses            | 58,460                          | 22.09      | 71,803                          | 21.48      | 85,978                          | 20.3       | 95,412                          | 19.45      |
| Trains                  | 10,645                          | 4.02       | 15,946                          | 4.77       | 24,458                          | 5.77       | 32,134                          | 6.55       |
| Airplanes               | 10,543                          | 3.98       | 14,234                          | 4.26       | 21,358                          | 5.04       | 25,284                          | 5.15       |
| <b>Total</b>            | <b>264,673</b>                  | <b>100</b> | <b>334,219</b>                  | <b>100</b> | <b>423,597</b>                  | <b>100</b> | <b>490,612</b>                  | <b>100</b> |

Source: The Traffic and Transportation Model

When comparing the proportion of transportation types between 2015 and 2050, it was found that in 2050, travel by personal cars and public buses would decrease while travel by train and plane would increase. This could be explained by the fact that the State organizations have been promoting public transportation system within their important planning and policy; for example, The Development Project of the Double Tracks Train System which will provide travel speed and punctuality by train; The Development of Travel and Transport by Plane which has been supporting low cost airlines to attract more passengers. However, The Road Network

Development Plan also aims to develop motorway system between Hat Yai and Malaysian border to meet the increasing volume of travel in and out at Sadao border check point.

#### ■ The Projection of Passenger Volume at the Study Location

The Projection of Passenger Volume of the Hat Yai-Padang Bezar Train as shown in **Table 3.4-4** has indicated that in 2021, the starting year of the train operation, the volume of boarding passengers would be 4,732 people/day and increase to 7,405, 10,857 and 15,470 people/day in 2030, 2040 and 2050 respectively. When considering the number of boarding and de-boarding passengers at each station, it was found that the highest number was found at Hat Yai Station, and secondly Padang Bezar Station which is the departure and destination station. It showed that 35% of the total number of passengers was at Hat Yai Station. When considering the MaxLine Load as shown in **Table 3.4-5** and **Table 3.4-6**, it was found that in 2021, the maximum volume would be 2,319 people/day/direction with an increase to 3,629, 5,320 and 7,581 people/day/direction in 2030, 2040 and 2050 respectively.

**Table 3.4-4**  
The Projection of Passenger Number (people-trip/day)

| Year | Passenger Number(people/day) | Passenger Number(people/year) |
|------|------------------------------|-------------------------------|
| 2021 | 4,732                        | 1,727,180                     |
| 2030 | 7,405                        | 2,702,825                     |
| 2040 | 10,857                       | 3,962,805                     |
| 2050 | 15,470                       | 5,646,550                     |

Source: The Traffic and Transportation Model

**Table 3.4-5**  
**The Projection of Southward Passenger Number (people/day)**

| Stations                         | 2021  |     |           | 2030  |       |           | 2040  |       |           | 2050  |       |           |
|----------------------------------|-------|-----|-----------|-------|-------|-----------|-------|-------|-----------|-------|-------|-----------|
|                                  | On    | Off | Line Load | On    | Off   | Line Load | On    | Off   | Line Load | On    | Off   | Line Load |
| External                         | -     | -   | 643       | -     | -     | 1,006     | -     | -     | 1,475     | -     | -     | 2,102     |
| Hat Yai Depot                    | 1,670 | 0   | 2,313     | 2,614 | 0     | 3,620     | 3,833 | 0     | 5,308     | 5,462 | 0     | 7,564     |
| Ban Phru Stop                    | 10    | 4   | 2,319     | 15    | 6     | 3,629     | 21    | 9     | 5,320     | 30    | 13    | 7,581     |
| Sala Thung Lung Station (Patong) | 33    | 139 | 2,213     | 50    | 216   | 3,463     | 74    | 317   | 5,077     | 105   | 490   | 7,196     |
| Khlong Ngae Station              | 3     | 307 | 1,909     | 7     | 480   | 2,990     | 11    | 703   | 4,385     | 15    | 964   | 6,247     |
| KhLong Ram Stop                  | 5     | 7   | 1,907     | 8     | 11    | 2,987     | 12    | 16    | 4,381     | 17    | 23    | 6,241     |
| Tha Khoy Stop                    | 7     | 10  | 1,904     | 11    | 15    | 2,983     | 16    | 21    | 4,376     | 23    | 30    | 6,234     |
| Padang Besar Station             | 0     | 748 | 1,156     | 0     | 1,172 | 1,811     | 0     | 1,718 | 2,658     | 0     | 2,336 | 3,898     |
| Onward to Malaysia               | -     | -   | 1,156     | -     | -     | 1,811     | -     | -     | 2,658     | -     | -     | 3,898     |

Source: The Traffic and Transportation Model

**Table 3.4-6**  
**The Projection of Northward Passenger Number (people/day)**

| Stations                         | 2021 |       |           | 2030  |       |           | 2040  |       |           | 2050  |       |           |
|----------------------------------|------|-------|-----------|-------|-------|-----------|-------|-------|-----------|-------|-------|-----------|
|                                  | On   | Off   | Line Load | On    | Off   | Line Load | On    | Off   | Line Load | On    | Off   | Line Load |
| From Malaysia                    | -    | -     | 1,167     | -     | -     | 1,825     | -     | -     | 2,675     | -     | -     | 3,925     |
| Padang Besar Station             | 709  | 0     | 1,876     | 1,111 | 0     | 2,936     | 1,628 | 0     | 4,303     | 2,207 | 0     | 6,132     |
| Tha Khoy Stop                    | 7    | 3     | 1,880     | 11    | 5     | 2,942     | 16    | 7     | 4,312     | 23    | 10    | 6,145     |
| Khlong Ram Stop                  | 10   | 6     | 1,884     | 15    | 9     | 2,948     | 21    | 13    | 4,320     | 30    | 19    | 6,156     |
| Khlong Ngae Station              | 313  | 4     | 2,193     | 490   | 7     | 3,431     | 719   | 11    | 5,028     | 987   | 15    | 7,128     |
| Sala Thung Lung Station (Patong) | 150  | 30    | 2,313     | 234   | 47    | 3,618     | 344   | 69    | 5,303     | 527   | 98    | 7,557     |
| Ban Phru Stop                    | 5    | 11    | 2,307     | 8     | 17    | 3,609     | 12    | 24    | 5,291     | 17    | 34    | 7,540     |
| Hat Yai Depot                    | 0    | 1,482 | 825       | 0     | 2,319 | 1,290     | 0     | 3,399 | 1,892     | 0     | 4,844 | 2,696     |
| External                         | -    | -     | 825       | -     | -     | 1,290     | -     | -     | 1,892     | -     | -     | 2,696     |

Source: The Traffic and Transportation Model

## 6) The Projection of Freight Volume

### • The Projection of Freight Transport on the Hat Yai-Padang Bezar Train

From the records of SRT of the freight transport during 2008-2014 as shown in **Table 3.4-7**, it was found that most of the freight transport on this train route was international transport of containers while only a small number would be other products such as noodles, flour, sugar, gypsum, etc. When considering the transport volume by train during 2008-2014, it was found that the volume had decreased significantly. From interviews with the concerned offices and business operators, it revealed that train transport was still in high demand but there was not enough containers or locomotive engines for service.

### • The Projection of Future Freight Volume

In the Projection of future freight volume which includes possible changes in transport mode to train transport, the hypotheses were:

- For processed agricultural products, train transport from the manufacturing factories would be within 50-100 km from the train route;
- SRT is equipped with locomotive engines, transport carriage, service staff, loading area and container yard at the departure and destination stations;
- SRT can provide service to multiple customers on one train (without requiring customers to rent the whole train)
- SRT has promotion measures for rail transport to small and medium sized business operators

From the collection of data on freight transport, the factors determining the decision to choose rail transport were the potentials and suitability of the cargo for freight transport. On the Hat Yai- Padang Bezar route onward to Malaysia, the cargo would be export items either through Padang Bezar border customs or currently through Sadao check point such as rubber products, rubber wood products, tapioca, rice, sugar and other goods such as electronics equipment, electrical appliances, appliances and engines, etc. The types of freight for rail transport on each study location were found to vary in terms of transport activities and depending on varying factors of the economic growth of the South. In the Projection, the Consultants have applied Time Series/Forecasting method in the analysis to project the growth of each product and have included the interview with the business operators on trends and changes of transport type to rail transport. This can be summed up on the Projection of Freight Volume by the Hat Yai-Padang Bezar route as shown in **Table 3.4-8** and **Table 3.4-9**.

Table 3.4-7 The Records of Freight Transport on the Hat Yai-Padang Bezar Train Route

| Types of Cargo           | 2008           |                | 2009           |               | 2010           |               | 2011           |               | 2012           |               | 2013           |               | 2014          |              |
|--------------------------|----------------|----------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|---------------|--------------|
|                          | Export         | Import         | Export         | Import        | Export         | Import        | Export         | Import        | Export         | Import        | Export         | Import        | Export        | Import       |
| International Containers | 326,309        | 130,149        | 174,844        | 59,819        | 126,039        | 32,808        | 108,591        | 23,443        | 101,733        | 13,640        | 83,620         | 10,208        | 80,481        | 2,642        |
| Sugar                    | 1,540          | -              | 1,883          | -             | 705            | -             | 1,499          | -             | 974            | -             | 1,050          | -             | 870           | -            |
| Noodles, Flour           | -              | -              | -              | -             | -              | -             | 23,843         | -             | 20,874         | -             | 18,520         | -             | 11,571        | -            |
| Gypsum                   | 12,255         | -              | 5,658          | -             | 4,010          | -             | -              | -             | -              | -             | -              | -             | -             | -            |
| Rice products            | -              | -              | 45             | -             | -              | -             | -              | 0.2159        | -              | 0.1341        | -              | 0.1221        | -             | 0.0328       |
| <b>Total</b>             | <b>340,104</b> | <b>130,149</b> | <b>182,430</b> | <b>59,819</b> | <b>130,754</b> | <b>32,808</b> | <b>133,933</b> | <b>23,443</b> | <b>123,581</b> | <b>13,640</b> | <b>103,190</b> | <b>10,208</b> | <b>92,922</b> | <b>2,642</b> |

Source: SRT

Table 3.4-8 The Summary of Rail Transport on the Hat Yai-Padang Besar Train Route

| Year | Rubber    | Rubber wood products and Rubber wood furniture | Palm oil | Cassava | Rice   | Sugar  | Other products | Total     |
|------|-----------|------------------------------------------------|----------|---------|--------|--------|----------------|-----------|
| 2020 | 554,755   | 218,204                                        | 81,871   | 32,229  | 27,980 | 24,116 | 255,256        | 1,194,411 |
| 2021 | 569,416   | 222,937                                        | 85,871   | 35,023  | 29,244 | 24,845 | 257,305        | 1,224,641 |
| 2022 | 584,464   | 227,670                                        | 90,066   | 37,935  | 30,569 | 25,573 | 259,369        | 1,255,646 |
| 2023 | 599,911   | 232,403                                        | 94,466   | 40,965  | 31,953 | 26,301 | 261,451        | 1,287,450 |
| 2024 | 615,765   | 237,136                                        | 99,081   | 44,114  | 33,397 | 27,029 | 263,549        | 1,320,071 |
| 2025 | 632,039   | 241,869                                        | 103,921  | 47,381  | 34,901 | 27,758 | 265,664        | 1,353,533 |
| 2026 | 648,743   | 246,602                                        | 108,998  | 50,766  | 36,464 | 28,486 | 267,796        | 1,387,855 |
| 2027 | 665,888   | 251,335                                        | 114,322  | 54,269  | 38,088 | 29,214 | 269,945        | 1,423,061 |
| 2028 | 683,486   | 256,068                                        | 119,907  | 57,891  | 39,771 | 29,942 | 272,112        | 1,459,177 |
| 2029 | 701,549   | 260,801                                        | 125,765  | 61,631  | 41,514 | 30,671 | 274,296        | 1,496,227 |
| 2030 | 720,090   | 265,534                                        | 131,909  | 65,490  | 43,317 | 31,399 | 276,497        | 1,534,236 |
| 2031 | 736,450   | 270,267                                        | 137,792  | 69,466  | 45,179 | 32,127 | 278,174        | 1,569,455 |
| 2032 | 753,182   | 275,000                                        | 143,938  | 73,561  | 47,102 | 32,855 | 279,860        | 1,605,498 |
| 2033 | 770,293   | 279,733                                        | 150,358  | 77,775  | 49,084 | 33,583 | 281,557        | 1,642,383 |
| 2034 | 787,794   | 284,466                                        | 157,065  | 82,106  | 51,126 | 34,312 | 283,265        | 1,680,134 |
| 2035 | 805,692   | 289,199                                        | 164,070  | 86,556  | 53,228 | 35,040 | 284,982        | 1,718,767 |
| 2036 | 823,997   | 293,932                                        | 171,388  | 91,124  | 55,389 | 35,768 | 286,710        | 1,758,308 |
| 2037 | 842,717   | 298,665                                        | 179,033  | 95,811  | 57,611 | 36,496 | 288,449        | 1,798,782 |
| 2038 | 861,863   | 303,398                                        | 187,018  | 100,616 | 59,892 | 37,225 | 290,198        | 1,840,210 |
| 2039 | 881,444   | 308,131                                        | 195,359  | 105,539 | 62,233 | 37,953 | 291,958        | 1,882,617 |
| 2040 | 901,470   | 312,864                                        | 204,073  | 110,580 | 64,634 | 38,681 | 293,728        | 1,926,030 |
| 2041 | 916,913   | 317,597                                        | 213,872  | 115,740 | 67,095 | 39,409 | 296,647        | 1,967,273 |
| 2042 | 932,621   | 322,330                                        | 224,141  | 121,018 | 69,615 | 40,138 | 299,594        | 2,009,457 |
| 2043 | 948,598   | 327,063                                        | 234,904  | 126,414 | 72,195 | 40,866 | 302,571        | 2,052,611 |
| 2044 | 964,849   | 331,796                                        | 246,183  | 131,929 | 74,835 | 41,594 | 305,578        | 2,096,764 |
| 2045 | 981,378   | 336,529                                        | 258,004  | 137,561 | 77,535 | 42,322 | 308,614        | 2,141,943 |
| 2046 | 998,190   | 341,262                                        | 270,392  | 143,313 | 80,295 | 43,051 | 311,681        | 2,188,184 |
| 2047 | 1,015,290 | 345,995                                        | 283,376  | 149,182 | 83,114 | 43,779 | 314,778        | 2,235,514 |
| 2048 | 1,032,683 | 350,728                                        | 296,982  | 155,170 | 85,994 | 44,507 | 317,906        | 2,283,970 |
| 2049 | 1,050,374 | 355,461                                        | 311,242  | 161,276 | 88,933 | 45,235 | 321,065        | 2,333,586 |
| 2050 | 1,068,369 | 360,194                                        | 326,187  | 167,500 | 91,932 | 45,964 | 324,255        | 2,384,401 |

Source: The Consultants



Table 3.4-9 The Summary of Rail Transport on the Northbound and Southbound Hat Yai-Padang Besar Train Route

|                                                  | 2021       |         |            |         | 2030       |           |            |         | 2040       |           |            |         | 2050       |           |            |         |
|--------------------------------------------------|------------|---------|------------|---------|------------|-----------|------------|---------|------------|-----------|------------|---------|------------|-----------|------------|---------|
|                                                  | Southbound |         | Northbound |         | Southbound |           | Northbound |         | Southbound |           | Northbound |         | Southbound |           | Northbound |         |
|                                                  | On         | Off     | On         | Off     | On         | Off       | On         | Off     | On         | Off       | On         | Off     | On         | Off       | On         | Off     |
| External                                         | 762,289    | -       | -          | 216,256 | 992,234    | -         | -          | 245,478 | 1,263,754  | -         | -          | 308,165 | 1,588,536  | -         | -          | 381,504 |
| Hat Yai                                          | 193,240    | -       | -          | 52,856  | 235,155    | -         | -          | 61,369  | 277,070    | -         | -          | 77,041  | 318,985    | -         | -          | 95,376  |
| Through Padang Besar border check point Malaysia | -          | 955,529 | 269,112    | -       | -          | 1,227,389 | 306,847    | -       | -          | 1,540,824 | 385,206    | -       | -          | 1,907,521 | 476,880    | -       |
| Total                                            | 955,529    | 955,529 | 269,112    | 269,112 | 1,227,389  | 1,227,389 | 306,847    | 306,847 | 1,540,824  | 1,540,824 | 385,206    | 385,206 | 1,907,521  | 1,907,521 | 476,880    | 476,880 |
| Total two Directions                             | 1,224,641  |         |            |         | 1,534,236  |           |            |         | 1,926,030  |           |            |         | 2,384,401  |           |            |         |

Source: The Consultants

### 3.4.1.3 The Operation, Maintenance and Number of the Trains

In the planning of the train operation and the analysis of the capacity, the main objective is to conduct a review study of the data on passengers and freight to develop and recommend suitable train operation plan for the Hat Yai-Padang Besar Double Tracks Train route which will covers 44.50 kilometers.

#### 1) The Train Operation Development

The main objective is to study and review data on passengers and freight transport to develop and recommend a suitable type of train operation along the Hat Yai-Padang Besar Double Tracks Train route. The basic steps and procedures are:

- The specification of the location and number of the stations, storing and distribution yard for freight, distance and the route
- The Consultants will bring into the development analysis the projection of passengers and freight, the locations and number of the stations, the storing and distribution yard for freight, distance and the train route and the stopping area for the train.
- The calculation of the required service operation time.
- The calculation of the train fleet size and required train numbers to meet the set service and schedule
- The preliminary findings of the efficient operation planning on route capacity, passenger or freight service capacity, train schedule, and train diagram

#### 2) Types and Services

The concept of the train operation and service in this Project will be based on the present types and services offered by SRT with only additional electric trains operated by Malaysia. However, if additional electric train is needed, the system should be in line with that in Malaysia as already specified in the Kuala Lumpur Electric Train Project which requires all train fleet to be Electrified Multiple Unit.

However, as the specified train route is located near Thai-Malaysian border and far from Bangkok, the train operation from Hua Lampong Station still uses non-air-conditioned fleet and has a small number of passengers. This has affected the management of the route capacity. The Consultants therefore suggested the use of local trains in linking the route and did not propose acquiring any ordinary train to the Project. The overall concept of the train fleet in this Project includes the following:

- **The Electrified Multiple Unit (EMU):** These are passenger electric trains operated on a long distance route without stopping at every station.

- **Diesel-Powered Long Distance Trains** : These are Express Trains, Rapid Trains and Ordinary Trains with diesel-powered locomotive engine with passenger carriage, freight carriage and supply carriage
- **Diesel-Powered Commuter Trains** : These are short distance train operated as Diesel Multiple Unit: DMU with the engine at the head and tail of the fleet for shuttle service convenience.
- **Diesel-Powered Freight Train** : The freight trains operated by the diesel-powered engine at the head of the fleet which transport many types of cargo such as heavy freight, containers, oil containers, dry cement container and others.

### 3) The Electrical System for the Train Operation

As mentioned above, the locomotive to be used in the planning and model drawing consist of 4 types:

- Diesel Electric Locomotives with AC-AC power made by CSR Qishuyan, procured in 2014; maximum 20 tons of weight on the axle; to be used in the passenger train
- Diesel Electric Locomotive of General Electric (GEA) No. 4523-4560 operated since 1995 with 14.42 tons of maximum weight/axle will be brought back for long-distance service
- Diesel Train of APD60 (APD) of Daewoo No.2525-2544 operated since 1996 with 14 tons of maximum weight /axle will be brought back for long-distance service
- Electrified Train with the same Bombardier basic data as used in the Preliminary Design of the Kuala Lumpur-Padang Besar Train Route by Keretapi Tanah Melayu Berhad (KTMB), Malaysia.

### 4) The Planning of the Train Operation Schedule

#### ■ Train Operation Schedule and Line Load

In the Project Study, the Consultants have analysed and applied the basic data in the planning of the train operation at various speed levels: 140, 120, 100 and 80 km./hour to be incorporated with the train scheduling and fleet management. The Train Running Simulation has been used in the calculation of the train schedule and line load.

In the Train Operation Model, the Consultants have set the stopping time at each station at 1 minute for every type of train fleet as all stations on the route are stops and small stations. The preliminary results of the time for the train operation at various speeds are shown in **Table 3.4-10**

In the beginning, the Consultants have designed the Model without any Train Rolling Resistance value as the data was still incomplete. However, since the obtained data on the line load was satisfactorily precise and valid and the distance of the route was quite short, without any irregular case, the track shuffling should not be included in the Operation Plan as it could cause unnecessary delay. The Train Running Model can then

be set on basic data and procedures without any track shuffling at the line load of 152 trains per day per two running directions.

**Table 3.4-10**  
**Train Operation Schedule at a Various Speed**

| Stations/Stops                   | Location  | Distance (km.) | Operation Time (min. excluding stop) |              |              |              | Station size        |
|----------------------------------|-----------|----------------|--------------------------------------|--------------|--------------|--------------|---------------------|
|                                  |           |                | 80 km/hr                             | 100 km/hr    | 120 km/hr    | 140 km/hr    |                     |
| Hat Yai Depot                    | 928+580   | 0.000          | –                                    | –            | –            | –            | Large station       |
| Ban Phru Stop                    | 935+925   | 7.345          | 6:19                                 | 5:32         | 5:2          | 3:39         | Stop                |
| Sala Thung Lung Station (Patong) | 944+887.5 | 8.963          | 7:41                                 | 7:41         | 5:33         | 5:7          | Small station       |
| Khlong Ngae Station              | 952+625   | 7.738          | 5:50                                 | 6:11         | 4:25         | 4:31         | Small station       |
| Khlong Ram Stop                  | 961+100   | 8.475          | 6:22                                 | 6:35         | 4:45         | 4:24         | Stop                |
| Tha khoy Stop                    | 967+450   | 7.350          | 5:1                                  | 5:27         | 3:48         | 3:8          | Stop                |
| Padang Besar Station             | 972+900   | 4.450          | 4:20                                 | 4:16         | 3:39         | 2:45         | Medium size station |
| <b>Total</b>                     |           | <b>44.320</b>  | <b>37:26</b>                         | <b>37:10</b> | <b>28:56</b> | <b>24:44</b> |                     |

Source: The Consultants

#### ■ The Volume of Passengers and Freight

In drawing the Preliminary Train Operation Plan, there must be a projection of the distribution of passenger volume in terms of Line Load which has been summed up in **Table 3.4-11** and **Table 3.4-12**. The types of train operation can be classified into 4 types for the northbound trains from Hat Yai via Padang Besar and the southbound trains from Padang Besar via Hat Yai. it was found that on both directions, the projection of the passengers indicated a maximum of 37.69% and 33.685 for the northbound and southbound trains respectively. While travel to and from Malaysia connecting with the Project route would be 35.20% and 31.38% respectively. On the freight volume, the projection is displayed in **Table 3.4-13**

**Table 3.4-11**  
**The Projection of Line Load of the Northbound Passengers**

| (Northbound)                     | 2021      | 2030  | 2040  | 2050  |
|----------------------------------|-----------|-------|-------|-------|
| Station                          | Line Load |       |       |       |
| From Bangkok                     | 612       | 1,006 | 1,475 | 2,102 |
| Hat Yai Depot                    | 2,201     | 3,620 | 5,308 | 7,564 |
| Ban Phru Stop                    | 2,207     | 3,629 | 5,320 | 7,581 |
| Sala Thung Lung Station (Patong) | 2,106     | 3,463 | 5,077 | 7,196 |
| Khlong Ngae Station              | 1,817     | 2,990 | 4,385 | 6,247 |
| Khlong Ram Stop                  | 1,815     | 2,987 | 4,381 | 6,241 |
| Tha Khoy Stop                    | 1,812     | 2,983 | 4,376 | 6,234 |
| Padang Besar Station             | 1,100     | 1,811 | 2,658 | 3,898 |
| To Malaysia                      | 1,100     | 1,811 | 2,658 | 3,898 |

Source: The Consultants

**Table 3.4-12**  
**The Projection of Line Load of the Southbound Passengers**

| (Southbound)                     | 2021      | 2030  | 2040  | 2050  |
|----------------------------------|-----------|-------|-------|-------|
| Stations                         | Line Load |       |       |       |
| From Malaysia                    | 1,110     | 1,825 | 2,675 | 3,925 |
| Padang Besar Station             | 1,785     | 2,936 | 4,303 | 6,132 |
| Tha Khoy Stop                    | 1,789     | 2,942 | 4,312 | 6,145 |
| Khlong Ram Stop                  | 1,793     | 2,948 | 4,320 | 6,156 |
| Khlong Ngae Station              | 2,087     | 3,431 | 5,028 | 7,128 |
| Sala Thung Lung Station (Patong) | 2,201     | 3,618 | 5,303 | 7,557 |
| Ban Phru Stop                    | 2,195     | 3,609 | 5,291 | 7,540 |
| Hat Yai Depot                    | 785       | 1,290 | 1,892 | 2,696 |
| To Bangkok                       | 785       | 1,290 | 1,892 | 2,696 |

**Table 3.4-13**  
**The Projection of the Freight Volume**

| Freight Volume<br>(ton/day) | 2021         |             | 2030         |             | 2040         |             | 2050         |             |
|-----------------------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|
|                             | North bound  | South bound | North bound  | South bound | North bound  | South bound | North bound  | South bound |
| Bangkok                     | 2,088        | 523         | 2,718        | 673         | 3,462        | 844         | 4,352        | 1,046       |
| Hat Yai                     | 529          | 131         | 644          | 168         | 759          | 211         | 874          | 261         |
| Padang Besar                | 654          | 2,617       | 841          | 3,362       | 1,055        | 4,221       | 1,307        | 5,226       |
| <b>Total</b>                | <b>2,617</b> |             | <b>3,362</b> |             | <b>4,221</b> |             | <b>5,226</b> |             |

Source: The Consultants

#### ■ The Train Route and Fleet Operation

From the preliminary study of the data of the present train route, there are 3 main routes and/or types of service : 1) The Bangkok-Butterworth Long-Distance Air-Conditioned Sleeper

Train 2) The Kula Lumpur-Hat Yai Long-Distance Air-Conditioned Sleeper Train 3) Transit Freight Train to Padang Bezar Cargo Station

In this Project, the Consultants will increase the number of local trains to provide pick-up and send-off transportation to local passengers at every station from Nakhon Sri Thammarat (Khao Choomthong Depot) vai Hat Yai Depot to Padang Bezar Station. The Consultants have proposed 5 main types of train management and service as follow:

- **Rapid Trainds (Kuala Lumpur-Hat Yai)** The initial plan would be the long distance train service from Kuala Lumpur via Butterworth, Padang Bezar to Hat Yai Depot, the destination station in this Project, with stops to send off and pick up passengres along the route at Khlong Ngae Station and Sala Thung lung Station (with a possible adjustment). This will be Electrified Multiple Unit.
- **Special Diesel Express Trains (Bangkok-Butterworth)** This provides long distance train service from Hua Lampong Station via Choomporn, Suratthani, hat Yai, Pdang Bezar to Butterworth Station, the final destination in the Project with stops to send off and pick up passengers along the route only at Khlong Ngae Station. The train will be operated with Diesel-powered locomotive and with passenger cars and a dining car
- **Special Diesel Express Trains (Kuala Lumpur-Hat Yai)** This provides long distance train service from Kuala Lumpur Station via Tan Jong Malim, Kuala Lumpur, Butterworth, Padang Bezar to Hat Yai Depot, the final destination in this Project without any stop along the route. The traint will be operated with Diesel-powered locomotive and with First, Second and Third Class passenger cars and a dining car
- **Local Diesel Train (Suratthani-Padang Bezar)** This provides train service from Suratthani via Thoong Song Depot, Pattalung, Hat yai depot to Padang Bezar Station, the final destination in the Project, with stops to send off and pick up passengers at every station along the route. The train will be operated with Diesel-powered locomotive and with First, Second and Third Class sleeper cars and a dining car.
- **Diesel Freight Train (Bangkok-Padang Bezar)** This provides train service from Bangkok to Pa, the final destination in the Project. Thedang Bezar Station. The train will be operated with Diesel-powered locomotive and with freight carriers of various specifications. In the beginning, the Consultants have suggested only large-sized containers carriers and highest transport weight on the axle for border crossing.

The Consultants have prepared the summary report on the number of the stations and stops of each type of the trains starting from Special Express Trains, Express Trains, Rapid Trains and Local Commuter Trains and Freight Trains as shown in **Figure 3.4-4**

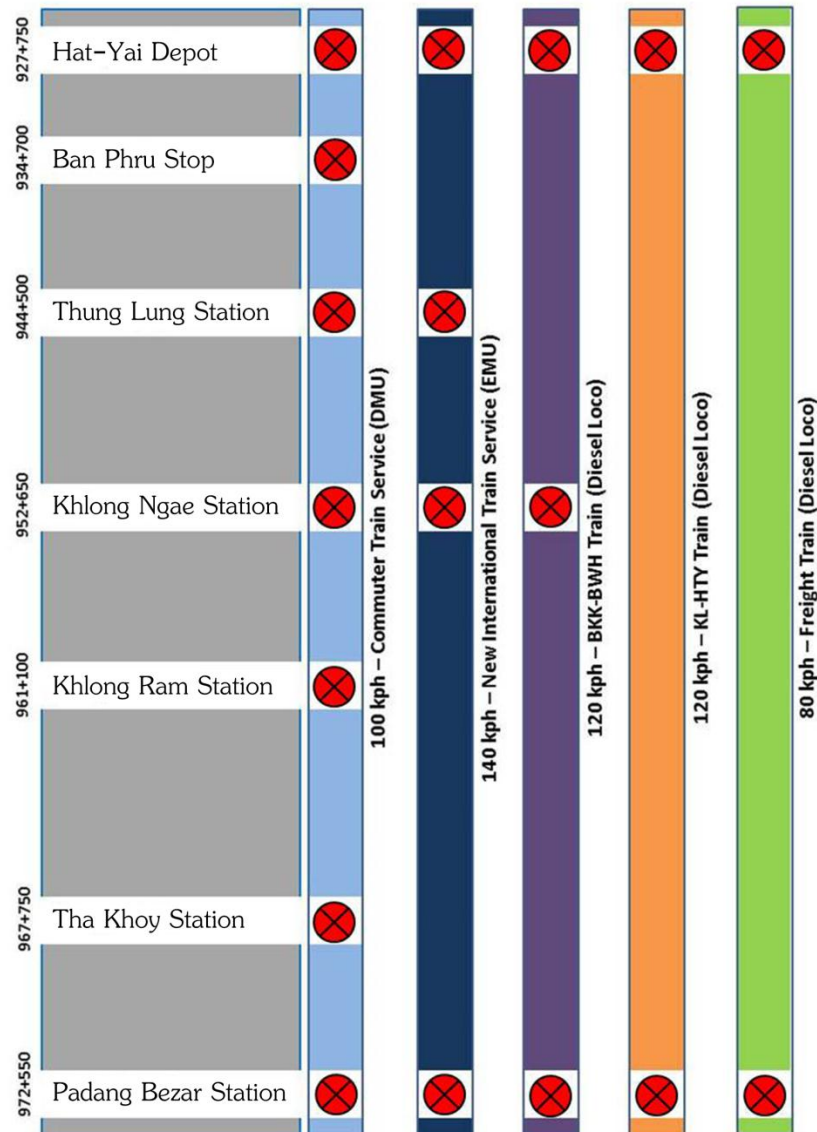


Figure 3.4-4 The Stop Plan for each Train Type

#### ■ The Number of Trains and Train Operation Plan

The Consultants have calculated the number of train operations and Rolling Stock of each type of the trains in order to estimate the cost of train procurement and the expenses of maintenance and train operation.

The Consultants have analysed the Train Operation Plan into 2 cases: with the electrified system and without the electrified system. The results of the necessary number of passenger trains and freight trains for each case as shown in **Table 3.4-14** to **Table 3.4-15** will be illustrated in the 2050 Train Operation Diagram in **Figure 3.4-5**.

**Table 3.4-14**  
**The Suitable Number of Trips with the Electrified Train System**

| Number of Trips (per day per direction)                |                                  | 2021  | 2030   | 2040   | 2050   |
|--------------------------------------------------------|----------------------------------|-------|--------|--------|--------|
| Special Diesel Express Trains (Bangkok-Butterworth)    | Number of trips(2 directions)    | 2 (4) | 2 (4)  | 3 (6)  | 4 (8)  |
|                                                        | Passenger Line Load (people/day) | 736   | 968    | 1,452  | 1,936  |
| Rapid Electric Train (Kuala Lumpur-Hat Yai)            | Number of trips(2 directions)    | 1 (2) | 2 (4)  | 2 (4)  | 4 (8)  |
|                                                        | Passenger Line Load (people/day) | 450   | 900    | 900    | 1,800  |
| Special Diesel Express Trains (Kuala Lumpur-Hat Yai)   | Number of trips(2 directions)    | 1 (2) | 1 (2)  | 2 (4)  | 2 (4)  |
|                                                        | Passenger Line Load (people/day) | 344   | 496    | 992    | 992    |
| Diesel Local Commuter Trains (Suratthani-Padang Besar) | Number of trips(2 directions)    | 2 (4) | 3 (6)  | 4 (8)  | 6 (12) |
|                                                        | Passenger Line Load (people/day) | 760   | 1,596  | 2,128  | 3,192  |
| Total Passenger Line Load (people/day)                 |                                  | 2,320 | 4,020  | 5,532  | 8,040  |
| Max. Passenger Line Load (people/day)                  |                                  | 2,207 | 3,629  | 5,320  | 7,581  |
| Freight Trains (Bangkok-Padang Besar)                  | Number of trips(2 directions)    | 4 (8) | 5 (10) | 6 (12) | 7 (14) |
| Freight Line Load (ton/day)                            |                                  | 2,700 | 3,375  | 4,320  | 5,355  |
| Max. Freight Line Load (ton./day)                      |                                  | 2,617 | 3,362  | 4,221  | 5,226  |
| Total number of trains (train/day/2 directions)        |                                  | 20    | 26     | 34     | 46     |

Source: The Consultants

**Table 3.4-15**  
**The Suitable Number of Trips without the Electrified System**

| Number of Trips (per day per direction)                |                                  | 2021  | 2030   | 2040   | 2050   |
|--------------------------------------------------------|----------------------------------|-------|--------|--------|--------|
| Special Diesel Rapid Trains (Bangkok-Butterworth)      | Number of trips(2 directions)    | 3 (6) | 4 (8)  | 5 (10) | 7 (14) |
|                                                        | Passenger Line Load (people/day) | 1,104 | 1,936  | 2,420  | 3,398  |
| Rapid Electric Trains (Kuala Lumpur-Hat Yai)           | Number of trips(2 directions)    | -     | -      | -      | -      |
|                                                        | Passenger Line Load (people/day) | -     | -      | -      | -      |
| Special Diesel Express Trains (Kuala Lumpur-Hat Yai)   | Number of trips(2 directions)    | 1 (2) | 1 (2)  | 2 (4)  | 2 (4)  |
|                                                        | Passenger Line Load (people/day) | 344   | 496    | 992    | 992    |
| Local Diesel Commuter Trains (Suratthani-Padang Besar) | Number of trips(2 directions)    | 2 (4) | 3 (6)  | 4 (8)  | 6 (12) |
|                                                        | Passenger Line Load (people/day) | 760   | 1,596  | 2,128  | 3,192  |
| Total Passenger Line Load (people/day)                 |                                  | 2,208 | 4,028  | 5,540  | 7,582  |
| Max. Passenger Line Load (ton./day)                    |                                  | 2,201 | 3,629  | 5,320  | 7,581  |
| Diesel Freight Trains (Bangkok-Padang Besar)           | Number of trips(2 directions))   | 4 (8) | 5 (10) | 6 (12) | 7 (14) |
| Freight Line Load (ton/day)                            |                                  | 2,700 | 3,375  | 4,320  | 5,355  |
| Max. Freight Line Load (ton./day)                      |                                  | 2,617 | 3,362  | 4,221  | 5,226  |
| Total number of Trains (trains/day/2 directions)       |                                  | 20    | 26     | 34     | 46     |

Source: The Consultants



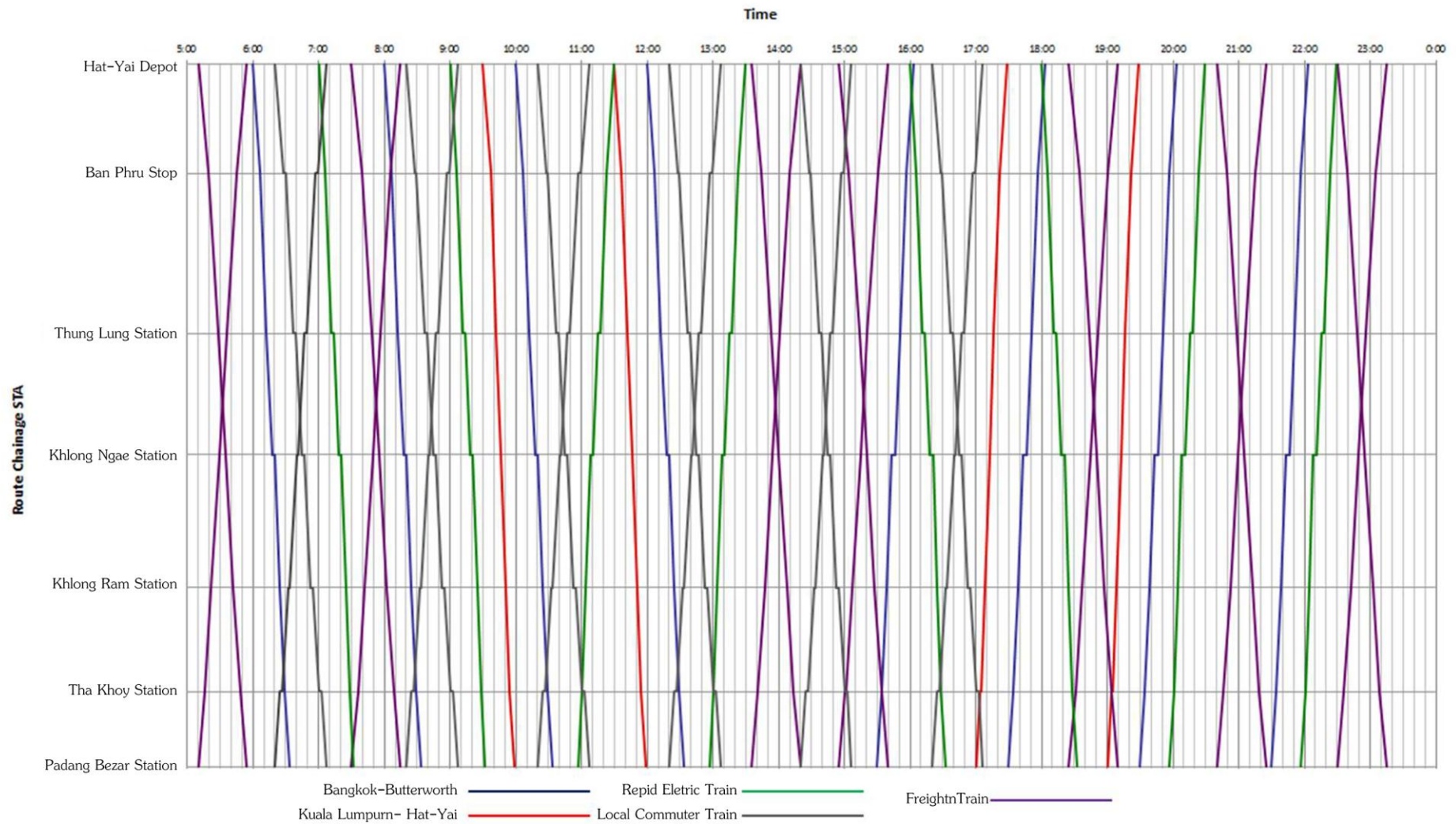


Figure 3.4-5 The Train Operation Diagram in 2050

### ■ The Cost Estimate of the Train Operation and Maintenance

The Cost Estimates of the Train Operation in this Project have been based on the extension of the connecting routes between major cities and will calculate only the cost of fuel including the expenses of the train operation by the track system in this Project. This will not cover the train operation outside of the Project as the returns from the passenger fares will not be part of the Project.

From the suitable number of trips for the Project Train Operation as discussed above and from the Train Operation of each route, the number of trains needed for the operation is shown in **Table 3.4-16**

From the collected data, the Cost Estimates of Maintenance and Train Operation with and without the Electrified System are shown in **Table 3.4-17** and **Table 3.4-19**

**Table 3.4-16**  
The Suitable Number of Trains for Each Route

| The Suitable Number of Trains                               | With the Electrified System |      |      |      | Without the Electrified System |      |      |      |
|-------------------------------------------------------------|-----------------------------|------|------|------|--------------------------------|------|------|------|
|                                                             | 2021                        | 2030 | 2040 | 2050 | 2021                           | 2030 | 2040 | 2050 |
| Special Diesel Express Trains<br>(Bangkok-Butterworth)      | 4                           | 4    | 6    | 8    | 6                              | 8    | 8    | 14   |
| Rapid Electric Trains<br>(Kuala Lumpur-Hat Yai)             | 1                           | 2    | 2    | 4    | -                              | -    | -    | -    |
| Special Diesel Express Trains<br>(Kuala Lumpur-Hat Yai)     | 1                           | 1    | 2    | 2    | 1                              | 1    | 2    | 2    |
| Diesel Freezer Train<br>(Nakhon Sri Thammarat-Padang Besar) | 2                           | 3    | 4    | 6    | 2                              | 3    | 4    | 6    |
| Diesel Freight Train<br>(Bangkok-Padang Besar)              | 6                           | 8    | 10   | 12   | 6                              | 8    | 10   | 12   |
| Diesel Freight Train<br>(Hat Yai-Padang Besar))             | 1                           | 1    | 1    | 1    | 1                              | 1    | 1    | 1    |

**Table 3.4-17**  
The Suitable Number of Rolling Stock of each Type for the Train Operation

| (Car)                      | Number of Rolling Stock /Electrified System |            |            |            | Number of Rolling Stock /Non-Electrified System |            |            |            |
|----------------------------|---------------------------------------------|------------|------------|------------|-------------------------------------------------|------------|------------|------------|
|                            | 2021                                        | 2030       | 2040       | 2050       | 2021                                            | 2030       | 2040       | 2050       |
| Diseel Track               | 14                                          | 29         | 29         | 38         | 14                                              | 29         | 29         | 38         |
| Locomotive                 | 16                                          | 19         | 25         | 30         | 22                                              | 30         | 35         | 47         |
| Container Carrier          | 149                                         | 181        | 221        | 276        | 149                                             | 181        | 221        | 276        |
| Brake Van                  | 9                                           | 11         | 13         | 15         | 9                                               | 11         | 13         | 15         |
| First Class Passenger Car  | 3                                           | 3          | 5          | 6          | 5                                               | 6          | 8          | 11         |
| Second Class Passenger Car | 3                                           | 6          | 9          | 12         | 5                                               | 12         | 15         | 21         |
| Third Class Passenger Car  | 13                                          | 16         | 24         | 31         | 19                                              | 31         | 39         | 54         |
| Dining Car                 | 3                                           | 3          | 5          | 6          | 5                                               | 6          | 8          | 11         |
| <b>Total</b>               | <b>210</b>                                  | <b>268</b> | <b>331</b> | <b>414</b> | <b>228</b>                                      | <b>306</b> | <b>368</b> | <b>473</b> |

**Table 3.4-18**  
**The Cost of the Train Operation with the Electrified System**

|                                                      |                                      | The Cost of Train Operation and Maintenance |                    |                    |                    |
|------------------------------------------------------|--------------------------------------|---------------------------------------------|--------------------|--------------------|--------------------|
| (baht/year)                                          |                                      | 2021                                        | 2030               | 2040               | 2050               |
| Maintenance                                          | Diesel Track Train                   | 4,952,682                                   | 10,259,128         | 10,259,128         | 13,442,995         |
|                                                      | Locomotive                           | 9,177,787                                   | 10,898,622         | 14,340,293         | 17,208,351         |
|                                                      | Container Carrier                    | 449,191                                     | 545,662            | 666,250            | 832,059            |
|                                                      | Brake Van                            | 73,109                                      | 89,355             | 105,602            | 121,848            |
|                                                      | First Class Passenger Car            | 7,117,573                                   | 7,117,573          | 11,862,621         | 14,235,145         |
|                                                      | Second Class Passenger Car           | 979,095                                     | 1,958,190          | 2,937,284          | 3,916,379          |
|                                                      | Third Class Passenger Car            | 4,243,089                                   | 5,222,263          | 7,833,394          | 10,118,134         |
|                                                      | Dining Car                           | 251,469                                     | 251,469            | 419,115            | 502,938            |
|                                                      | <b>Total cost of maintenance</b>     | <b>27,243,995</b>                           | <b>36,342,261</b>  | <b>48,423,687</b>  | <b>60,377,849</b>  |
| Train operation                                      | Personnel Management                 | 26,376,000                                  | 28,492,800         | 30,609,600         | 32,726,400         |
|                                                      | Fuel                                 | 42,769,935                                  | 58,144,820         | 78,946,772         | 100,657,632        |
|                                                      | Electrical Power for Train operation | 12,143,412                                  | 17,966,465         | 17,966,465         | 31,566,429         |
|                                                      | <b>Total cost of train operation</b> | <b>81,289,347</b>                           | <b>104,604,085</b> | <b>127,522,837</b> | <b>164,950,460</b> |
| <b>Total cost of train operation and maintenance</b> |                                      | <b>108,533,342</b>                          | <b>140,946,346</b> | <b>175,946,524</b> | <b>225,328,310</b> |

Source: The Consultants

**Table 3.4-19**  
**The Cost of the Train Operation without the Electrified System**

|                                                      |                                      | The Cost of Train Operation and Maintenance |                    |                    |                    |
|------------------------------------------------------|--------------------------------------|---------------------------------------------|--------------------|--------------------|--------------------|
| (baht/year)                                          |                                      | 2021                                        | 2030               | 2040               | 2050               |
| Maintenance                                          | Diesel Track Train                   | 4,952,682                                   | 10,259,128         | 13,442,995         | 20,164,493         |
|                                                      | Locomotive                           | 12,619,458                                  | 17,208,351         | 20,076,410         | 26,959,750         |
|                                                      | Container Carrier                    | 449,191                                     | 545,662            | 666,250            | 832,059            |
|                                                      | Brake Van                            | 73,109                                      | 89,355             | 105,602            | 121,848            |
|                                                      | First Class Passenger Car            | 11,862,621                                  | 14,235,145         | 18,980,193         | 26,097,766         |
|                                                      | Second Class Passenger Car           | 1,631,825                                   | 3,916,379          | 4,895,474          | 6,853,664          |
|                                                      | Third Class Passenger Car            | 6,201,437                                   | 10,118,134         | 12,729,266         | 17,625,137         |
|                                                      | Dining Car                           | 419,115                                     | 502,938            | 670,584            | 922,053            |
|                                                      | <b>Total cost of maintenance</b>     | <b>38,209,437</b>                           | <b>56,875,092</b>  | <b>71,566,773</b>  | <b>99,576,769</b>  |
| Train operation                                      | Personnel Management                 | 23,352,000                                  | 25,242,000         | 27,132,000         | 29,022,000         |
|                                                      | Fuel                                 | 53,988,373                                  | 78,711,956         | 97,659,533         | 132,466,252        |
|                                                      | Electrical Power for Train operation | -                                           | -                  | -                  | -                  |
|                                                      | <b>Total cost of train operation</b> | <b>77,340,373</b>                           | <b>103,953,956</b> | <b>124,791,533</b> | <b>161,488,252</b> |
| <b>Total cost of train operation and maintenance</b> |                                      | <b>115,549,810</b>                          | <b>160,829,048</b> | <b>196,358,306</b> | <b>261,065,021</b> |

Source: The Consultants

### 3.4.2 The Engineering Feasibility

In the Design of the Hat Yai-Padang Besar Double Tracks Electric Train, the Project route will combine the high speed trains (120-160 km/hour) and the international freight trains (120 km/hour) from the ASEAN countries such as Singapore, Malaysia into Thai borders. Therefore the Design has been drawn to accommodate transportation of both passenger trains and freight trains.

#### 1) The Geometric Requirement of the Track System

**Table 3.4-20**  
**The Geometric Requirement of the Track System**

| Item                                              | Passenger Train | Freight Train | Remarks                            |
|---------------------------------------------------|-----------------|---------------|------------------------------------|
| Maximum Design Speed                              | 160 km/hr       | 120 km/hr     |                                    |
| Maximum operational Speed                         | 120 km/hr       | 100 km/hr     |                                    |
| Number of tracks between station on the main line | 2               |               |                                    |
| Track gauge                                       | 1,000 mm.       |               |                                    |
| Rail Profile                                      |                 |               |                                    |
| Main Track                                        | EN54 E1(UIC54)  |               |                                    |
| Side track & Maintenance Shop                     | EN54 E1(UIC54)  |               |                                    |
| Track Spacing                                     |                 |               |                                    |
| Between main tracks                               | 4.50 m.         |               | for Maximum Design Speed 160 km/hr |
| Between main track & side track                   | 6.00 m.         |               |                                    |

### 3.4.2.1 Track Structure

#### 1) Track Types

The track structure is Ballasted Track or Classical Track or Conventional Track with the weight shifting components of rail, fastening system, sleeper, ballast bed, sub-ballast and subgrade, the general component of a ballasted track.

The rail/wheel interaction will be shifted to the rail fastener, sleeper, sub-ballast and sub-grade via protective ballast layer as shown in **Figure 3.4.6** The impact of the rail/wheel interaction will depend on the thickness of the designed protective ballast layer.

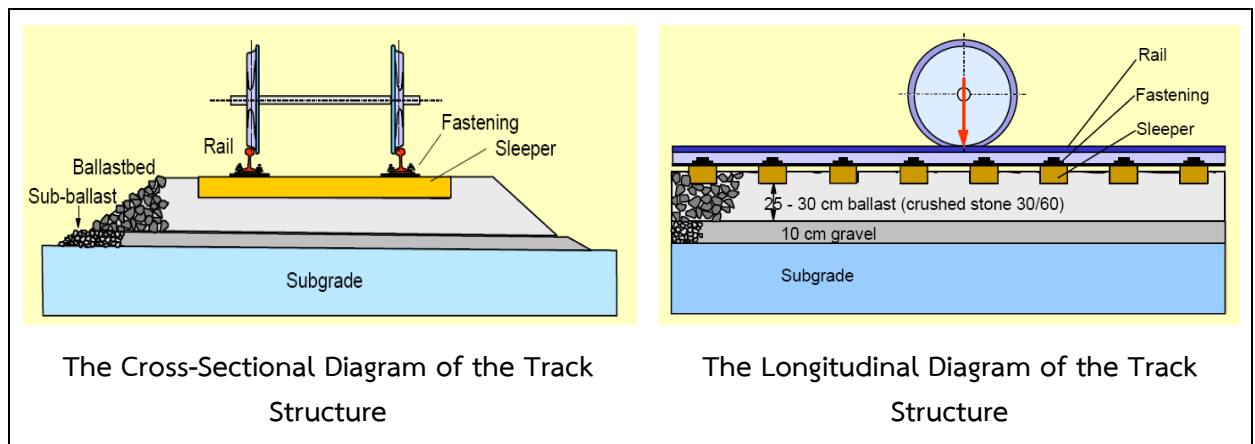


Figure 3.4-6 The Structure of Ballasted Tracks

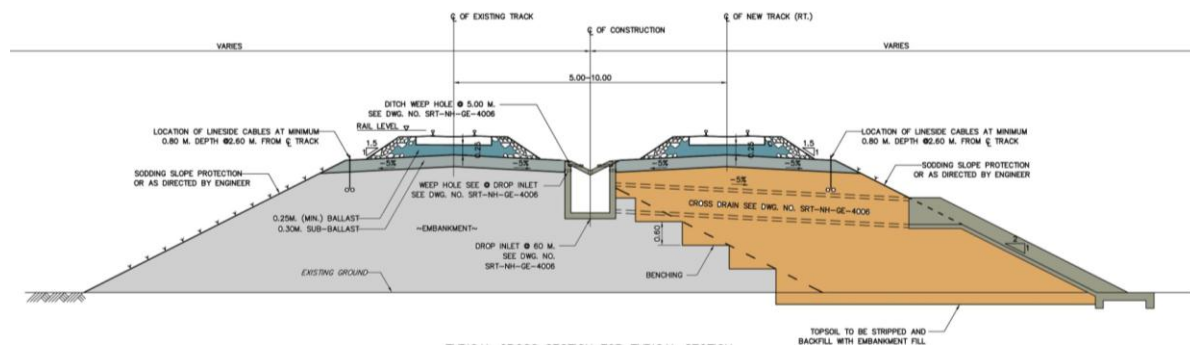
**Table 3.4-21**  
**Summary of the Project Track System**

| Item                                                  | Details                                                                    |
|-------------------------------------------------------|----------------------------------------------------------------------------|
| 1. Design Axle Loads                                  | - 16 tons for passenger Trains<br>- 20 tons for freight trains             |
| 2. Track Gauge                                        | - 1,000 mm.                                                                |
| 3. Rail profile                                       | - UIC 54                                                                   |
| 4. Rail Inclination                                   | - 1:70                                                                     |
| 5. Long connecting rail (CWR)                         | - For the principal track                                                  |
| 6. The lowest thickness of ballast under the sleepers | - 300 mm. for the principal track<br>- 250 mm. for the alternating track   |
| 7. Sleeper                                            | - Prestressed Monoblock Concrete Sleeper                                   |
| 8. Turnout Angle                                      | - 1:16 For the principal track<br>- 1:10 and 1:8 for the alternating track |

### 3.4.2.2 Permanent Way Structure

In the Design of the Way Structure, the Consultants have analysed the stability and strength of the subgrade along the train line of the Project as it passes through diverse geological structures and foundation soil qualities on the assumption that the quality of the soil structure would be significant to the stability of the way structure.

As for the location for the design of the subgrade which starts from km. 932+000 to km. 945+500, the soil structure is softer than in the other location along the train line as it is found on the low basin often flooded. However, from the analysis, it was found that no fortification of the soil will be needed and there is no need for the modification of the way structure or prevention of land collapse as the land collapse tendency is still stable and will not cause any damage to the tracks as shown in **Figure 3.4-7**



**Figure 3.4-7 The Ground Level Track Structure**

### 3.4.2.3 The Elevated Train Tracks

#### The Design of the Elevated Train Tracks

The Project will use the elevated tracks in two sections: from Sta.933+077 to Sta.93+572 of 2,495 meters and from Sta.951+558 to Sta.953+687 of 2,120 meters.

In the design of the elevated tracks or bridge, the Consultants have foreseen the following objectives:

- Strong and durable structure
- Aesthetic presentation
- Modern construction technology suitable with the location
- Reasonable cost of construction
- Maximal use of construction materials from within the country
- Minimal maintenance cost

The suitability of the design will be considered from the following factors: construction cost, safety, stability of the structure, construction methods, construction time, topographical condition, environment and geological conditions.

In general, the elevated track structure will be constructed at the crossing point with the main street in the city. The Consultants have followed the procedures according to the criteria and international standard with some modifications of the existing track structure that may come into the elevated train line. The design of the track type will depend on several factors such as distance of the bridge, topographical condition, etc. If the distance of the elevated track is not too long, the structure will be reinforced concrete cast on location but if the distance is longer, compressed concrete beams or metal bridge will be used.

For this Project, the elevated tracks will use double tracks combined with the elevated bridge of 25 meters with compressed concrete beams as this structure can be conveniently built and is not costly. Many builders in the South can cast these beams. The Design of the elevated track structure is shown in **Figure 3.4-8**

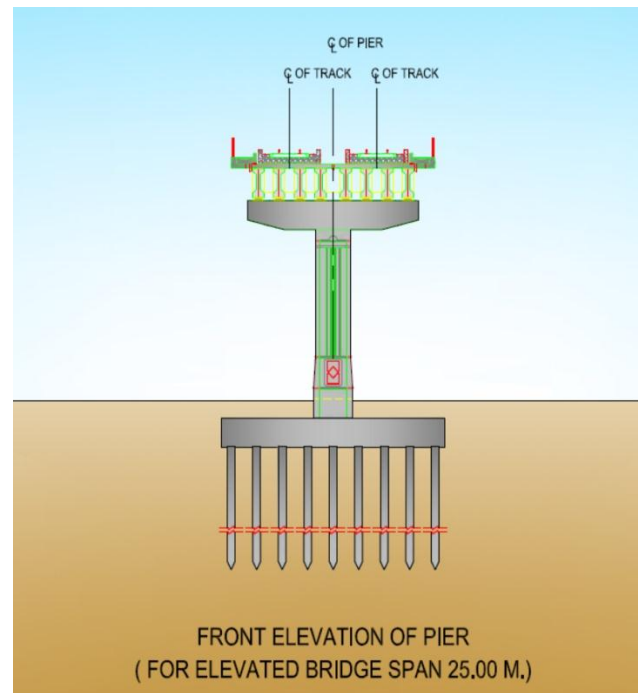


Figure 3.4-8 The Structure of the Elevated Tracks

### 3.4.2.4 The Design of the Elevated Bridge

#### 1) Summary of the Bridge Structure

Along the Project Train Line, there will be construction of 31 bridges, a total distance of 5,770 meters, which are: the ground level bridge for the single track train (using the existing bridge structure) of 635 m., the ground level bridge for the double tracks train of 520m., and the elevated bridge for the double tracks train of 4,615 m. as shown in **Table 3.4-22**

Table 3.4-22 Summary of the Train Bridge

| No. | Sta.                                          | Number of Track       | Type of Structure         | No. Span x Span Length                    | Total Length (m.) |
|-----|-----------------------------------------------|-----------------------|---------------------------|-------------------------------------------|-------------------|
| 1   | STA. 929+279.334(RT.)                         | Single Track          | Concrete Bridge           | 4x10.00=40.00 M.                          | 40                |
| 2   | STA. 930+370.013(RT.)                         | Single Track          | Steel Bridge              | 25.00+50.00=75.00 M.                      | 75                |
| 3   | STA. 931+052.058(RT.)                         | Single Track          | Steel Bridge              | 2x20.00=40.00 M.                          | 40                |
| 4   | STA. 932+117.659(RT.)                         | Single Track          | Steel Bridge              | 3x10.00=30.00 M.                          | 30                |
| 5   | STA. 933+077.068(RT) to STA. 935+572.068 (RT) | Double Track Elevated | Concrete and Steel Bridge | (33x25.00)+(2x60.00)+(62x25.00) = 2495 M. | 2,495             |
| 6   | STA. 936+673.485(RT.)                         | Single Track          | Steel Bridge              | 1x10.00=10.00 M.                          | 10                |
| 7   | STA. 936+868.416(RT.)                         | Single Track          | Concrete Bridge           | 1x20.00 = 20.00 M.                        | 20                |



| No. | Sta.                                          | Number of Track       | Type of Structure         | No. Span x Span Length                                                     | Total Length (m.) |
|-----|-----------------------------------------------|-----------------------|---------------------------|----------------------------------------------------------------------------|-------------------|
| 8   | STA. 938+391.891(RT.)                         | Single Track          | Steel Bridge              | 1x25.00 = 25.00 M.                                                         | 25                |
| 9   | STA. 940+181.409(RT.)                         | Single Track          | Steel Bridge              | 1x25.00 = 25.00 M.                                                         | 25                |
| 10  | STA. 941+235.961(RT.)                         | Single Track          | Steel Bridge              | 3x20.00 = 60.00 M.                                                         | 60                |
| 11  | STA. 941+777.927(RT.)                         | Single Track          | Concrete Bridge           | 3x10.00=30.00 M.(x2)                                                       | 30                |
| 12  | STA. 942+746.129(RT.)                         | Single Track          | Steel Bridge              | 1x25.00 = 25.00 M.                                                         | 25                |
| 13  | STA. 944+391.129(RT.)                         | Double Track          | Steel Bridge              | 1x30.00 = 30.00 M.                                                         | 30                |
| 14  | STA. 945+474.129(RT.)                         | Double Track          | Steel Bridge              | 1x50.00 = 50.00                                                            | 50                |
| 15  | STA. 946+058.802(RT.)                         | Double Track          | Steel Bridge              | 1x20.00 = 20.00 M.                                                         | 20                |
| 16  | STA. 946+480.312 (RT)                         | Single Track          | Concrete Bridge           | 1x20.00=20.00 M. (x2)                                                      | 20                |
| 17  | STA. 947+057.930(RT.)                         | Single Track          | Steel Bridge              | 1x10.00=10.00 M.                                                           | 10                |
| 18  | STA. 947+825.930(RT.)                         | Single Track          | Steel Bridge              | 1x25.00 = 25.00 M.                                                         | 25                |
| 19  | STA. 948+332.777(RT.)                         | Single Track          | Steel Bridge              | 3x10.00=30.00 M.                                                           | 30                |
| 20  | STA. 948+887.085(RT.)                         | Single Track          | Steel Bridge              | 1x40.00 = 40.00 M.                                                         | 40                |
| 21  | STA. 950+845.746(RT.)                         | Single Track          | Steel Bridge              | 1x30.00 = 30.00 M.                                                         | 30                |
| 22  | STA. 951+558.881(RT) to STA. 953+687.881 (RT) | Double Track Elevated | Concrete and Steel Bridge | (30x25.00)+(2x60.00)+(22x25.00)+50.00+(17x25.00)+50.00+(7x25.00) = 2120 M. | 2,120             |
| 23  | STA. 954+314.500(RT.)                         | Double Track          | Steel Bridge              | 30.00+50.00+30.00=110 M.                                                   | 110               |
| 24  | STA. 954+656.235(RT) to STA. 954+906.235 (RT) | Double Track          | Concrete and Steel Bridge | 10x25.00=250.00 M.                                                         | 250               |
| 25  | STA. 956+332.772(RT.)                         | Double Track          | Steel Bridge              | 1x15.00 = 15.00                                                            | 15                |
| 26  | STA. 956+887.970(RT)                          | Single Track          | Concrete Bridge           | 1x10.00=10.00 M. (x2)                                                      | 20                |
| 27  | STA. 957+230.715(RT.)                         | Single Track          | Concrete Bridge           | 1x10.00 = 10.00 M.                                                         | 10                |
| 28  | STA. 960+178.028(RT.)                         | Single Track          | Steel Bridge              | 1x15.00=15.00 M.                                                           | 15                |
| 29  | STA. 962+926.830(RT.)                         | Single Track          | Concrete Bridge           | 2x10.00 = 20.00 M.                                                         | 20                |
| 30  | STA. 963+664.830(RT.)                         | Single Track          | Concrete Bridge           | 2x10.00 = 20.00 M.                                                         | 20                |
| 31  | STA. 965+695.852(RT.)                         | Double Track          | Steel Bridge              | 1x15.00 = 15.00 M.                                                         | 15                |
| 33  | STA. 967+080.697(RT.)                         | Double Track          | Steel Bridge              | 1x30.00=30.00 M.                                                           | 30                |

| No. | Sta.                  | Number of Track | Type of Structure | No. Span x Span Length | Total Length (m.) |
|-----|-----------------------|-----------------|-------------------|------------------------|-------------------|
| 35  | STA. 972+314.524(RT.) | Single Track    | Steel Bridge      | 1x15.00=15.00 M.       | 15                |
|     |                       |                 |                   | Total                  | 5,770             |

### 3.4.2.5 Types of the Bridge Structure

In the Design of the Train Bridge, the Consultants have considered the volume of the stream running under the bridge and suitable topographical condition according to the international engineering standard such as strength, durability and safety. Moreover, the Consultants also considered suitability to the environment by laying a minimal number of piles in the water.

The factors for the selection of the bridge type are:

- 1) The construction cost  
As there are a number of bridges to be constructed, the cost of construction in the bridge structure work will be high. Besides designing the bridges for suitable cost, the Consultants have also looked into suitable types of bridge to the water channel and reasonable construction cost.
- 2) The method of construction  
As at some location, the access to the bridge construction is difficult, the construction method has to be appropriate and practical.
- 3) The type of nearby bridge  
In finding the suitable location of each bridge, the Consultants will bring into consideration the positioning of the piles and the span of the underpass of the nearby bridges.
- 4) Aesthetic value  
The design of each bridge will consider the structure and the suitable proportion to yield aesthetic value to the bridge.
- 5) Difficulty of the construction  
The Consultants have designed the construction method of each bridge not to be complicated and without complex technology so most building contractors can operate and only necessary heavy equipment will be required.
- 6) Time for the Construction  
To reduce field work, the bridges have been designed to use pre-fab materials that will be assembled on site. The construction of each bridge should take between 12-18 months except for the long bridges.

## 7) Construction Materials

As for most construction materials, the Consultants have chosen those that are made in Thailand with international standard and certified with ISO.

The structure of the Train Bridge suitable for each length is:

| <u>The length of the Bridge (m.)</u> | <u>The structure of the Upper Part of the Bridge</u>                                 |
|--------------------------------------|--------------------------------------------------------------------------------------|
| 10                                   | Cast In-situ Reinforced Concrete Slab                                                |
| 15, 20, 25, 30                       | Pre-stressed Concrete Girder when there is no restriction on height under the bridge |
| 15, 20, 25, 30                       | Steel bridge when there is not enough height under the bridge                        |
| 40 up                                | Steel bridge                                                                         |

In the design of the bridge across the running stream or over the existing train tracks, the drainage bridge has been included. The Consultants have chosen the bridges with the length wider than the stream so it will not block the running course. In case of an existing bridge, the piles of the new bridge will be set parallel with the old bridge not blocking the water course. If the length of the bridge is not too long, cast in-situ reinforced concrete slab will be used but if the length is longer, pre-stressed concrete slab or steel bridge will be used instead. Examples of the bridge structure are shown in Figure 3.4-9 to Figure 3.4-11

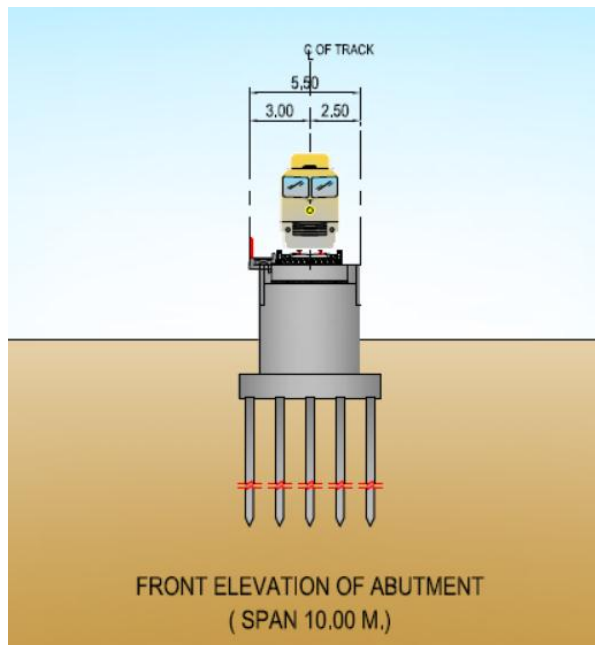


Figure 3.4-9 The Bridge Structure with Cast In-Situ Reinforced Concrete Slabs

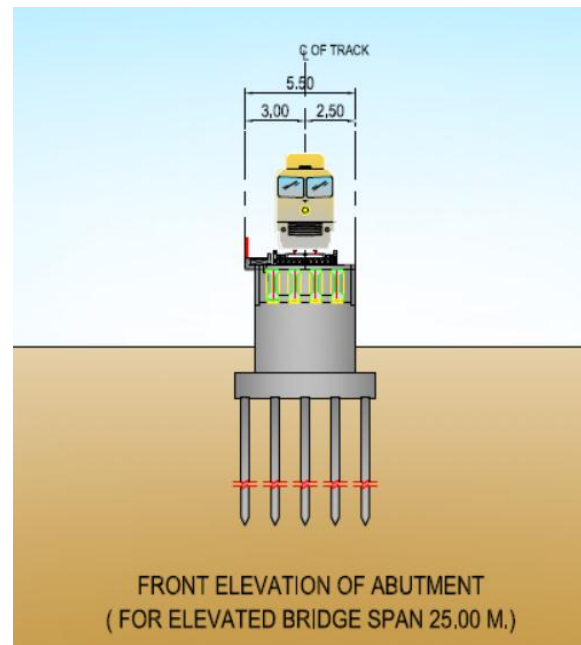


Figure 3.4-10 The Bridge Structure of Pre-Stressed Concrete Slabs

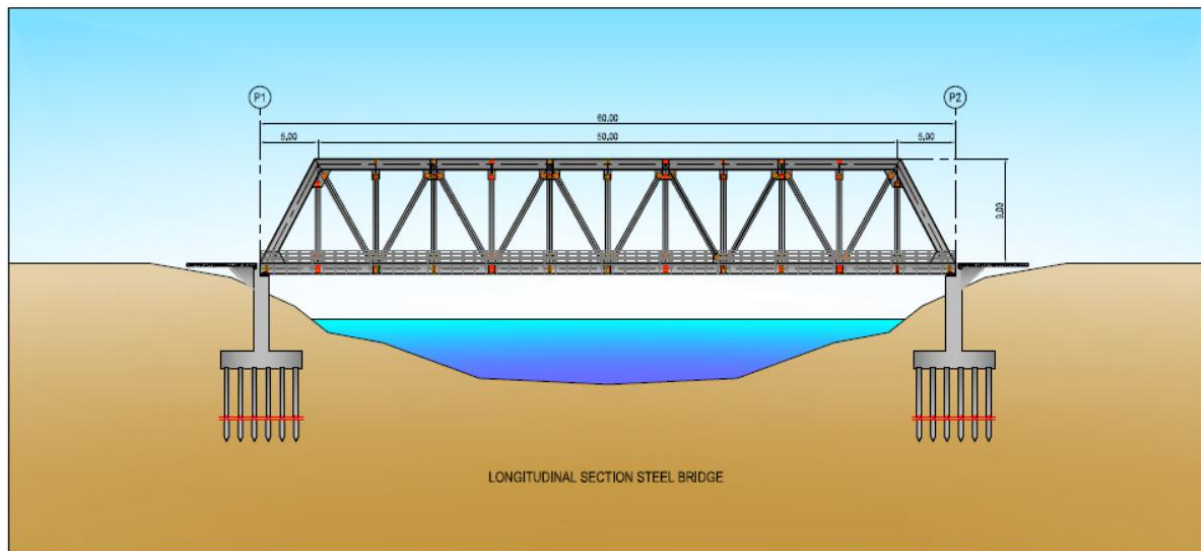


Figure 3.4-11 The Steel Bridge Structure

### 3.4.2.6 The Stations and the Compound

#### 1) The Location of the Station and the Compound

Along the Hat Yai-Padang Besar Train route, there will be 4 stations and 3 stops. The design of the Project has adjusted the station compound to suit the new concept of the Train Operation and the Train Line which will connect with other transportation modes in the future. The old stations will be renovate and modernized into future stations such as Sala Thung Lung Station. The station compound will be developed to suit future development plan such as Khlong Ngae Station. Additional train stops will be included to serve a complete service cycle such as Ban Phru Stop, Khlong Ram Stop, Tha Khoy Stop.

In order to comply with City Planning Measures and Land Management, considerations should be made on the suitable locations of the buildings at the train station and the design should focus on the maximal use of land, facilities supporting service and access to the station, land preparation for future development to avoid impact to the people from and land expropriation.

In the modification of the roles of the station and the development guidelines of the station compound, the types of the locations of the 4 stations and 3 stops are:

- **Hat Yai Junction** Located at the current Hat Yai Depot and working as the departure point; the design already included in the renovation of Hat Yai Depot under the Suratthani-Hat Yai-Songkhla Double Tracks Train.
- **Ban Phru Stopping Point** Located within the train area at Ban Phru Sub-district, Hat Yi District, Songkhla Province.

- **Sala Thung Lung Junction** Located at Sala Thung Lung Station, Patong Sub-district, Hat Yai District, Songkhla Province
- **Khlong Ngae Junction** Located at the current Khlong Ngae Station
- **Khlong Ram Stopping Point** Located within the train line at Ban Khlong Ram, Thung Mor Sub-district, Sadao District, Songkhla Province
- **Ban Tha Khoy Stopping point** Located within the train line at Ban Tha Khoy, Padang Bezar Sub-district, Sadao District, Songkhla Province
- **Padang Bezar 2 Junction** Located within the train area near Padang Bezar Station 2 on the Thai border, Padang Bezar Sub-district, Sadao District, Songkhla Province. At present, this area has been turned into public park and some occupied as residence and business shops.

The modifications of the roles of the stations and development guidelines of the station compound can be summed up as follow:

**Table 3.4-23 Modifications of Roles and Functions of the Stations and Development Guidelines of the Station Compound**

| Stations/Stops  | Modifications of Roles         |         | Development                    |                                                         |
|-----------------|--------------------------------|---------|--------------------------------|---------------------------------------------------------|
|                 | Present                        | Future  | Present station building       | Future station building                                 |
| Hat Yai         | Station                        | Station | Still in operation             | Under the Suratthani-Hat Yai Double Track train Project |
| Ban Phru        | Non-existing station condition | Stop    | None                           | New stop building for new train                         |
| Sala Thung Lung | Remaining station compound     | Station | None                           | New building (Type-S)                                   |
| Khlong Ngae     | Station                        | Station | Still in operation             | New building (Type-S)                                   |
| Khlong Ram      | Non-existing station condition | Stop    | None                           | New stop building for new rain                          |
| Tha Khoy        | Non-existing station condition | Stop    | None                           | New stop building for new train                         |
| Padang Bezar 2  | Sub-station under construction | Station | New station (not in operation) | New building (Type-M)                                   |

## 2) The Architectural Design of the Station

To adhere with Thailand's vision of Transportation Infrastructure Development and the Rail Transport Development Plan, in the Study and the Design of the hat Yai-Padang Bezar Double Tracks Train project, the Consultants have conducted a Feasibility Study and Review of the Locations of the Stations and the Compound, all necessary components, related facilities by referring to the projection of transportation needs of freight and passengers, and the number of trains. The Master Plan includes the architectural design to be used in the calculation of the

construction cost, and also the effective road network entering and leaving the station and the compound.

### 1. The Principle Concept of the location of the Station and Compound

- Located in the community area for travel convenience
- Available parking area or transportation linkage
- No problem of landscape with historical or religious sites
- Avoiding as much land expropriation as possible
- Avoiding removing public utilities
- Allowing business development to service providers and the community around the station

### 2. The Station Planning

The station planning should harmonize with the location and represent the unique image of the community and consider facilities for the disabled.

The main considerations in the design of the station are efficiency, economics, clear understanding, safety and architectural creativity. The architectural design should be easy to apply and durable and representing the unique image of the Train system. The success of the station design would depend on the followings:

- convenient connection with other transport mode
- providing pleasant atmosphere to the surrounding area by allowing shops, restaurants and other facilities which aim to promote the community along the train line
- designing attractive entrance and exits

Without complicated approaches, the station would reach its goal in being compact in size, efficient and worthy of investment. The project will efficiently provide convenience to city travellers not only to meet the State's objectives but also the needed of the people in the society.

The ideal planning of the station and its compound must include convenience in transportation connection, necessary facilities for passengers, support system for freight transport and logistics. As for the Hat Yai-Padang Besar Train Project, considerations must include international standard customs procedures, convenience and practicality of use, economics and suitability to the train operation, lower cost of investment and management and finally safety measures for the passengers.

The architectural design of the station structure can choose contemporary Thai identity image of modern design depending on each station with consideration to the nearby location. As the station area is not large, the added architectural value may not require large budget but it will be worthwhile for the local people.

The station planning will also include emergency evacuation from the station in many cases such as fire so passengers and the disabled can be safely evacuated in time.

### 3) The Design of the Passenger Building

- **The Design Concept of the Station Building**

The design concept of the station building focuses on the use of the overall area and the technical access of the staff and station users and for the general public. Considerations should be made of transportation standard around the station for convenience and safe access. The architectural design should be aware of the weather condition and the uniqueness of the location, the projected number of passengers, types of service, the length of the fleet and future expansion. Good planning of the station will successfully meet future needs.

The design of the station compound includes the use of equipment and facilities according to the international standard of architecture and engineering such as safety system, emergency evacuation system according to National Fire Protection Association (NFPA), Universal design (UD), Standards and Regulations of National Safety Council of Thailand, Standards and Regulations of the Fire department, department of Civil Work and City Planning, etc.

- **The Design Concept of Architectural Form**

With consideration of the unique identity of the location and modern architecture, the design of the station and the compound for passengers should be:

***“Retaining the traditional and unique architectural form on the use area with modernity and Universal Design”***

This means integration between “modernity” and “locality” to create new unique image of the community around the station. The modern architectural design could be represented by simplicity of form and structure including the use of modern construction materials. The uniqueness of the location can be displayed in integrating the present station which is historically significant with the physical configurations of the surrounding community and location especially along the Hat Yai-Padang Besar Train line. (Figure 3.4-12) Moreover, the architectural design must correspond with the weather condition with heavy rain for convenience of passengers.



**Figure 3.4-12 The Architectural Concept of the Project Train Station**

In the design of the stations for the Hat Yai-Padang Besar Train Project, the following points are considered:

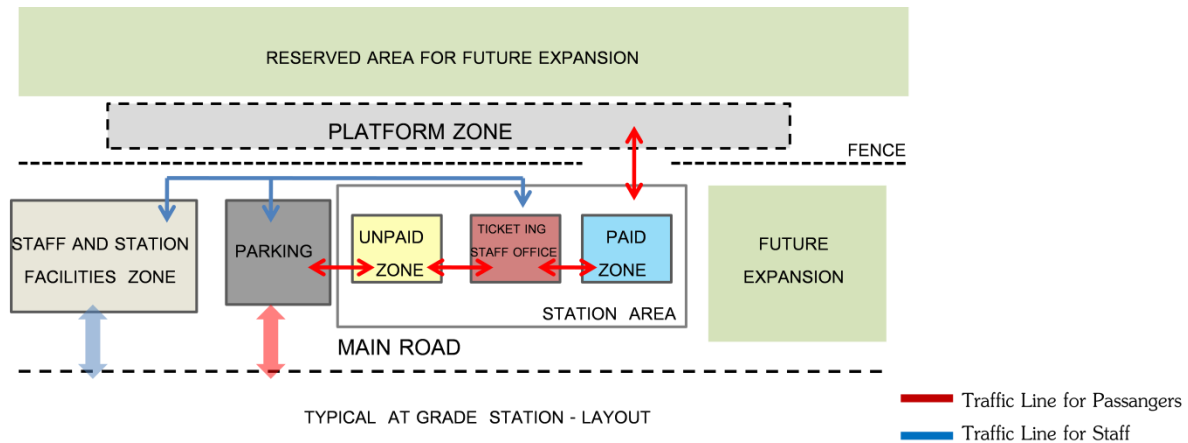
- History and significance of the station building and compound along the Hat Yai-Padang Besar Train Line
- The architectural form of the station building along the Hat Yai-Padang Besar Train Line
  - The building will be a mixture of European and Thai architecture with the arch form decorated with sculpted stucco along the gable and roofline or Clipped Gable with 30 degree slope, terra cotta roof tiles and wooden doors and windows.
  - The building has an applied Thai architecture design with a unique form of the Thai gable with minimal decorations
- The architectural form that influences the design of the Hat Yai-Padang Besar Train Station is that of the Khlong Ngae Station which had been built during King Chulalongkorn in 1909 for the train connection with Malaysia. The Khlong Ngae Station is one of the historical train stations with unique building design that is still in operation on the train route from Hat Yai to Padang Besar. The building was a mixture of concrete and wood influenced by the Victorian architecture with carvings and delicate arch roof support. The building was painted with cream color outlined with brown and dark brown color.



#### 4) The Concept of the Function Area

- The Detailed Design of the Function Area of the Station Building and Outlying Buildings

- The layout of the station building and other outlying buildings is in line with the planning of the compound, the train operation system and number of passengers projected at each station. The composition of the station building and outlying buildings are:



- The Station Plaza consists of parking area for passengers, multi-purpose parking, area connecting with other transport modes and facilities for the community such as green area for recreation, , activity area, monument sculpture of important local people or symbol, police box, etc.
- The Station building is divided into public area for passengers and special area for staff
- The Platform is designed to serve the train operation, entrance and exit to the station
- The detailed design of the station building and outlying buildings focuses on convenience for passengers and staff. The layout of the function area is as follow:
  - The area for passenger traffic and service such as the entrance hall, ticketing area, waiting area, PR section including First Aid Room, telecommunication service area, banking service, Prayer Room, rest rooms. These areas should be set as Paid Area for passengers with the train tickets and Unpaid Area for those without the tickets. Facilities should be provided for the elderly and the disabled according to the Universal.
  - Design Concept. The function area for the staff includes ticket booth, train operation control room, offices for the Station Manager and clerical staff, meeting room, inventory room, rest room.

- Business area such as restaurants, shops, souvenir shops, bookstores. This area should be separate from the main station building with connecting walkway for convenience and future expansion.

The layout of the station building includes:

- Station Plaza: parking for passengers, multi-purpose parking connected with the outlying community
- Station buildings: public area for passengers and restricted area for staff
- Platform: servicing area for traffic and train operation work

The design of the layout of the station will suit the location and the outlying buildings for easy access to the station and emergency evacuation. The entrance-exit must connect with other transportation modes. The station plaza will provide activities area and keep close to the identity of the local community near the station.

The design of the station and plaza will consider the specific location, number of running trains, projected number of passengers and freight volume at each station, number of staff and local community attractions such as tourist attractions, government offices, etc.

The number of passengers is the main factor in deciding the size of the station to meet future expansion. From the study of maximal number of passengers, there will be 3 types of station classified according to the number of passengers per hour:

- (1) Small stations servicing 1-80 passengers per hour or not more than 900 passengers per day such as Sala Thung Lung Station.
- (2) Medium stations servicing 81-160 passengers per hour or between 900-1,600 passengers per day such as Khlong Ngae Station.
- (3) Large stations servicing more than 161-400 passengers per hour or between 1,600-4,000 passengers per day such as Padang Besar Station.

Most station buildings in the Project will be built new at nearby locations so not to affect the local way of living or the existing train operation. However, there should be conservation of the original station and promotion of activities for the benefit of the local Community in conjunction with travel and tourism such as turning the building into library, local museum, etc.

As for the development plan for Khlong Ngae Station, there will be preservation of the original building and construction of new buildings only around them by not adding any new structure to the original building so not to cause any damage to this distinctive historical station building. The new building will be built next to the original one along with the train bridge or underpass for convenience of transportation connection at present and future expansion.

## 1. Sala Thung Lung Station

The station compound of Sala Thung Lung Station is located in the suburban area south of Hat Yai near Hat Yai Airport. The old residential community which has a unique structure is quite dense along Kanjanawarit Road and Sala Thung Lung Station. The development plan of Sala Thung Lung Station compound to serve the electric train must consider the followings:

- 1) The location of the station will turn to be future urban space but the original public park should be kept and future development should serve the new station
- 2) Preparation for parking area for personal cars, passengers and staff and activities required for transportation connection such as parking for public buses, hired vehicles, bicycles, motorcycles and common area of the station such as passenger pick-up area, freight pick up area.
- 3) Preparation for future expansion of travel activities and linkage to Transit-Oriented Development from growth in travel and transport and Hat Yai itself
- 4) Effective traffic system that will not pose any problem to travel or the community activities but in fact support travel and transportation with facilities for passenger and freight transportation by trains at Sala Thung Lung Station

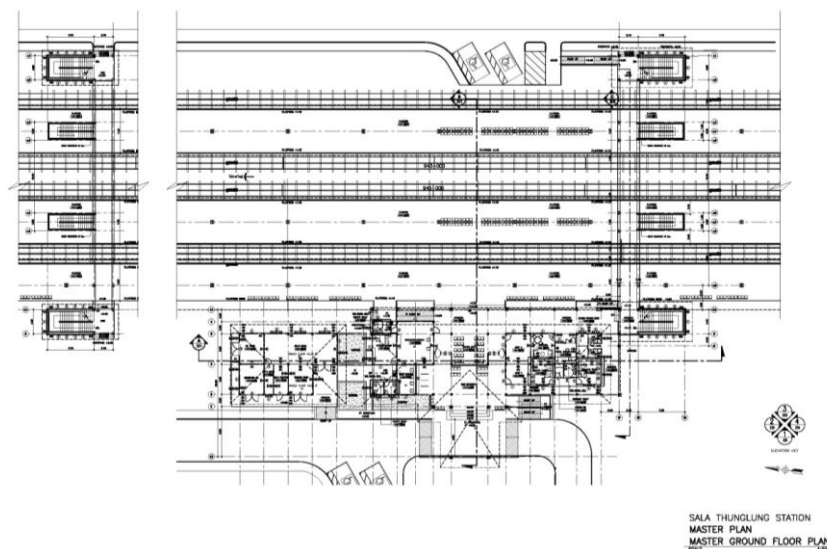


Figure 3.4-13 The Sala Thung Lung Station Plan

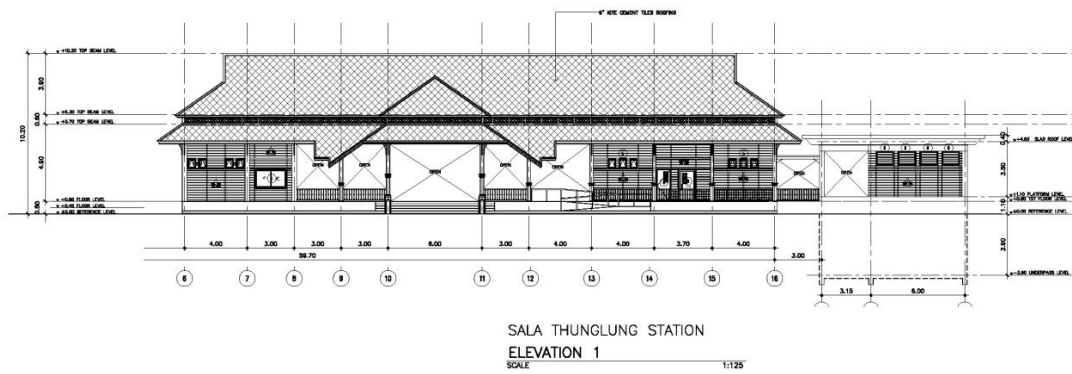


Figure 3.4-14 The Front View of Sala Thung Lung Station

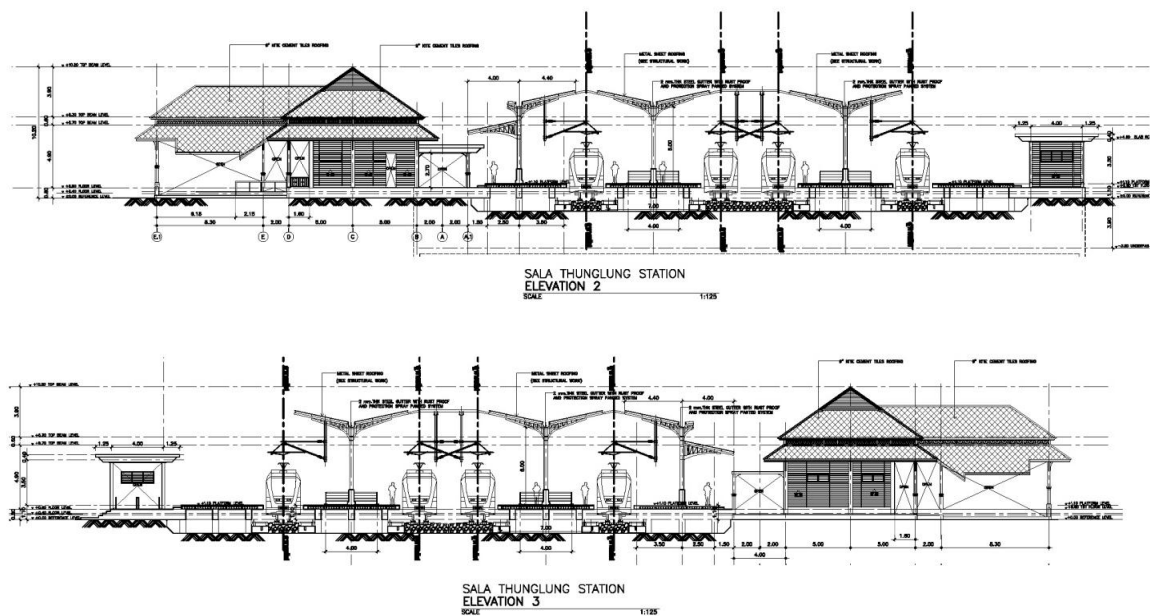


Figure 3.4-15 The Side View of Sala Thung Lung Station



Figure 3.4-16 The View of the Platform at Sala Thung Lung Station

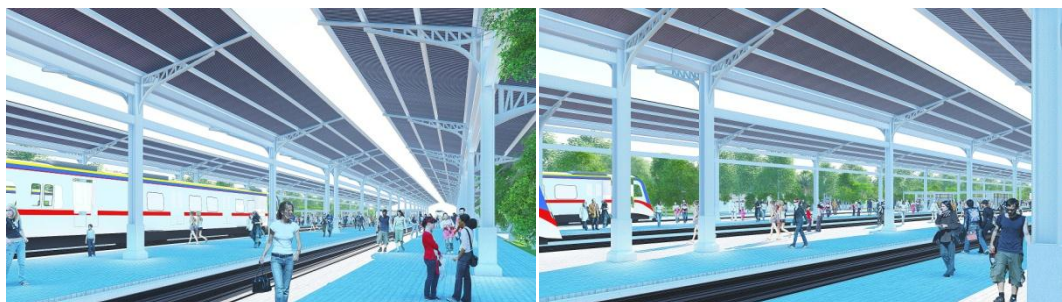


Figure 3.4-17 The View of the Platform at Sala Thung Lung Station

## 2. Khlong Ngae Station

The Station is located at Phang La Sub-district with highly populated Khlong Ngae residential community situated east of Kanjanawanit Road across from the old train station. This is an old business section and has been a center of the road network to the border such as Sadao. In the future, if there is a construction of Route 4145 to Satun Province, the connection will then be extended to Prajandai Border Check Point. Khlong Ngae Community has high growth potential in serving border trading and future development. The development of the Padang Besar-Hat Yai Station and the Station Compound should consider the followings:

- 1) Khlong Ngae Station is an elevated train track and platform above ground. The area in the south of the Station can be used as parking area and travel supporting activities area, and helps reduce the crossing point between the train tracks and the road.
- 2) The area at the Station classified as ROW can be used as parking area, and Inter-Transport Facility with the area under the platform above the crossing point between the track and the road.
- 3) For inter-transport activities into the Station, the Station compound has been connected for smooth convenience by the use of bridge and underpass of the elevated structure. The preparation of the area and use of the land around the Station has been made to serve future change of the city from the Trend of Development in commerce (TOD).
- 4) The change of the original road network into a loop cycle has provided smooth circulation system in passenger pick-up and entry/exit to the local roads
- 5) Preparation of the structure and the area to meet future expansion of train operation and freight transport and preparation of the area for equipment for train operation and container yard.



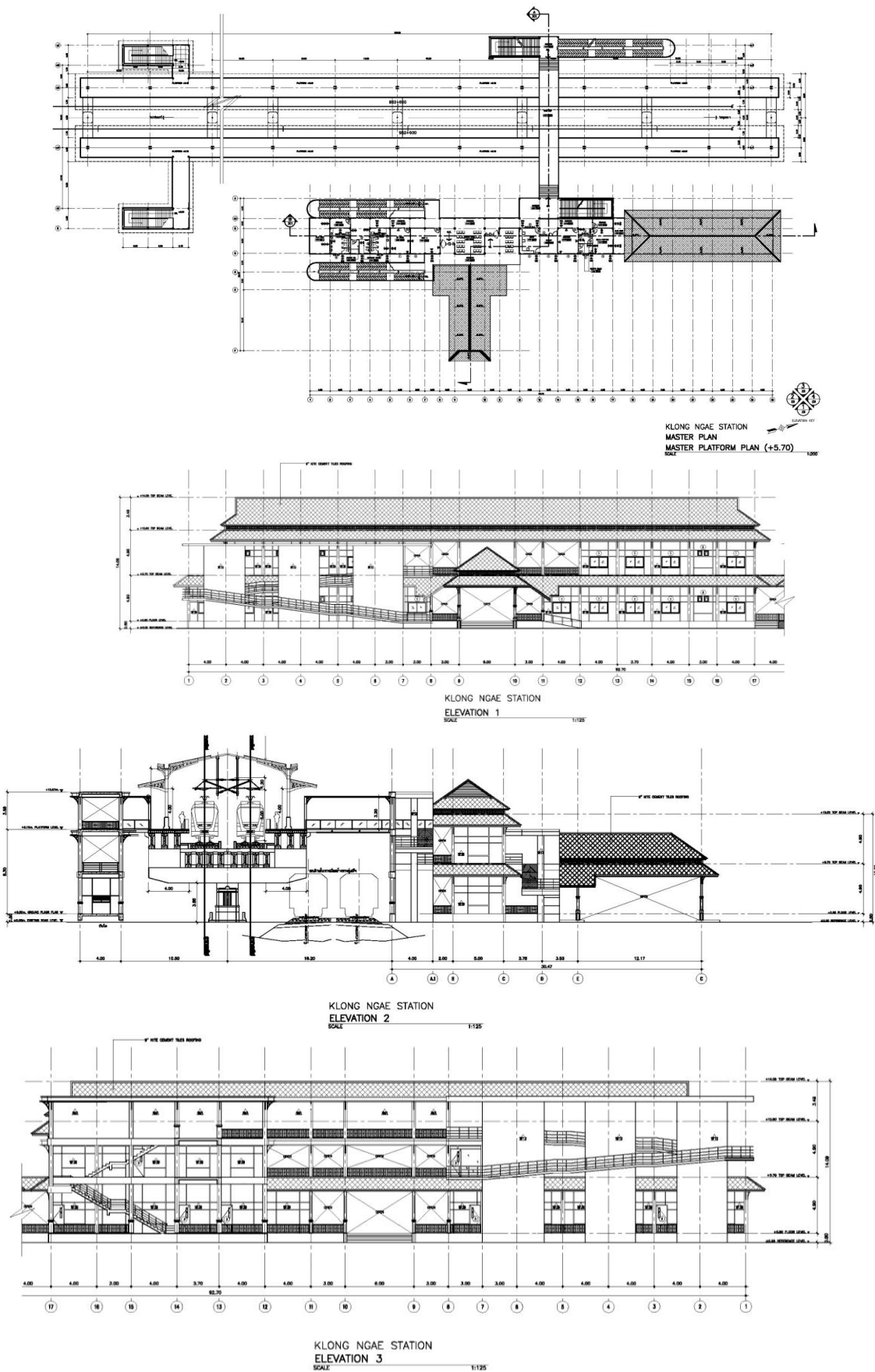


Figure 3.4-18 Khlong Ngae Station Plan



Figure 3.4-19 The Front View of Khlong Ngae Station



Figure 3.4-20 The Front View of Khlong Ngae Station



Figure 3.4-21 The Panorama View of Khlong Ngae Station





Figure 3.4-22 The Outlook of the Slope Area at Khlong Ngae Station



Figure 3.4-23 The Outlook of the Ground Floor Walkway at Khlong Ngae Station

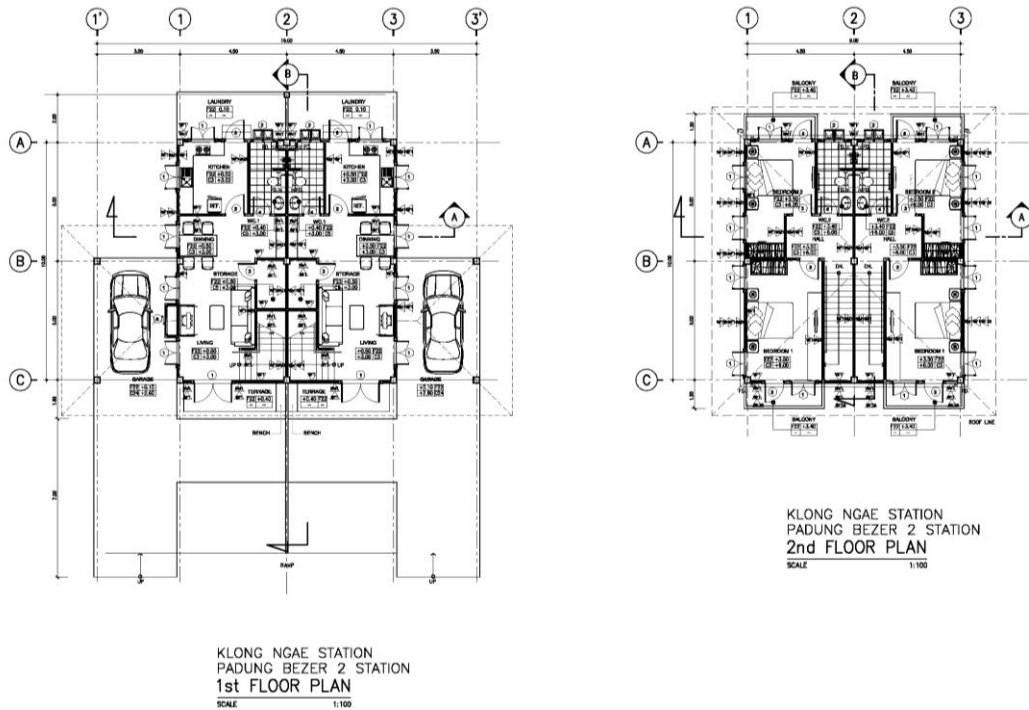


Figure 3.4-24 The Staff Lodge Type-A Plan at Khlong Ngae Station

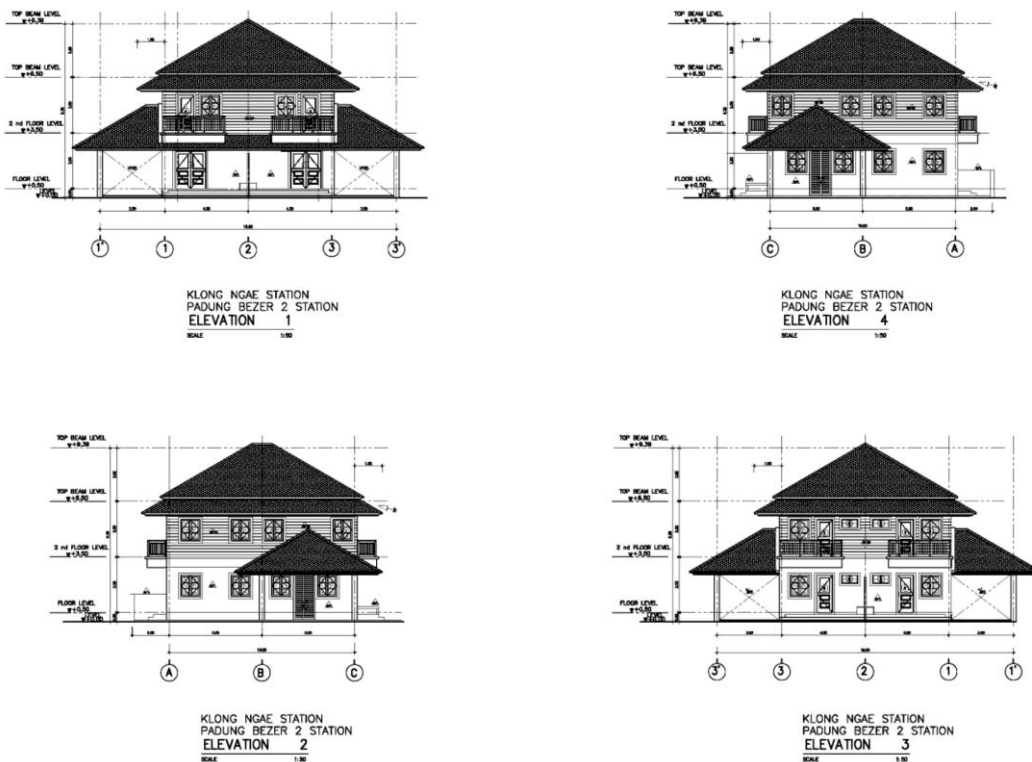


Figure 3.4-25 The Side View of the Staff Lodge Type A at Khlong Ngae Station

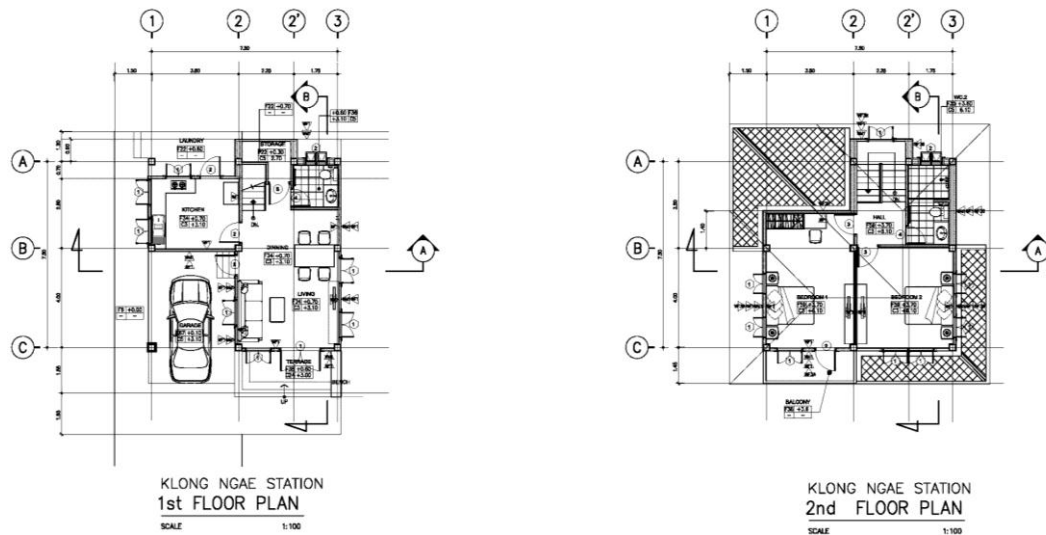


Figure 3.4-26 The Staff Lodge Type-B Plan at Khlong Ngae Station

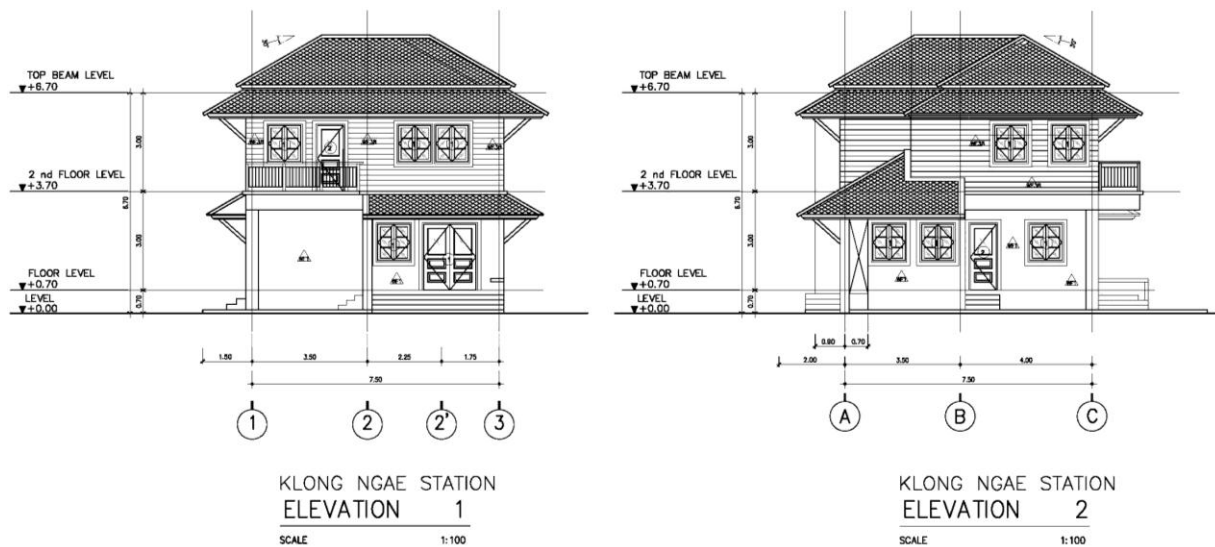


Figure 3.4-27 The Side View of the Staff Lodge Type B at Khlong Ngae Station

### 3. Padang Besar Station

From the study of the urban area and the not too busy road network in the community and the location of the train station which is near the border, the development plan of the outlying area of Padang Besar Station should consider the followings:

- 1) The location of the station for the Double Track Electric Train should be on the unoccupied lot of the public park which will be the center of future business development. This will provide convenience and suitability to travel activities across the border.
- 2) The use of the unoccupied land on the west as parking area, container yard, and related activities such as customs process, inter-transit activities and equipment storing area.

- 3) The landscape design of the central area of the Station takes an Urban Park design to be suitable with the property development into commercial use to generate income to SRT with ROW regulations. The station compound will be orderly and efficiently managed to serve travel activities and border trading.
- 4) The development of the road network to solve traffic problem should look into separating cargo transport from travelling activity or reducing traffic congestion such as reducing the crossing points between the road and the train track, elevating the train track and lowering the road at the crossing point in front of the border check point.
- 5) There should be planning for a special area to accommodate future urban expansion, changes in the use of land as a result of the State projects in the area, the joint commercial development with private sector related with border trading and tourism.

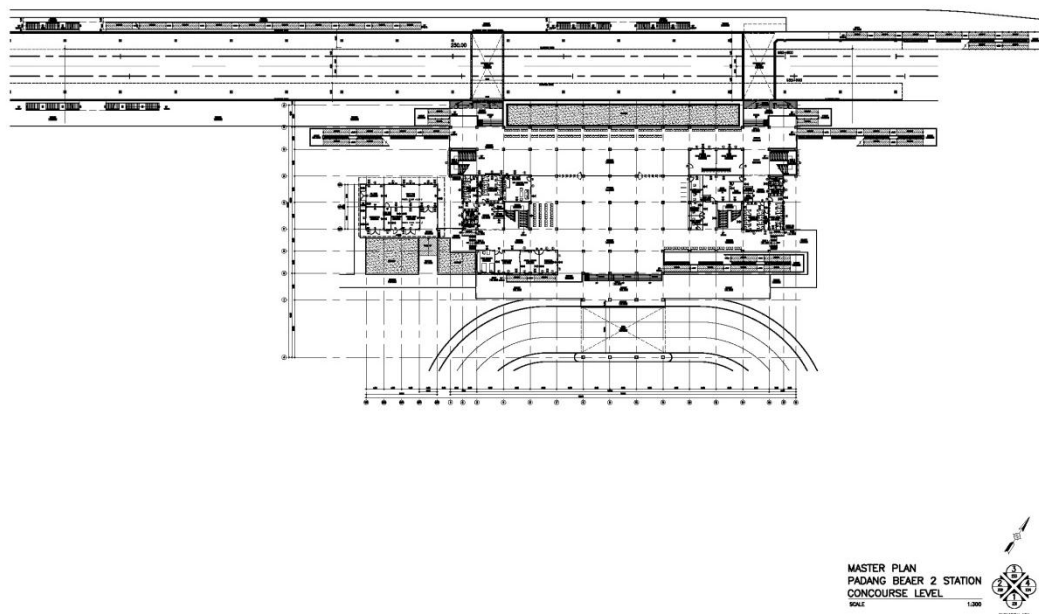


Figure 3.4-28 Concourse Plan of Pradang Bezar 2 Station

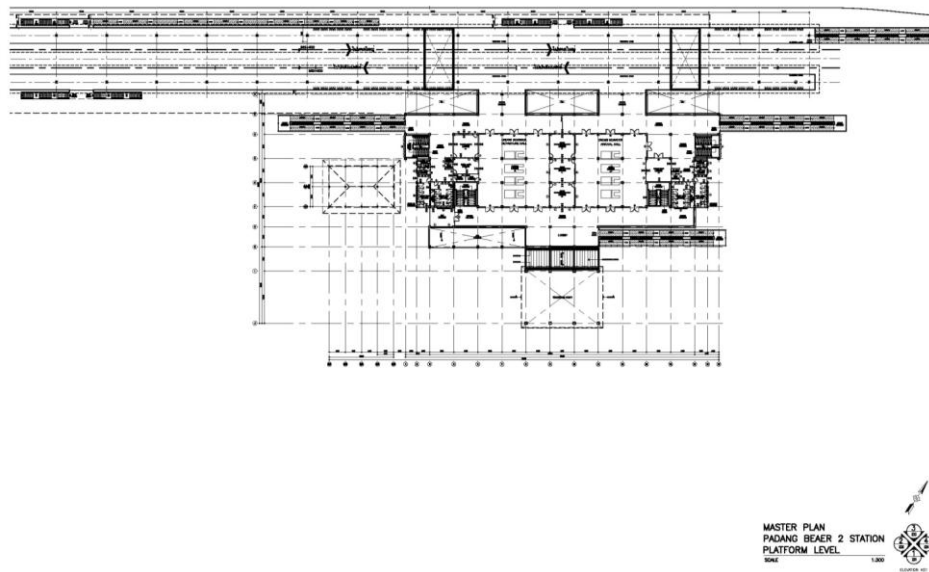


Figure 3.4-29 Platform Plan of Padang Besar 2 Station

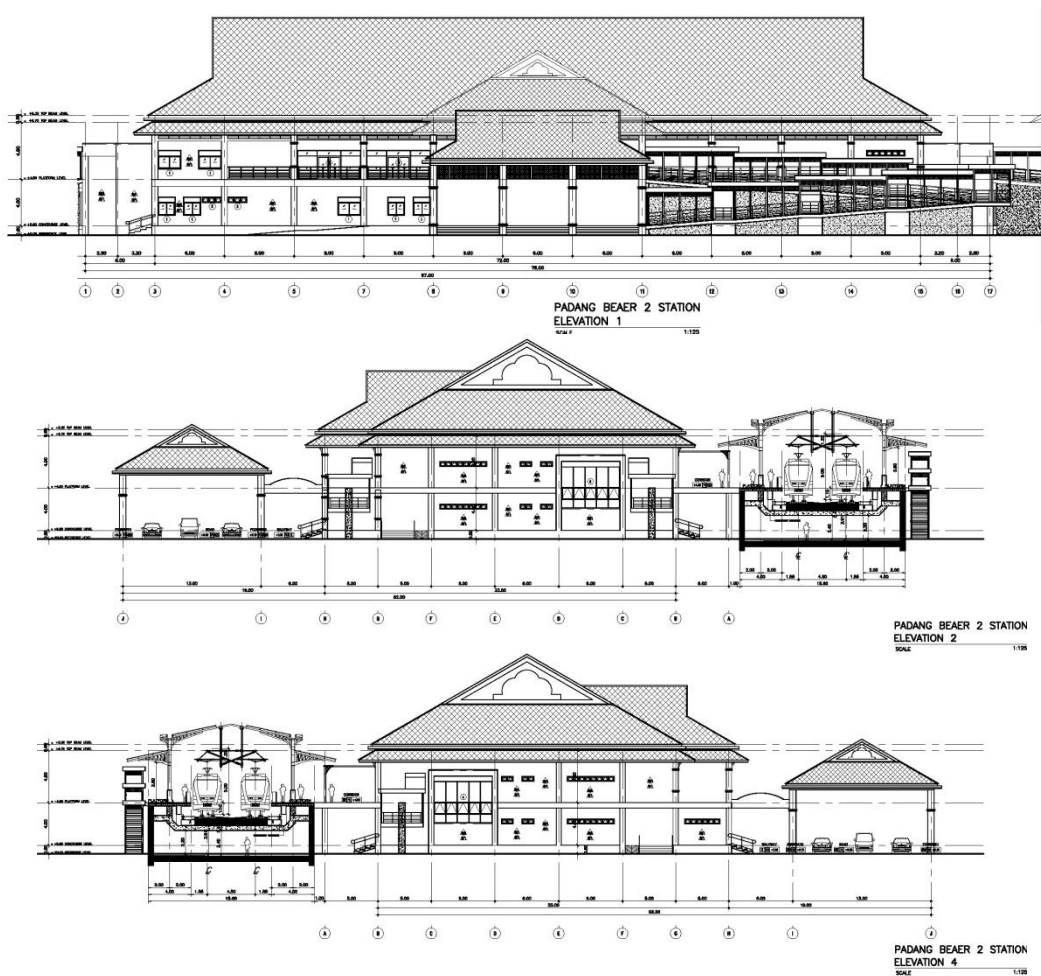


Figure 3.4-30 The Side View of Padang Besar 2 Station



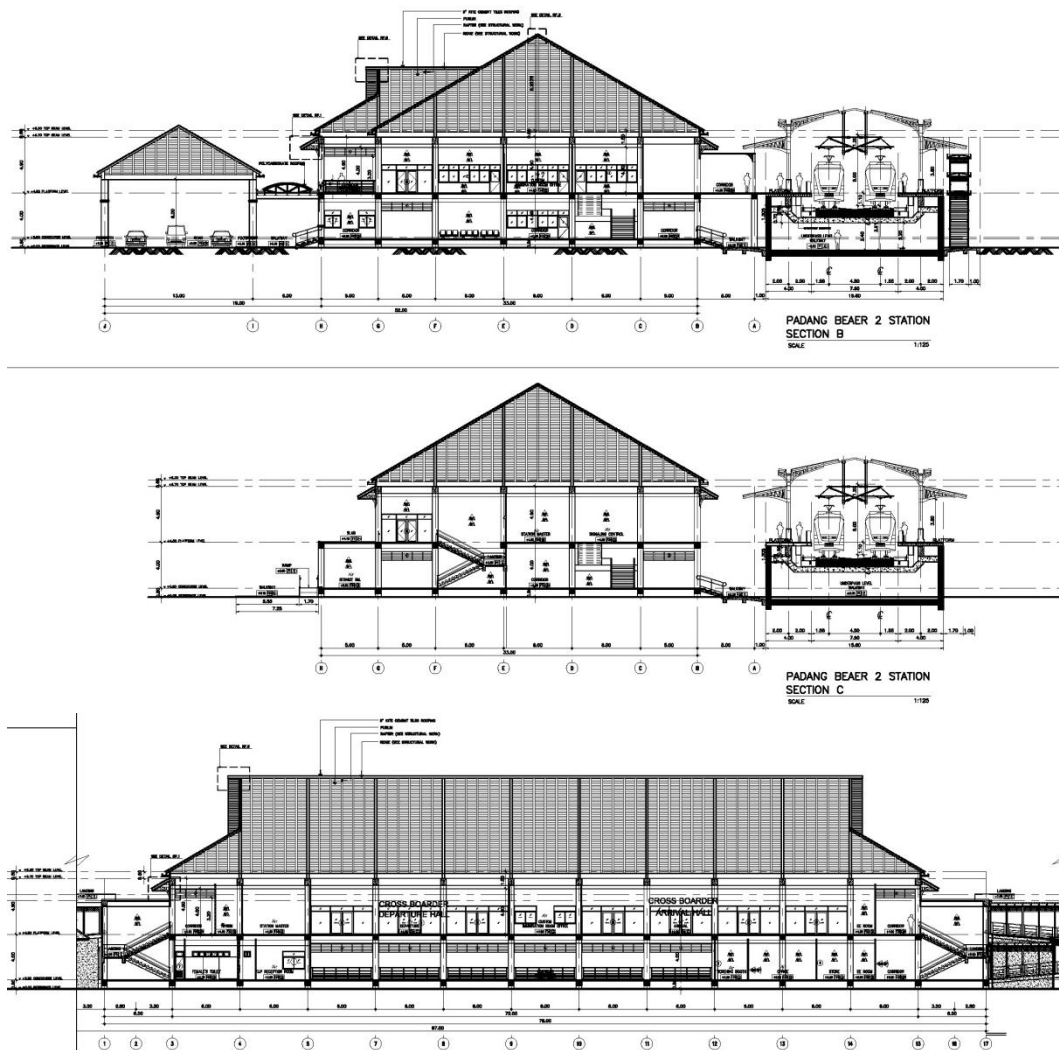


Figure 3.4-31 The Cross Sectional View of Padang Bezar 2 Station



Figure 3.4-32 The Panoramic View of the Exterior of Padang Besar 2 Station



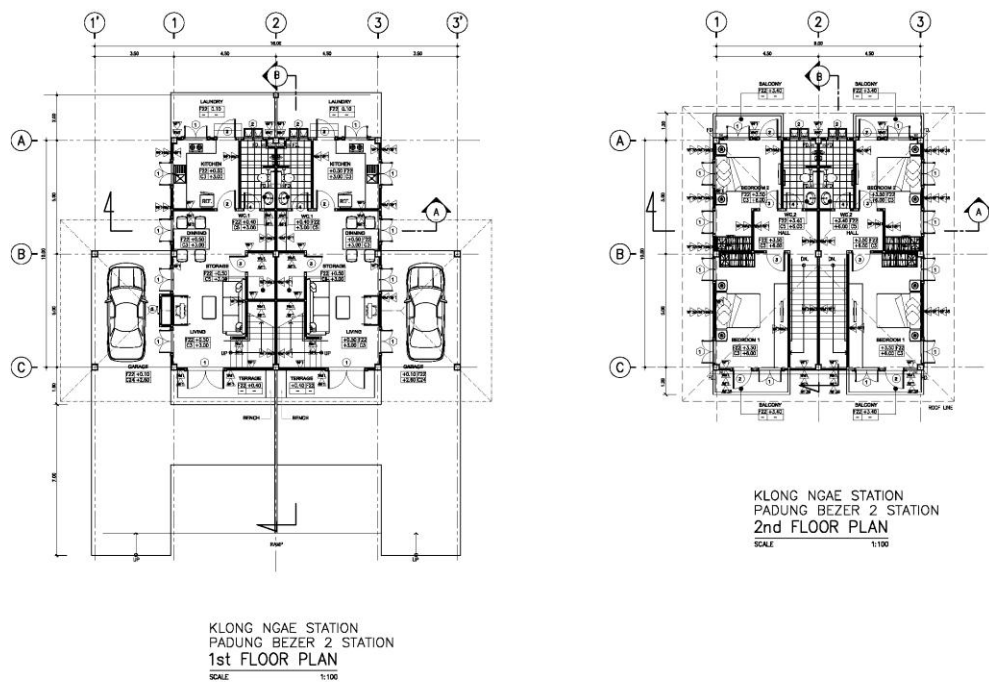


Figure 3.4-33 The Staff Lodge Type A Plan, Padang Bezar 2 Station

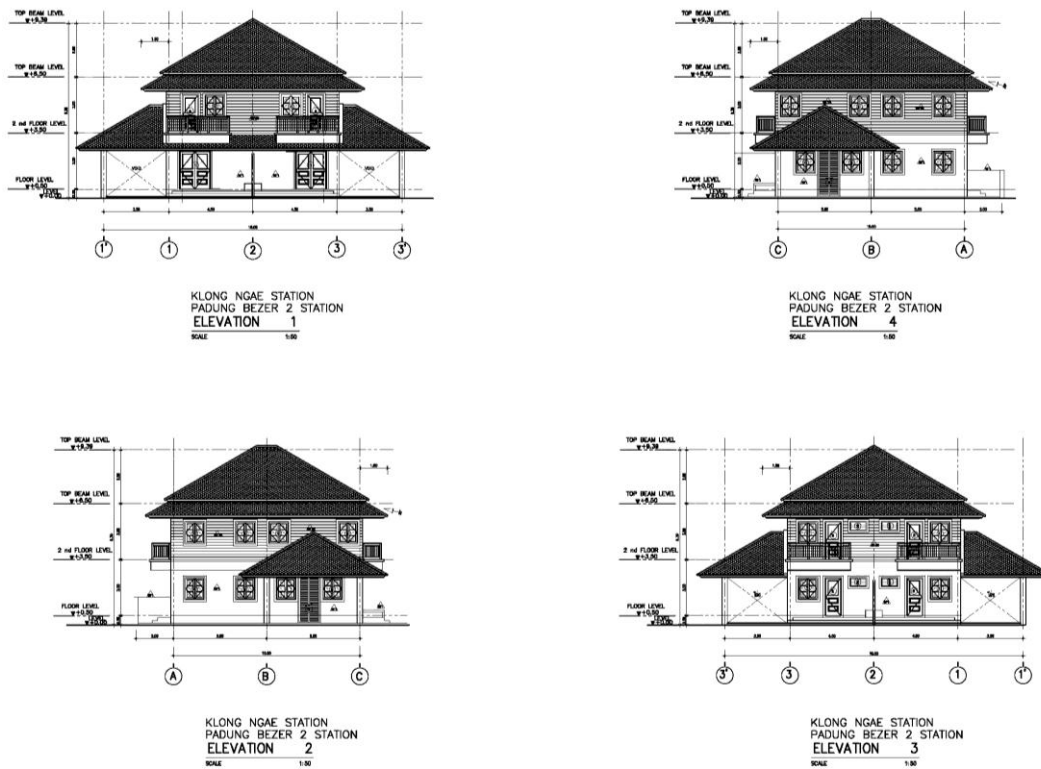


Figure 3.4-34 The Side View of the Staff Lodge Type A Plan, Padang Bezar 2 Station



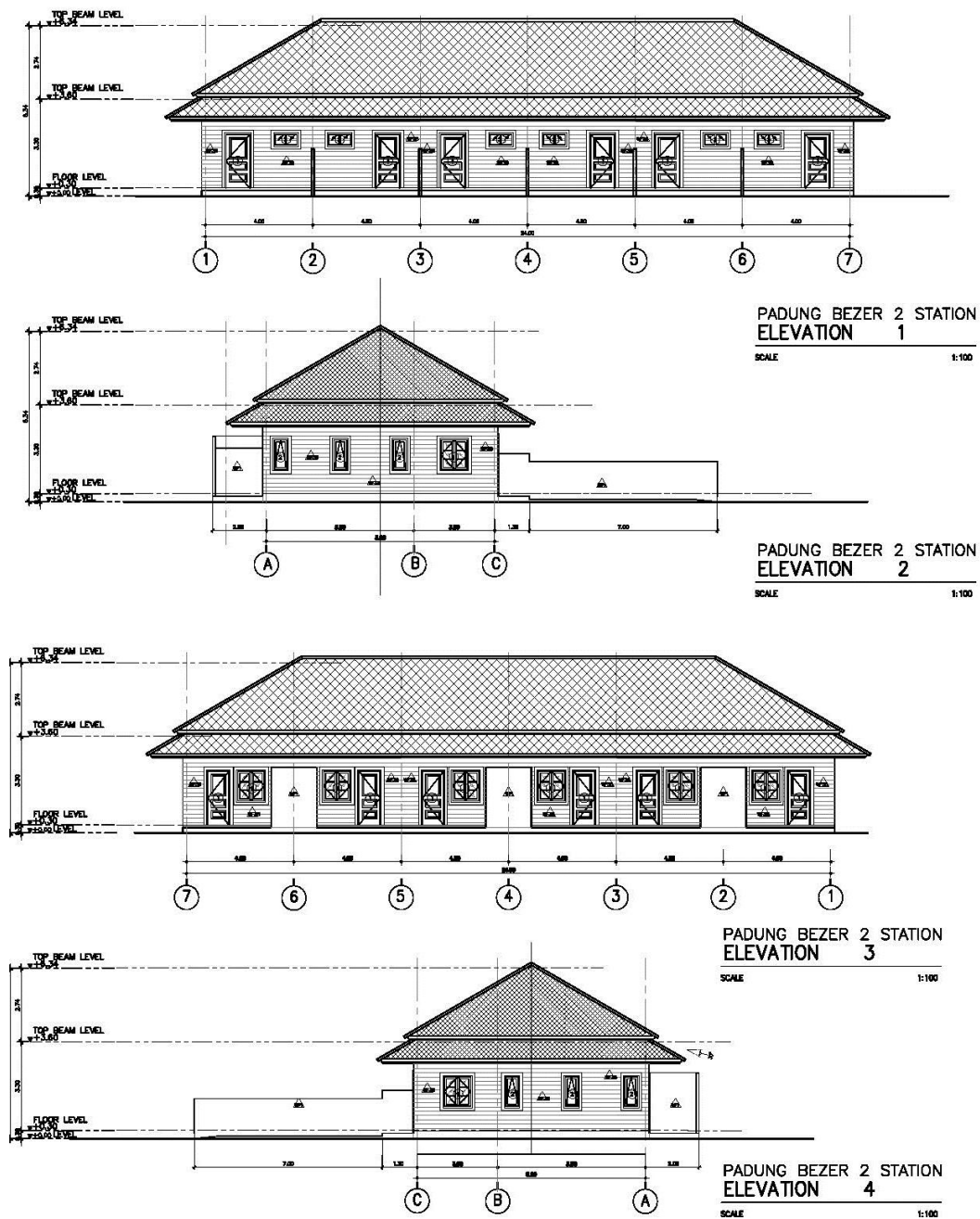


Figure 3.4-36 The Side View of the Staff Lodge RUNNING ROOM Plan, Padang Bezar 2 Station

### 3.4.2.7 Signaling and Telecommunication System

#### 1) The Design of Signaling Control System

- The Design Principle

The Signaling System has been designed initially with the 3-Color Code Electric System as basically used on the SRT Double Track Trains before changing into the Automatic train Protection System-ATP which provides higher automatic safety level.

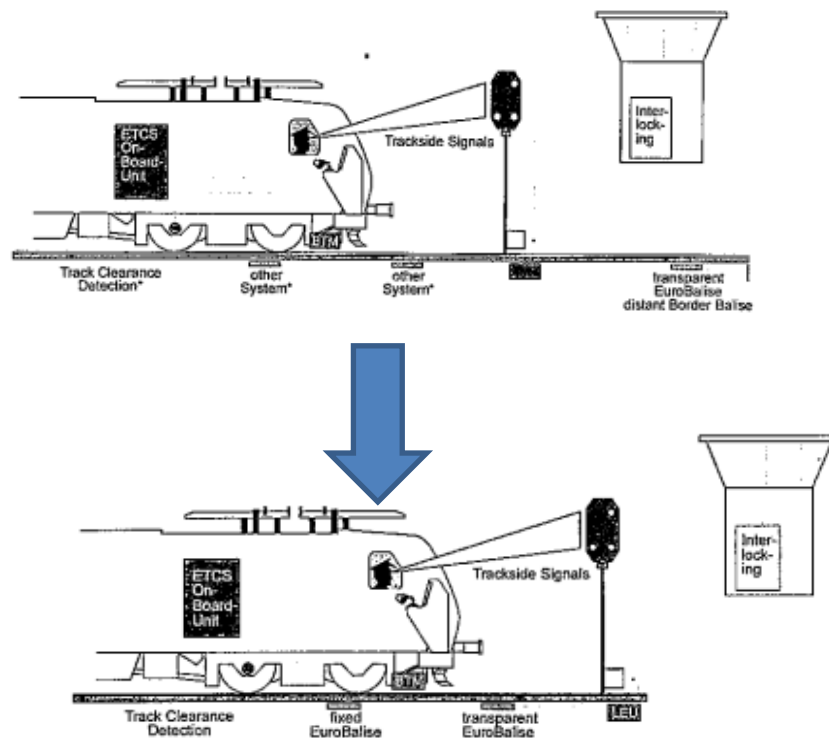


Figure 3.4-37 The Development of the Signaling System

- The Present Signaling System

The Signaling System on the Hat Yai-Padang Besar Train Route (on the Thai border), the system and control operation has been found with faults and damage from long years of operation. Besides, it will not support with the new technology for the Electric Train.

From the data analysis form the field survey, it was found that the signaling control system ha to be changed in line with the Electric Trains in Malaysia to facilitate the continued running of the Malaysian Electric Trains crossing into Thai border.



**Figure 3.4-38 The Present Signaling System at Padang Besar Station**

From **Figure 3.4-38**, The stationary signaling system at Hat Yai Station heading toward Padang Besar Station (on Thai border), the Consultants have designed the new system to serve the speed of different types of trains. The signaling poles and equipment will be replaced with the Automatic Signaling System for more safety on the train operation. In designing the system, the Consultants have collected data from Track Work, Track Alignment, Overhead Catenary System and System Operation Plan for precision and efficiency in the train operation.

## 2) The Signaling System on Ipoh-Padang Besar Train Project

At present, Malaysia has already installed the Automatic Train Protection System on all their double track trains to prevent train collision and also installed the Signaling System and OCS to boost train operation. This has offered many transportation options to passengers.

The Malaysian Signaling System Development which has met the European Standard consists of the following systems:

- Computer-based Interlocking System: CBI Certified with European Train Control level 1 Standard, the system has been designed to be connected efficiently with other systems under the same standard. As the system is computer-based, the data processing is precise. Besides, improvement or repair of the system takes very little time.
- Automatic Train Protection System: ATP Malaysia also faces the same problem with the train operation as in Thailand at present. In the previous system before the change to the European Standard, there is a risk when the train runs at a higher speed than specified or the train conductor runs through the signaling light. The

Malaysian engineer have noticed the Incidents and have therefore installed the new system for better standard and prevention of accident.

- The positioning of the signaling poles: Malaysia has set The positioning of the signaling poles according to different speeds of each train and adjusted the signaling lighting system to 4 lights to accommodate higher number of trains.
- The Signaling Control System: Malaysia has installed computer-based Signaling Control system for safety and efficiency.

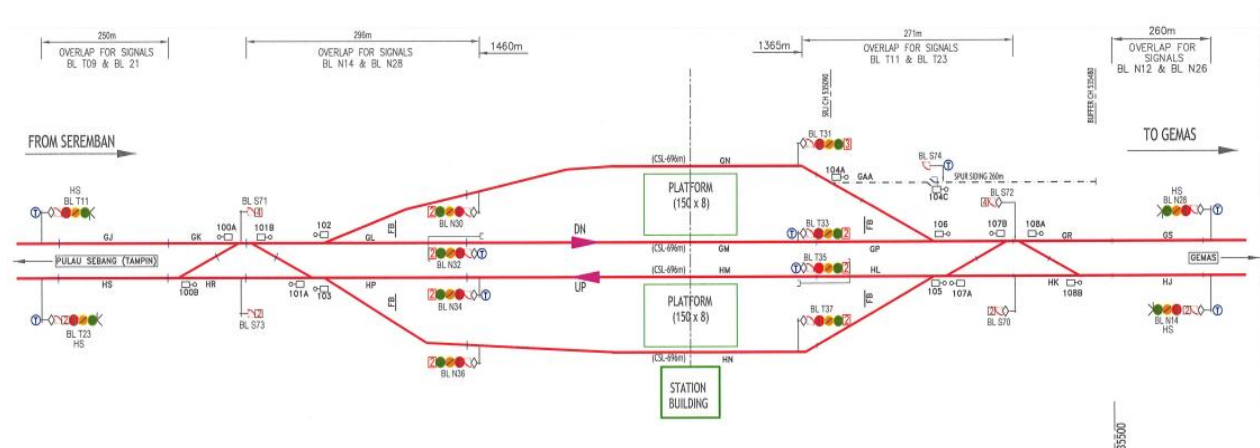


Figure 4.3-39 Malaysian Signaling Poles System

### 3) Recommendations on the Project Signaling System

As the Signaling System of the two countries are different in terms of technology, the design of the system must be synchronized with that of Malaysia to prevent problem of running the trains across the border and to facilitate the linking of the two systems to prevent accident when there are trains running on the same route.

In designing the Project Signaling System to have the same European Standard as that in Malaysia, the Consultants have chosen the European Train Control Level 1 Standard (ETCS L1) to efficiently facilitate the train operation across the border and to lower the Project cost in technological connection work. This will not create any advantage or disadvantage to any manufacturer as the distribution and installment of the system and equipment has already been used in many countries around the world.

#### 4) Supervisory Control And Data Acquisition, SCADA

The SCADA System to be used in the Project consists of basic equipment as follow:

- Workstations Control and Terminal Maintenance Control : display of control status of the equipment network
- Servers: This is the operation system of SCADA with sufficient data memory unit and 50% on reserve
- Remote Terminal Units (RTU): Automatic system connecting with equipment control and monitoring system
- Data Storage: Storage of data and the system software
- Printers: printing records such as warning signals, sent commands
- Signaling cable connected with the equipment under control and monitoring using copper wire for short distance and fiber optic for long distance. Backbone Transmission System is also used for connection between stations and the Traction and Feeder Sub-station.

The control and monitoring system through SCADA is operated from the main Workstation located in the Central Control Room at Hat Yai Depot and in case that the Main Workstation is at fault, the control would be switched to Local Workstation located at Traction and Feeder Sub-Station at Khlong Ngae Station.

The storing and operation process under SCADA will be managed with the Remote Terminal Unit (RTU) which will be installed in the Telecommunication Equipment Room at Hat Yai Depot, Sala Thung Lung Station, Padang Besar Station and in the Control Room at Traction Power Substation (Feeder Station), Khlong Ngae Station.

This Project will use SCADA System in data storage and Traction Power System such as the system and equipment at Traction Substation, OCS Wayside Equipment and Back-up Power System.

The standard of telecommunication between the SCADA equipment and electrical equipment under the control and monitoring system of Serial Port type will apply Protocol Standard IEC 60870-5.

#### 5) The Design of the Telecommunication System

##### The Telecommunication System on the Train

The Telecommunication System on the Train consists of the following sub systems:



- The Radio System for Train Operation

At present, the Radio System has been used for connection between stations across Thai and Malaysian border at Padang Besar Station to facilitate border crossing of the trains. Therefore, no additional system is needed except when there will be more staff.

#### The Telecommunication System along the Route and at the Station

- The Basic Telecommunication Network (BTN): Certified technology such as Synchronous Digital Hierarchy Technologies (SDH), etc.
- Linkage with the existing network needs to be set up at Ban Phai Station through data and voice communication between SRT projects with the existing network and the Project Network
- The Basic Telecommunication Network (BTN) should use STM-4 and can be improved in the future as foreseen in SRT Development Plan for optimal benefit or at least linked with other sub-systems.
- STM-4 (622Mb/s, ITU-T G.957/8)

#### PABX Telephone System

- The main system should be linked with the Automatic Network System presently used by SRT similar to the TOT system
- All PABX sub units installed should be part of the extension of the main PABX system and should be precise and correct without any blocking between the Control Center and stations.
- All telephones must be DTMF dialing

#### Radio Communication System

- Traffic Controller: TC at Center of Train Operation Control: CTC and Train Operators: TO
- Station Master: SM and Train Operators
- Engineering Officers and Maintenance and Repair Officers
- Maintenance and Repair Officers and Train Operators at the Maintenance Center
- Maintenance and Repair Officers with mobile radio at the station along the route and at the Maintenance Center

### 6) Malaysia Telecommunication System

The Telecommunication System in Malaysia has been developed for the efficiency of the Train Operation at 160 km/hour. The System consists of 2 systems:

### The Telecommunication System at the Station

The Telecommunication System at the Station uses fiber optic cable in data transfer managed by Backbone Transmission System linked by PA System voice command, CCTV System, PID System, Radio System, Signaling System and **Master Clock**.



Figure 3.4-40 The Telecommunication System at Padang Besar Station



Figure 3.4-41 Master Clock



Figure 3.4-42 CCTV System

### The Telecommunication System on the Train

The Telecommunication System on the Train is used in the Train Operation for efficiency and safety consisting of the radio System, PA System, etc. This provides more convenience to passengers during their travel.

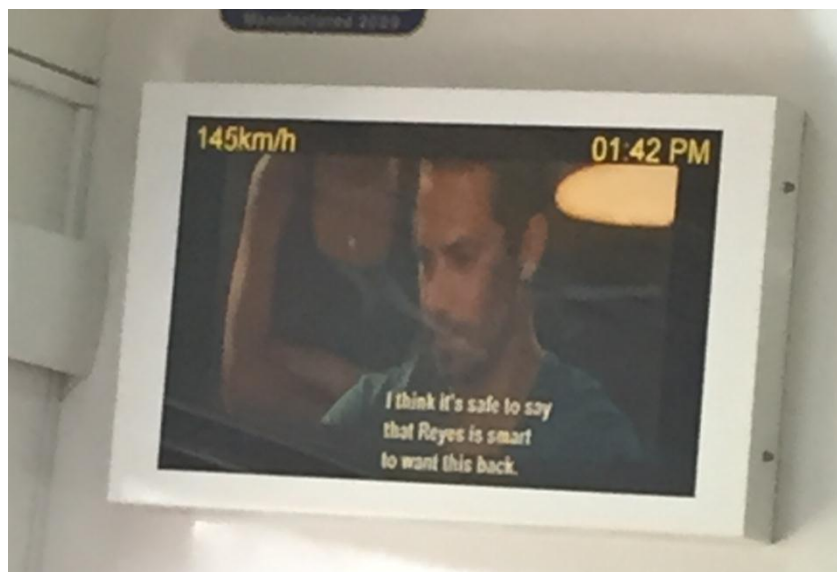


Figure 3.4-43 The Infotainment System on the Train

### Summary of the Telecommunication System

The Design of the Telecommunication System should consider data transfer between trains, stations and Control Center for efficient communication with international standard. The system should be stable and low in maintenance cost. The new system must work effectively with the system SRT presently uses and future system according to the Investment Plan.

### 3.4.2.8 Power Supply

From the Needs Analysis and the Engineering Feasibility Study of the Project, the Consultants have concluded that the Power Supply System suitable for the Hat Yai-Padang Besar Double Tracks Train Project is The AC Voltage System at 25 kv AC, 50 Hz. With Overhead Contact Line System: OCLS.

Note: This is the Power Supply System used by the Airport rail Link between Bangkok Airport and Suvarnaphumi Airport and the Suburban Train System joint co-operation with Long distance Trains in linking with mass transit system in Bangkok and suburb (The Red Line)

The supporting data from the Engineering Feasibility Study are:

- Compatibility with the Electric Train System from Malaysia with no need for change of the electrical system
- The physical features of the Project including the train speed needed for the train operation is in line with this Power Supply System
- The Voltage System of 25kv AC, 50 Hz is more efficient and economical in maintenance cost than the Direct Current Electrified railway System currently used in the BTS and MRT System.
- The Voltage System of 25kv AC, 50 Hz can save the system installment cost. At present, the motor-driven Alternating Current is highly efficient and suitable to the operation of the high speed trains in yielding stability on speed acceleration on high slope and sharp curve. This system produces high power supply than other systems when compared with the same size and weight. Therefore, this system is being used in the train operation worldwide for both passenger trains, freight trains and high speed trains.
- The Voltage System of 25kv AC, 50 Hz will require preparation for Traction Power System installment at every 30-50 km.

From the Detailed Study and Train Operation Plan of the Project, the Consultants have made conclusion on the suitable Traction Power Supply System as shown in the Feeding Diagram below with all basic details of the Power Supply System:

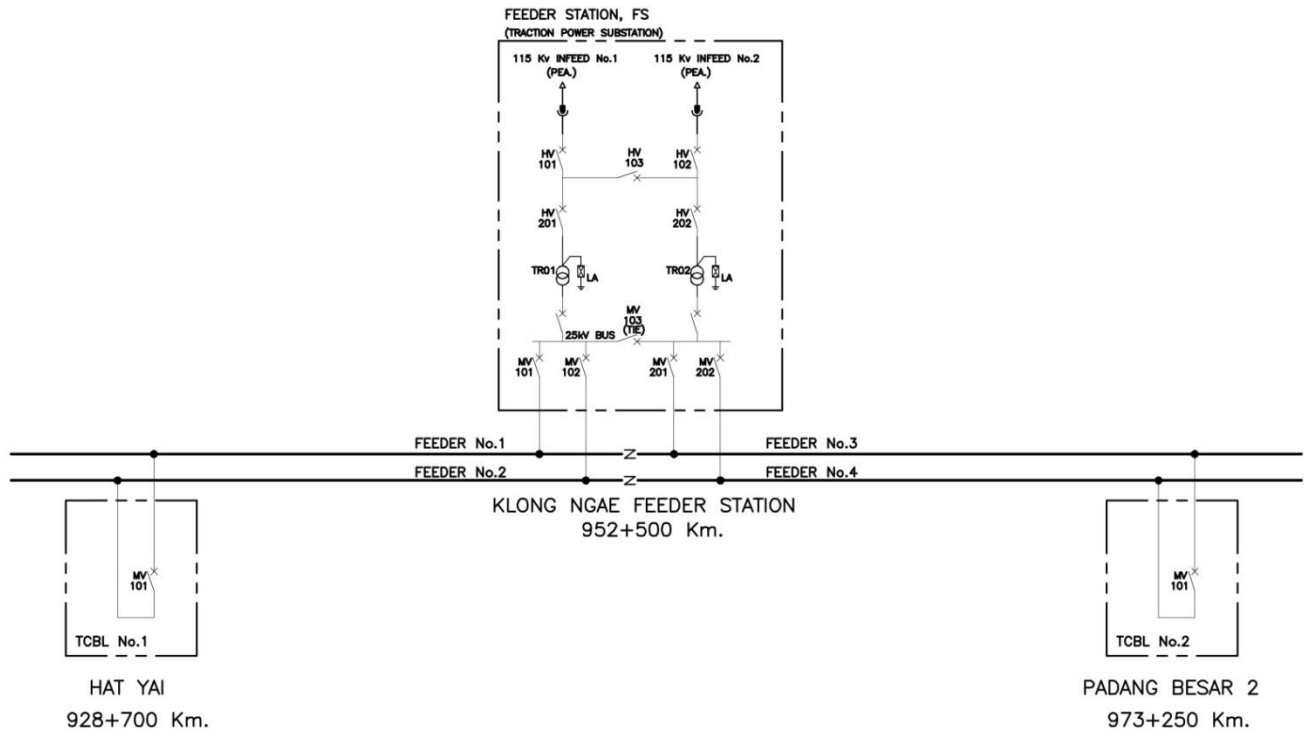


Figure 3.4-44 Feeding Diagram of the Project

From the details on the Feeder Diagram of the Power Supply System, there must be constructions of 3 Feeder Stations as follow:

#### The Construction of Feeder Station (FS) at Khlong Ngae Station

The Feeder Stations are most important to the Electric Train System as they provide the Traction Power Supply System vital for the train operation along the Project route.

The construction of the FS consists of the following main work and equipment

- Underground Duct Bank of 115kv to connect with the PEA Network
- The construction of the Station building and compound
- The procurement and installment of the main electrical equipment:
  - 115kV Switchgears (115kV circuit breakers or 115kV isolators)
  - 115 / 25kV Single phase power transformers
  - 25kV Switchgears (25kV Circuit breakers)
  - Protection / Control system equipments
- The construction of Underground Duct Bank of 25kv to connect with the Overhead Contact Line System: OCLS

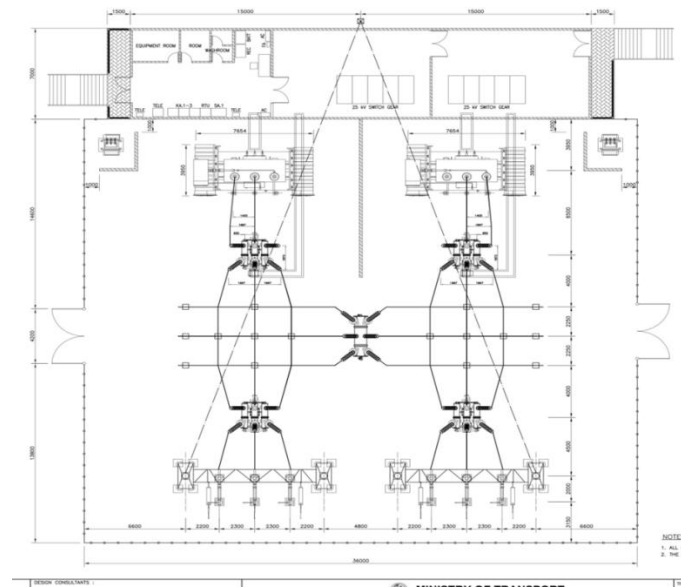


Figure 3.4-45 The Details of the Feeder Station (FS)



Figure 3.4-46 The Example of the Feeder Station(FS) from The Electric Train Project Overseas

### The Construction of the Circuit Breaker Location (TCBL) at Hat Yai Station and Padang Bezar Station

TCBL Stations are generally located where the OCLS needs connection of 25kv feeder circuit (for example, from feeder circuit No.1 to feeder circuit No.2) when the problem with any feeder circuit occurs or when there is a need for power supply to maintain the train operation. Normally, the Feeder Stations will be located at both ends of the Project.

The construction of the TCBL consists of the following work and equipment:

- The construction of the Underground Duct bank of 25kv to connect with the Overhead Contact Line System
- The construction of the station and compound
- Procurement and installment of basic electrical equipment:
  - 25kV Switchgears (25kV Circuit breakers)
  - Protection / Control system equipments

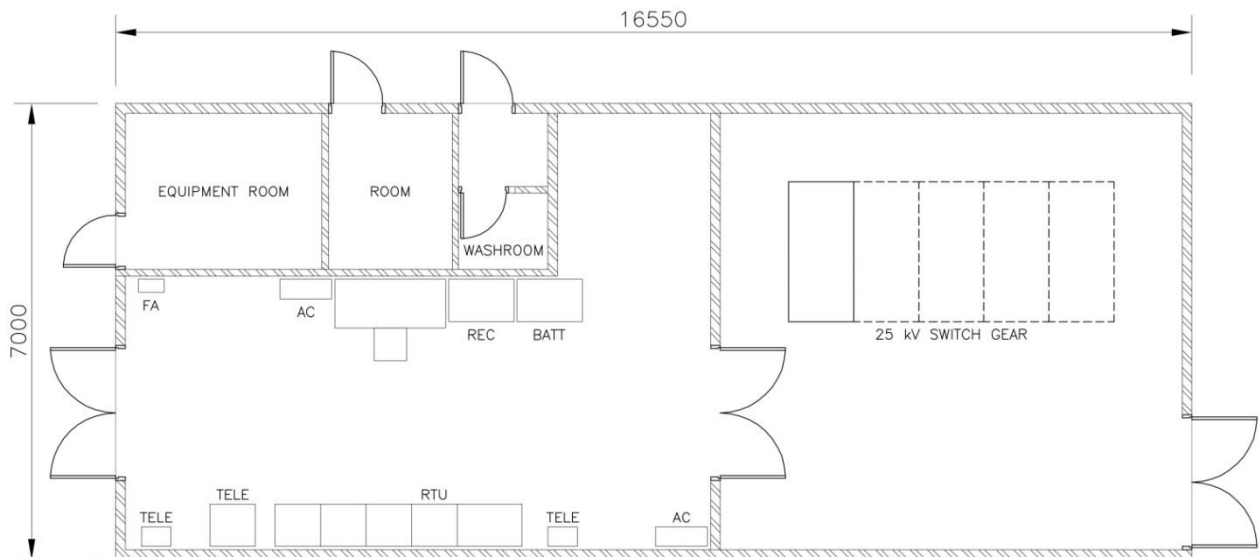


Figure 3.4-47 The Details of TCBL at Hat Yai Station and Padang Besar Station



Figure 3.4-48 The Example of TCBL from the Electric Train Project Overseas



## Overhead Contact Line System; OCLS

The most used standard system for electric trains worldwide can be classified into 2 types:

- 1 Third Rail: used by BTS and MRT
- 2 Overhead Contact Line System; OCLS

From the Needs Analysis and the Engineering Feasibility Study of the “Power Supply System” of the Project, the Consultants have concluded that the Power Supply System suitable for the Hat Yai-Padang Besar Double Tracks Train Project is the Overhead Catenary System: OCS.

The supporting data from the Electrical Engineering Feasibility Study are:

- Complete compatibility with the Electric Train System from Malaysia with no need for change of the electrical system
- No obstacle to the operation of the Diesel –powered trains or Diesel freight trains with the only restriction on clearing height of the Diesel locomotive
- Ability to accommodate the train speed at 160km/h as set for various types of the Project work
- The safety from the electrical system structure (as the electrified section is installed much higher)

## OCLS Components

The Power Supply System has been designed for approximately 30 years of Design life. The system equipment must have all specific descriptions which have been approved for their use. The main equipment of the OCLS are:

1. **Cantilever** : used in locking Catenary and Contact wire
2. **Tensioning Device** : used in maintaining the tensile forces of the Contact wire at a specified level
3. **Isolators** : used in splitting-connecting the electrical circuit for the Catenary and Contact wire in case of a need for sectional circuit control in the power supply system
4. **Sections Insulators** : used as electric insulation for the circuit of the Catenary and Contact wire with different phases such as at the Feeder Station
5. **Neutral Sections** : used in the separation of the Catenary and Contact wire of different phases such as at the Feeder Station
6. **Steel Poles (Mast) and Foundation** : used as support in the equipment installment such as cantilever, tensioning device, Isolators, etc.

### 3.4.2.9 The Drainage System

#### 1) The Study of the Water Retaining Area along the Train Route

In the design of the Drainage System, the Consultants have studied the data on the volume of rainwater during the Return Period of 100 years and divided the lowland by Songkhla Lake into small sections as shown in **Figure 3.4-49** The small lowland areas that Concerned with The Hat Yai-Padang Besar Train route are the 6th to 15th small Lowland area. However, from the records of Department of Irrigation, it was found that the volume of water in the 6th Lowland area will not affect the Project route as there are two canals: Lam Nui and Ram Yai canal, that have detoured the water course to the North before joining with U Ta Pao canal and flowing into Sonkhla Lake. **Figure 3.4-50** shows various streams in U Ta Pao Canal Lowland while **Figure 3.4-51** shows the Ground Level Value at different locations in that area. The Design Study of the Drainage System along the Project Route will include from the 7 th to 15th small Lowland area and the analysis will focus on 2 aspects: the Drainage system along the Project Route and the Drainage System crossing the train tracks.

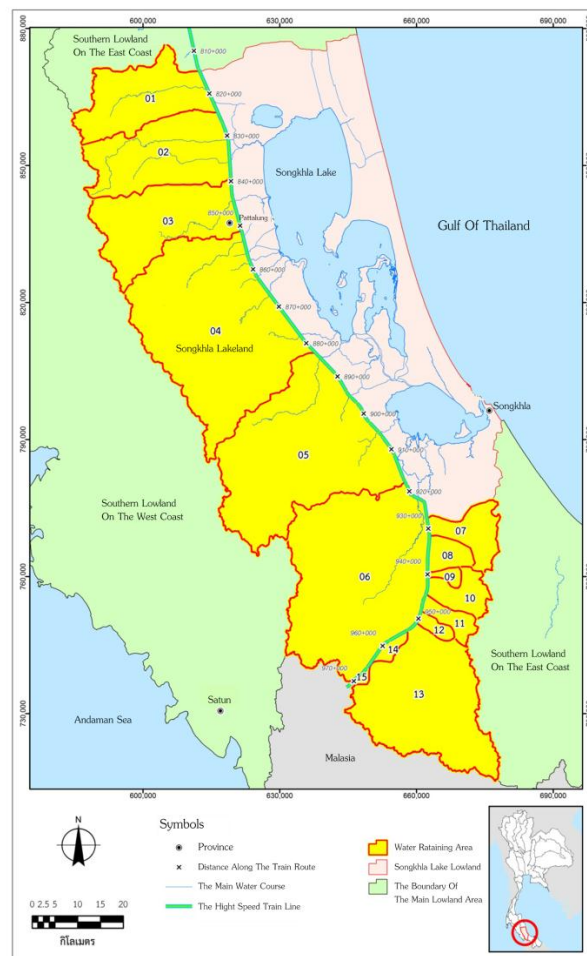
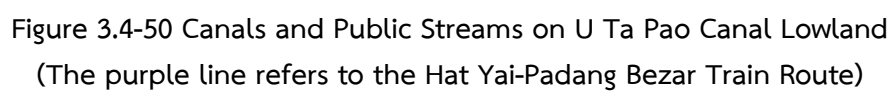


Figure 3.4-49 The Water Retaining Area in Songkhla Lake Lowland





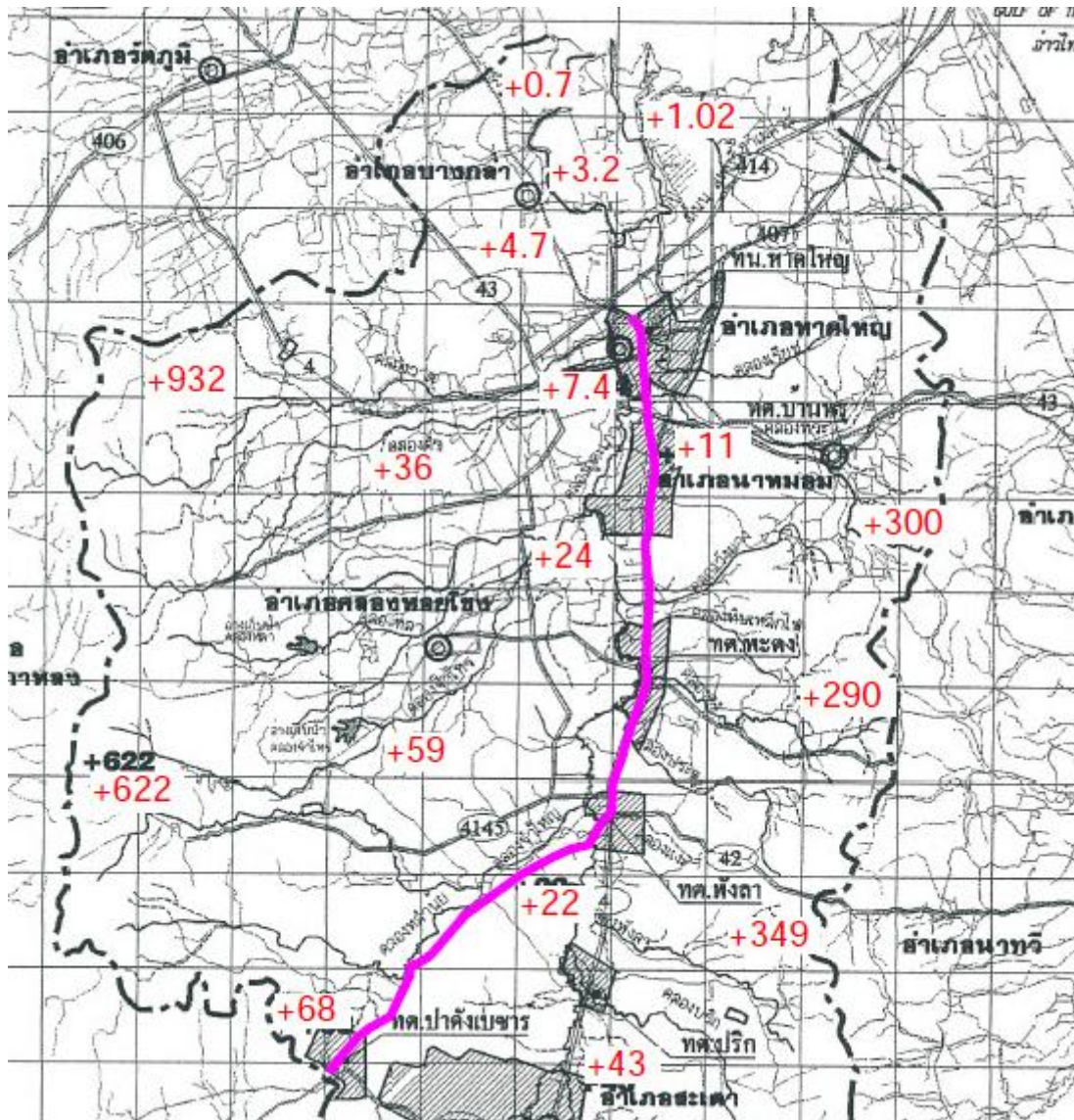


Figure 3.4-51 The Topographical Condition of the Lowland Area  
(The red number refers to the Ground Level Value of the previous level in that area)

## 2) The Analysis of the Volume of Rainfall

The Consultants have analysed the volume of rainfall in the area from various records of yearly highest volume to draw a Correlation Graph of Intensity, Frequency and IDF Curve and the distribution of collected rainfall in a day record of IDF Curve. This will be used in the assessment of immerse flood which will affect draining along the train route according to the Flood Volume Assessment Theory. The Consultants have collected the data form the Correlation Graph of Intensity, Frequency and IDF Curve collected by Department of Irrigation and the data of the rainfall volume collected at every 15 minutes at the Monitoring Station along the train route over the past 5-10 years. This will be used in adjusting the current IDF to be more relevant with the rainstorm activity affected by the global weather change. The Correlation Graph of Intensity, Frequency and IDF at the Rainfall Monitoring Station along the Train rote is shown in **Figure 3.4-52**

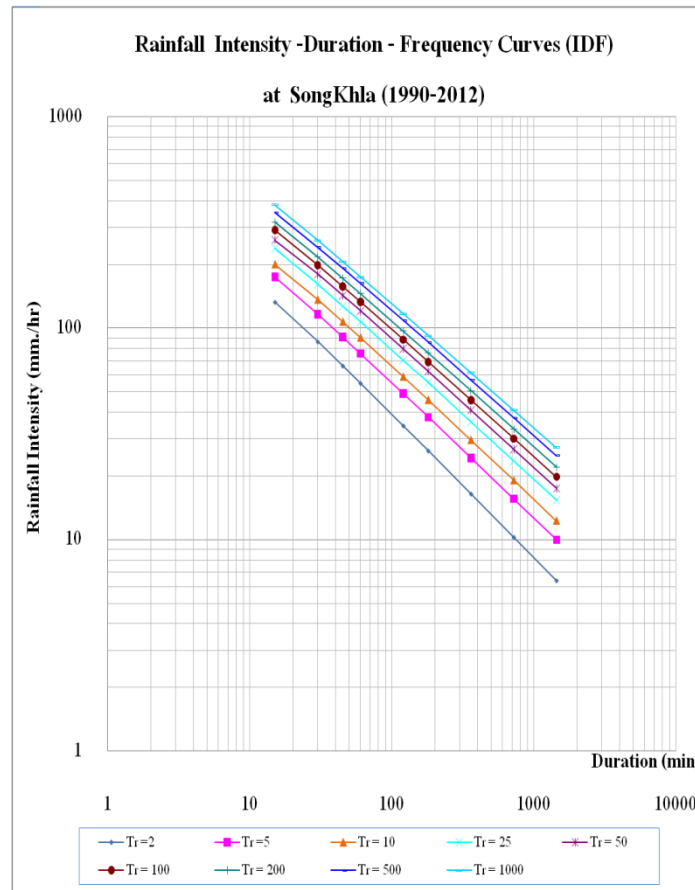


Figure 3.4-52 The Correlation Graph of the Rainfall Intensity (unit: mm./cm.) and Duration and IDF at Songkhla Rainfall Monitoring Station

### 3) The Size of the Draining Channel

The calculation of the size of the draining channel suitable for the rainfall volume of 100 years IDF will yield both speed and efficiency in draining the rainfall so it will not affect the nearby community. The design of the Draining Station, the size and number of the flood gates will be sufficient for the water volume as shown in **Table 3.4-24**

Table 3.4-24 The Recommended Size of the Draining Pipe along the Train Route

| Water Retaining Area | Km         | Flowing Rate | Draining Station Type |       |      | Slope Gradient | Accommodating Flowing rate | Safety Value | Recommended Size                                                        |
|----------------------|------------|--------------|-----------------------|-------|------|----------------|----------------------------|--------------|-------------------------------------------------------------------------|
|                      |            | (cub.m./sec) | P                     | A.    | R    | m/m            | (cub.m./sec)               |              |                                                                         |
| 7                    | 929+034.80 | 0.73         | 3.60                  | 1.44  | 0.40 | 0.001          | 1.902                      | 2.619        | Box culvert 1.5x 1.5 m.                                                 |
|                      | 929+420.88 | 0.94         | 3.60                  | 1.44  | 0.40 | 0.001          | 1.902                      | 2.019        | Box culvert 1.5x 1.5 m.                                                 |
|                      | 930+391.00 | 250.40       | 36.00                 | 90.00 | 2.50 | 0.001          | 403.267                    | 1.610        | 1 60m. bridge(calculated from the current stream of 30m.wide 3m. deep)  |
|                      | 931+066.00 | 16.20        | 21.00                 | 45.00 | 2.14 | 0.001          | 181.941                    | 11.229       | 1 25m. bridge (calculated from the current stream of 15.wide 3m. deep)  |
| 8                    | 932+135.00 | 26.61        | 13.00                 | 21.00 | 1.62 | 0.001          | 70.328                     | 2.643        | 3 8m. bridges (calculated from the current stream of 7m.wide 3m. deep)  |
|                      | 933+470.00 | 41.99        | 16.00                 | 30.00 | 1.88 | 0.001          | 110.963                    | 2.643        | 4 4m. bridges (calculated from the current stream of 10m.wide 3m. deep) |
|                      | 934+487.00 | 20.58        | 13.00                 | 18.00 | 1.38 | 0.001          | 54.394                     | 2.643        | 1 9m. bridge (calculated from the current stream of 9m.wide 2m. deep)   |
|                      | 935+310.00 | 41.99        | 16.00                 | 30.00 | 1.88 | 0.001          | 110.963                    | 2.643        | 4 8m. bridges(calculated from the current stream of 10m.wide 2m. deep)  |
|                      | 935+478.10 | 0.29         | 3.60                  | 1.44  | 0.40 | 0.001          | 1.902                      | 6.625        | Box culvert 1.5 x 1.5m.                                                 |

| Water Retaining Area | Km         | Flowing Rate | Draining Station Type |       |      | Slope Gradient | Accommodating Flowing rate | Safety Value | Recommended Size                                                        |
|----------------------|------------|--------------|-----------------------|-------|------|----------------|----------------------------|--------------|-------------------------------------------------------------------------|
|                      |            | (cub.m./sec) | P                     | A.    | R    | m/m            | (cub.m./sec)               |              |                                                                         |
| 8                    | 936+624.70 |              |                       |       |      |                |                            |              | Pedestrian bridge (Steel beam of 5.3m)                                  |
|                      | 936+878.50 | 16.98        | 11.00                 | 15.00 | 1.36 | 0.001          | 44.869                     | 2.643        | 1 12m. bridge (calculated from the current stream of 5m.wide 3m. deep)  |
|                      | 938+403.30 | 9.87         | 16.00                 | 30.00 | 1.88 | 0.001          | 110.963                    | 11.237       | 1 25m. bridge (calculated from the current stream of 10m.wide 3m. deep) |
| 9                    | 940+191.20 | 50.55        | 13.00                 | 21.00 | 1.62 | 0.001          | 70.328                     | 1.391        | 1 25m. bridge (calculated from the current stream of 7m.wide 3m. deep)  |
| 10                   | 941+247.20 | 21.39        | 11.00                 | 15.00 | 1.36 | 0.001          | 44.869                     | 2.098        | 3 20m. bridges (calculated from the current stream of 5m.wide 3m. deep) |
|                      | 941+810.00 | 86.72        | 21.00                 | 45.00 | 2.14 | 0.001          | 181.941                    | 2.098        | 2 10m. bridge (calculated from the current stream of 15m.wide 3m. deep) |
|                      | 942+759.30 | 33.52        | 13.00                 | 21.00 | 1.62 | 0.001          | 70.328                     | 2.098        | 1 25m. bridge (calculated from the current stream of 7m.wide 3m. deep)  |
|                      | 944+409.00 | 33.52        | 13.00                 | 21.00 | 1.62 | 0.001          | 70.328                     | 2.098        | 1 30m. bridge (calculated from the current stream of 7m.wide 2m. deep)  |
| 11                   | 945+481.40 | 62.57        | 16.00                 | 30.00 | 1.88 | 0.001          | 110.963                    | 1.774        | 1 50m. bridge (calculated from the current stream of 10m.wide 3m. deep) |



| Water Retaining Area | Km         | Flowing Rate | Draining Station Type |        |      | Slope Gradient | Accommodating Flowing rate | Safety Value | Recommended Size                                                         |
|----------------------|------------|--------------|-----------------------|--------|------|----------------|----------------------------|--------------|--------------------------------------------------------------------------|
|                      |            | (cub.m./sec) | P                     | A.     | R    | m/m            | (cub.m./sec)               |              |                                                                          |
| 11                   | 946+072.50 | 34.79        | 14.00                 | 20.00  | 1.43 | 0.001          | 61.710                     | 1.774        | 1 20m. bridge (calculated from the current stream of 10m.wide 3m. deep)  |
|                      | 946+500.00 | 14.71        | 9.00                  | 10.00  | 1.11 | 0.001          | 26.095                     | 1.774        | 1 10m. bridge (calculated from the current stream of 5m.wide 3m. deep)   |
|                      | 947+061.00 | 7.43         | 7.00                  | 6.00   | 0.86 | 0.001          | 13.170                     | 1.774        | 1 4.9m. bridge (calculated from the current stream of 3m.wide 3m. deep)  |
| 12                   | 948+351.70 | 15.59        | 16.00                 | 30.00  | 1.88 | 0.001          | 110.963                    | 7.116        | 3 8m. bridges (calculated from the current stream of 10m.wide 3m. deep)  |
|                      | 948+905.80 | 15.59        | 16.00                 | 30.00  | 1.88 | 0.001          | 110.963                    | 7.116        | 1 40m. bridge (calculated from the current stream of 10m.wide 3m. deep)  |
|                      | 950+863.50 | 35.81        | 26.00                 | 60.00  | 2.31 | 0.001          | 254.875                    | 7.116        | 1 25m. bridge (calculated from the current stream of 20m.wide 3m. deep)  |
| 13                   | 952+475.00 | 0.47         | 3.60                  | 1.44   | 0.40 | 0.001          | 1.902                      | 4.013        | Box Culvert 1.5 x 1.5 m.                                                 |
|                      | 953+491.60 | 7.63         | 8.00                  | 7.50   | 0.94 | 0.001          | 17.476                     | 2.291        | 1 30m. bridge (calculated from the current stream of 3m.wide 2.5m. deep) |
|                      | 954+320.30 | 384.39       | 40.00                 | 150.00 | 3.75 | 0.001          | 880.715                    | 2.291        | 1 60m. bridge (calculated from the current stream of 30m.wide 5m. deep)  |
|                      | 954+820.21 | 326.51       | 43.00                 | 140.00 | 3.26 | 0.001          | 748.097                    | 2.291        | 1 50m. bridge (calculated from the current stream of 35m.wide 4m. deep)  |

| Water Retaining Area | Km         | Flowing Rate | Draining Station Type |       |      | Slope Gradient | Accommodating Flowing rate | Safety Value | Recommended Size                                                             |
|----------------------|------------|--------------|-----------------------|-------|------|----------------|----------------------------|--------------|------------------------------------------------------------------------------|
|                      |            | (cub.m./sec) | P                     | A.    | R    | m/m            | (cub.m./sec)               |              |                                                                              |
| 14                   | 956+324.13 | 1.96         | 7.00                  | 6.00  | 0.86 | 0.001          | 13.170                     | 6.736        | 1 20m. bridge (calculated from the current stream of 3m.wide 2m. deep)       |
|                      | 956+793.40 | 0.51         | 4.50                  | 2.25  | 0.50 | 0.001          | 3.448                      | 6.736        | 1 2.80m. bridge (calculated from the current stream of 1.5m.wide 1.5m. deep) |
|                      | 957+258.30 | 3.87         | 9.00                  | 10.00 | 1.11 | 0.001          | 26.095                     | 6.736        | 1 8m. bridge (calculated from the current stream of 4m.wide 2.5m. deep)      |
|                      | 958+495.22 | 0.46         | 3.60                  | 1.44  | 0.40 | 0.001          | 3.803                      | 8.359        | Box Culvert 1.5 x 1.5 m. (2 pipes)                                           |
|                      | 959+185.50 | 0.46         | 3.60                  | 1.44  | 0.40 | 0.001          | 3.803                      | 8.359        | Box Culvert 1.5 x 1.5 m. (2 pipes)                                           |
|                      | 959+610.88 | 0.17         | 3.60                  | 1.44  | 0.40 | 0.001          | 1.902                      | 10.953       | Box Culvert 1.5 x 1.5 m.                                                     |
|                      | 960+207.00 | 4.89         | 10.00                 | 12.00 | 1.20 | 0.001          | 32.963                     | 6.736        | 1 8m. bridge (calculated from the current stream of 4m.wide 3m. deep)        |
|                      | 960+649.00 | 0.11         | 3.60                  | 1.44  | 0.40 | 0.001          | 1.902                      | 16.887       | Box Culvert 1.5 x 1.5 m.                                                     |
|                      | 961+684.65 | 0.46         | 3.60                  | 1.44  | 0.40 | 0.001          | 3.803                      | 8.359        | Box Culvert 1.5 x 1.5 m. (2 pipes)                                           |
|                      | 962+004.30 | 21.00        | 12.00                 | 16.00 | 1.33 | 0.001          | 47.149                     | 2.245        | 1 12m. bridge (calculated from the current stream of 12m.wide 4m. deep)      |
|                      | 962+491.70 | 0.17         | 3.60                  | 1.44  | 0.40 | 0.001          | 1.902                      | 10.953       | 1Box Culvert 1.5 x 1.5 m.                                                    |

| Water Retaining Area | Km         | Flowing Rate | Draining Station Type |       |      | Slope Gradient | Accommodating Flowing rate | Safety Value | Recommended Size                                                             |
|----------------------|------------|--------------|-----------------------|-------|------|----------------|----------------------------|--------------|------------------------------------------------------------------------------|
|                      |            | (cub.m./sec) | P                     | A.    | R    | m/m            | (cub.m./sec)               |              |                                                                              |
| 14                   | 962+955.92 | 16.47        | 16.00                 | 30.00 | 1.88 | 0.001          | 110.963                    | 6.736        | 2 8m. bridges (calculated from the current stream of 10m.wide 3m. deep)      |
|                      | 963+693.50 | 16.47        | 16.00                 | 30.00 | 1.88 | 0.001          | 110.963                    | 6.736        | 2 8m. bridges (calculated from the current stream of 10m.wide 3m. deep)      |
|                      | 964+803.00 | 0.11         | 3.60                  | 1.44  | 0.40 | 0.001          | 1.902                      | 16.887       | Box Culvert 1.5 x 1.5 m.                                                     |
| 15                   | 965+300.52 | 1.37         | 3.60                  | 1.44  | 0.40 | 0.001          | 3.803                      | 2.771        | Box Culvert 1.5 x 1.5 m. (2 pipes)                                           |
|                      | 965+717.92 | 3.16         | 5.50                  | 3.75  | 0.68 | 0.001          | 7.066                      | 2.233        | 1 2.7m. bridge (calculated from the current stream of 2.5m.wide 1.5m. deep)  |
|                      | 965+931.40 | 1.37         | 3.60                  | 1.44  | 0.40 | 0.001          | 3.803                      | 2.771        | Box Culvert 1.5 x 1.5 m. (2 pipes)                                           |
|                      | 966+301.30 | 2.33         | 6.30                  | 4.41  | 0.70 | 0.001          | 8.457                      | 3.637        | 1 10m. bridge                                                                |
|                      | 966+861.00 | 1.54         | 4.50                  | 2.25  | 0.50 | 0.001          | 3.448                      | 2.233        | 1 1.60m. bridge (calculated from the current stream of 1.5m.wide 1.5m. deep) |
|                      | 967+160.13 | 8.09         | 7.20                  | 5.76  | 0.80 | 0.001          | 36.224                     | 4.475        | 1 10m. bridge                                                                |
|                      | 967+513.39 | 8.09         | 7.20                  | 5.76  | 0.80 | 0.001          | 36.224                     | 4.475        | 1 10m. bridge                                                                |
|                      | 967+879.10 | 0.52         | 3.60                  | 1.44  | 0.40 | 0.001          | 1.902                      | 3.631        | Box Culvert 1.5 x 1.5 m.                                                     |
|                      | 968+338.40 | 0.52         | 3.60                  | 1.44  | 0.40 | 0.001          | 1.902                      | 3.631        | Box Culvert 1.5 x 1.5 m.                                                     |

| Water Retaining Area | Km         | Flowing Rate | Draining Station Type |      |      | Slope Gradient | Accommodating Flowing rate | Safety Value | Recommended Size                                                          |
|----------------------|------------|--------------|-----------------------|------|------|----------------|----------------------------|--------------|---------------------------------------------------------------------------|
|                      |            | (cub.m./sec) | P                     | A.   | R    | m/m            | (cub.m./sec)               |              |                                                                           |
| 15                   | 968+582.65 | 2.33         | 6.30                  | 4.41 | 0.70 | 0.001          | 8.457                      | 3.637        | Box Culvert 2.4 x 2.4 m.                                                  |
|                      | 969+119.55 | 4.05         | 6.00                  | 4.50 | 0.75 | 0.001          | 9.036                      | 2.233        | 1 4.9m. bridge (calculated from the current stream of 3m.wide 1.5m. deep) |
|                      | 970+000.13 | 1.37         | 3.60                  | 1.44 | 0.40 | 0.001          | 3.803                      | 2.771        | Box Culvert 1.5 x 1.5 m.(2 pipes)                                         |
|                      | 970+304.81 | 2.33         | 6.30                  | 4.41 | 0.70 | 0.001          | 8.457                      | 3.637        | Box Culvert 2.4 x 2.4 m.                                                  |
|                      | 970+606.00 | 0.34         | 3.60                  | 1.44 | 0.40 | 0.001          | 1.902                      | 5.598        | Box Culvert 1.5 x 1.5 m.                                                  |
|                      | 970+757.77 | 1.37         | 3.60                  | 1.44 | 0.40 | 0.001          | 3.803                      | 2.771        | Box Culvert 1.5 x 1.5 m. (2 pipes)                                        |
|                      | 972+389.09 | 1.37         | 3.60                  | 1.44 | 0.40 | 0.001          | 3.803                      | 2.771        | Box Culvert 1.5 x 1.5 m. (2 pipes)                                        |

### 3.4.2.10 The Design of the Carriageway to Solve Crossing Point between the Tracks and the Road

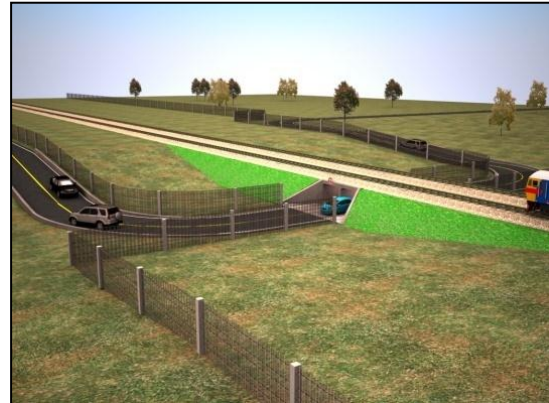
From the survey and collection of data, it was found that the Hat Yai-Padang Bezar Train Route will have 33 crossing points along the current train line. However, some of these points have already solved by constructing 2 split level crossing points, so still 31 points need to be managed: 9 stop barricades, 14 stop signs and bridges and 8 locally used roadways.

The summary of the solutions to the problems of the crossing points between the train track and the roadway is:

- Type 1: 6 Overpass U-Turns
- Type 2: 15 Under pass Boxes
- Type 3: 10 Elevated Railways



Overpass U-Turn



Underpass Box



Elevated Railway

### 3.4.2.11 The Estimate of the Construction Cost

The Estimate of the Construction Cost of the Project has been based on the set estimation of Department of Comptroller General, Ministry of Finance and SRT Regulations. The estimates of the construction cost is 13,341.00 million baht which covers the following works:

- 1) Civil Works and Building Engineering Service including the cost in the dismantling of public utilities blocking the designed infrastructure such as train tracks, draining station, crossing points, transit points and fencing along the train line.
- 2) Track Works System such as track installment along the route
- 3) Mechanical and Electrical Works such as Telecommunication System, Electrical System, Signaling System
- 4) Land expropriation and relocation of tenants along the train route
- 5) The Consultants' fees: 4%

**Table 3.4-25**  
**The Construction Cost Estimate of the Project**

| No.   | Items                                                                                             | Total Investment Capital | Factor F | Construction Cost 2015   | Notes                  |
|-------|---------------------------------------------------------------------------------------------------|--------------------------|----------|--------------------------|------------------------|
| 1     | GENERAL REQUIREMENTS                                                                              | 98,809,189.08            | 1.0000   | 98,809,189.08            | Factor F requirements  |
| 2     | EARTHWORKS                                                                                        | 416,413,133.11           | 1.1606   | 483,289,082.28           | - 10% advanced capital |
| 3     | ROAD AND STATION YARDS                                                                            | 685,059,191.28           | 1.1606   | 801,244,454.10           | - 10% collateral       |
| 4     | STRUCTURES                                                                                        | 2,141,783,197.22         | 1.1479   | 2,458,552,932.08         | - 7% loan interest     |
| 5     | BUILDING                                                                                          | 522,699,547.14           | 1.1781   | 615,792,336.48           | - 7% VAT               |
| 6     | PIPE AND DRAINAGE                                                                                 | 117,359,980.00           | 1.1479   | 134,717,521.04           |                        |
| 7     | UTILITIES                                                                                         | 4,157,961.12             | 1.0000   | 4,157,961.12             |                        |
| 8     | TRACK WORKS                                                                                       | 991,124,653.83           | 1.1606   | 1,150,299,273.23         |                        |
| 9     | SIGNALLING AND TELECOMMUNICATIONS                                                                 | 554,902,444.55           | 1.1606   | 644,019,777.14           |                        |
| 10    | POWER SUPPLY                                                                                      | 1,143,796,770.00         | 1.1606   | 1,327,490,531.26         |                        |
|       | <b>Total construction costs</b>                                                                   | <b>6,676,106,067.32</b>  |          | <b>7,718,373,057.83</b>  |                        |
| 11    | The Consultants' fees 4%                                                                          |                          |          | 308,734,922.31           |                        |
| 12    | Rolling Stock                                                                                     |                          |          | 5,263,000,000.00         |                        |
| 13    | Land expropriation fees and relocation of resident                                                |                          |          | 50,645,052.94            |                        |
| Total | The construction costs estimates<br>(Thirteen billion three hundred and fourty one million baths) |                          |          | <b>13,341,000,000.00</b> |                        |

### 3.5 The Economic Study

The Economic Study explores the impact from the Hat Yai-Padang Besar Double Tracks Train Project, both positive and negative impact, on Thailand including the impact from transport value and benefit on the road users such as cost of transportation, travel Saving Time , and decreasing accident, which will benefit travellers of other roads. The Project will solve traffic congestion, save fuel cost and benefit transport operators such as lower freight transport cost.

#### 3.5.1 The Financial Assessment of the Capital Investment

The Costs of Investment of the Project consist of the construction cost and expenditures of the Project operation as follow:

(1) The Investment Costs:

- Construction costs
- Land rights and property compensation costs
- Construction supervision costs
- Environmental management costs

(2) The Operation Costs:

- Regular operation and maintenance costs
- Periodic maintenance costs
- Environmental management costs

In the Financial Analysis of the Project, the monetary value has been converted to Economic Value for the Electrified Train Project (**Table 3.5-1**) and the Diesel Train Project (**Table 3.5-2**) In the analysis, the conversion Factor: CF has been applied as follow:

|                                                    |           |
|----------------------------------------------------|-----------|
| ■ Building compensations                           | CF = 0.92 |
| ■ The Detailed Design and construction supervision | CF = 0.92 |
| ■ Construction                                     | CF = 0.88 |
| ■ Operation and maintenance                        | CF = 0.92 |
| ■ Land                                             | CF = 1.00 |

The Conversion Factor: CF has been drawn from World Bank's Report on: Shadow Prices for Economic Appraisal of Project: An Application to Thailand published as the Working Paper (Number 609) 1983 by Sadig Ahmed



**Table 3.5-1**  
**The Economic Value of the Electrified Train Project**

Unit: million baht

| Year.        | Land Rights and Building Compensations | Civil Work      | Signaling & Telecom | Power Supply    | O&M             | Environment  | Total Investment Cost |
|--------------|----------------------------------------|-----------------|---------------------|-----------------|-----------------|--------------|-----------------------|
| 2018         | 50.65                                  | 1,011.54        | 113.35              | 233.64          |                 | 3.97         | 1,413.14              |
| 2019         |                                        | 2,023.08        | 226.70              | 467.28          |                 | 2.70         | 2,719.76              |
| 2020         |                                        | 2,023.08        | 226.70              | 467.28          |                 | 2.70         | 2,719.76              |
| 2021         |                                        |                 |                     |                 | 99.85           | 0.82         | 100.67                |
| 2022         |                                        |                 |                     |                 | 102.79          | 0.54         | 103.34                |
| 2023         |                                        |                 |                     |                 | 105.82          | 0.54         | 106.36                |
| 2024         |                                        |                 |                     |                 | 108.94          | 0.00         | 108.94                |
| 2025         |                                        |                 |                     |                 | 112.15          | 0.00         | 112.15                |
| 2026         |                                        |                 |                     |                 | 115.45          | 0.37         | 115.82                |
| 2027         |                                        |                 |                     |                 | 118.85          | 0.00         | 118.85                |
| 2028         |                                        |                 |                     |                 | 122.35          | 0.00         | 122.35                |
| 2029         |                                        |                 |                     |                 | 125.96          | 0.00         | 125.96                |
| 2030         |                                        |                 |                     |                 | 129.67          | 0.00         | 129.67                |
| 2031         |                                        |                 |                     |                 | 132.58          | 0.37         | 132.95                |
| 2032         |                                        |                 |                     |                 | 135.55          | 0.00         | 135.55                |
| 2033         |                                        |                 |                     |                 | 138.59          | 0.00         | 138.59                |
| 2034         |                                        |                 |                     |                 | 141.70          | 0.00         | 141.70                |
| 2035         |                                        |                 |                     |                 | 144.88          | 0.00         | 144.88                |
| 2036         |                                        |                 |                     |                 | 148.13          | 0.37         | 148.50                |
| 2037         |                                        |                 |                     |                 | 151.45          | 0.00         | 151.45                |
| 2038         |                                        |                 |                     |                 | 154.85          | 0.00         | 154.85                |
| 2039         |                                        |                 |                     |                 | 158.32          | 0.00         | 158.32                |
| 2040         |                                        |                 |                     |                 | 161.87          | 0.00         | 161.87                |
| 2041         |                                        |                 |                     |                 | 165.93          | 0.37         | 166.29                |
| 2042         |                                        |                 |                     |                 | 170.08          | 0.00         | 170.08                |
| 2043         |                                        |                 |                     |                 | 174.34          | 0.00         | 174.34                |
| 2044         |                                        |                 |                     |                 | 178.71          | 0.00         | 178.71                |
| 2045         |                                        |                 |                     |                 | 183.18          | 0.00         | 183.18                |
| 2046         |                                        |                 |                     |                 | 187.77          | 0.37         | 188.14                |
| 2047         |                                        |                 |                     |                 | 192.47          | 0.00         | 192.47                |
| 2048         |                                        |                 |                     |                 | 197.30          | 0.00         | 197.30                |
| 2049         |                                        |                 |                     |                 | 202.24          | 0.00         | 202.24                |
| 2050         |                                        |                 |                     |                 | 207.30          | 0.00         | 207.30                |
| <b>Total</b> | <b>50.65</b>                           | <b>5,057.70</b> | <b>566.74</b>       | <b>1,168.19</b> | <b>4,469.08</b> | <b>13.12</b> | <b>11,325.47</b>      |

Source: The Consultants

**Table 3.5-2**  
**The Economic Value of the Diesel Train Project**

Unit: million baht

| Year.        | Land Rights and Building Compensations | Civil Work      | Signalling & Telecom. | Power Supply | O&M             | Environment  | Total Investment Cost |
|--------------|----------------------------------------|-----------------|-----------------------|--------------|-----------------|--------------|-----------------------|
| 2018         | 50.65                                  | 1,011.54        | 113.35                | 0.00         |                 | 3.97         | 1,179.50              |
| 2019         |                                        | 2,023.08        | 226.70                | 0.00         |                 | 2.70         | 2,252.48              |
| 2020         |                                        | 2,023.08        | 226.70                | 0.00         |                 | 2.70         | 2,252.48              |
| 2021         |                                        |                 |                       |              | 106.31          | 0.82         | 107.12                |
| 2022         |                                        |                 |                       |              | 110.28          | 0.54         | 110.83                |
| 2023         |                                        |                 |                       |              | 114.41          | 0.54         | 114.95                |
| 2024         |                                        |                 |                       |              | 118.69          | 0.00         | 118.69                |
| 2025         |                                        |                 |                       |              | 123.13          | 0.00         | 123.13                |
| 2026         |                                        |                 |                       |              | 127.74          | 0.37         | 128.11                |
| 2027         |                                        |                 |                       |              | 132.52          | 0.00         | 132.52                |
| 2028         |                                        |                 |                       |              | 137.48          | 0.00         | 137.48                |
| 2029         |                                        |                 |                       |              | 142.63          | 0.00         | 142.63                |
| 2030         |                                        |                 |                       |              | 147.96          | 0.00         | 147.96                |
| 2031         |                                        |                 |                       |              | 150.95          | 0.37         | 151.31                |
| 2032         |                                        |                 |                       |              | 153.99          | 0.00         | 153.99                |
| 2033         |                                        |                 |                       |              | 157.09          | 0.00         | 157.09                |
| 2034         |                                        |                 |                       |              | 160.26          | 0.00         | 160.26                |
| 2035         |                                        |                 |                       |              | 163.49          | 0.00         | 163.49                |
| 2036         |                                        |                 |                       |              | 166.79          | 0.37         | 167.16                |
| 2037         |                                        |                 |                       |              | 170.15          | 0.00         | 170.15                |
| 2038         |                                        |                 |                       |              | 173.58          | 0.00         | 173.58                |
| 2039         |                                        |                 |                       |              | 177.08          | 0.00         | 177.08                |
| 2040         |                                        |                 |                       |              | 180.65          | 0.00         | 180.65                |
| 2041         |                                        |                 |                       |              | 185.87          | 0.37         | 186.24                |
| 2042         |                                        |                 |                       |              | 191.24          | 0.00         | 191.24                |
| 2043         |                                        |                 |                       |              | 196.76          | 0.00         | 196.76                |
| 2044         |                                        |                 |                       |              | 202.45          | 0.00         | 202.45                |
| 2045         |                                        |                 |                       |              | 208.30          | 0.00         | 208.30                |
| 2046         |                                        |                 |                       |              | 214.32          | 0.37         | 214.69                |
| 2047         |                                        |                 |                       |              | 220.51          | 0.00         | 220.51                |
| 2048         |                                        |                 |                       |              | 226.88          | 0.00         | 226.88                |
| 2049         |                                        |                 |                       |              | 233.44          | 0.00         | 233.44                |
| 2050         |                                        |                 |                       |              | 240.18          | 0.00         | 240.18                |
| <b>Total</b> | <b>50.65</b>                           | <b>5,057.70</b> | <b>566.74</b>         | <b>0.00</b>  | <b>5,035.13</b> | <b>13.12</b> | <b>10,723.33</b>      |

Source: The Consultants

### 3.5.2 The Financial Assessment of the Benefit

The Benefit from the Project can be classified into Direct Benefit and Indirect Benefit.

- **Direct Benefit**

Direct Benefit is obtained from the Project Operation to be studied in this Study which includes:

- (1) Vehicle Operating Cost Saving: VOC
- (2) Value of Time Saving : VOT
- (3) Accident Cost Saving : ACC
- (4) Environmental Cost
- (5) Transport Cost

The Financial Analysis of the Benefit of the Project can be summed up for the Electrified Train Project in **Table 3.5-3** and the Diesel Train project in **Table 3.5-4**

**Table 3.5-3**  
**The Economic Value of the Electrified Train Project**

Unit: million baht /year

| Year | Benefit |       |                   |      |                     |
|------|---------|-------|-------------------|------|---------------------|
|      | VOC     | VOT   | Saving of Poution | ACC  | Saving of Transport |
| 2021 | 513.8   | 252.1 | 374.3             | 6.1  | 50.3                |
| 2030 | 879.2   | 458.8 | 542.9             | 8.9  | 61.9                |
| 2040 | 1,344.4 | 677.9 | 767.5             | 12.6 | 72.3                |
| 2050 | 1,876.3 | 871.3 | 1,057.8           | 17.4 | 96.1                |

Source: The Consultants

**Table 3.5-4**  
**The Economic Value of the Diesel Train Project**

Unit: million baht /year

| Year | Benefit |       |                   |      |                     |
|------|---------|-------|-------------------|------|---------------------|
|      | VOC     | VOT   | Saving of Poution | ACC  | Saving of Transport |
| 2021 | 418.2   | 202.7 | 305.5             | 5.0  | 40.7                |
| 2030 | 712.3   | 368.5 | 475.3             | 7.3  | 52.6                |
| 2040 | 1,081.8 | 529.7 | 654.7             | 10.0 | 62.2                |
| 2050 | 1,476.0 | 679.1 | 837.0             | 13.7 | 84.0                |

Source: The Consultants

- **Indirect Benefit**

- (1) The Development Boost of the Project Area

- The Development of the Double Tracks Train will boost the development of the local community and major area of the Project and will be beneficial in the followings:
- Creating incentive for investment growth and employment for personal income growth and in turns, increasing GDP
- Boosting transport business and investment incentive and in turn creating jobs in the local community and economic benefit to the country as a whole

- (2) Tourism Promotion

Transportation is very vital to tourist industry development which is the main national income. The Double Tracks Electric Train Project will benefit freight transport and services in freight volume and punctuality of transport time as it evades traffic congestion on the roadways.

- (3) The Economic Boost

Freight Rail Transport is crucial to freight transport industry and services in terms of volume. The development of the Double Tracks Electric train will efficiently facilitate freight transport and service and provide punctuality of transport time.

### 3.5.3 The Assessment of the Economic Indicator

The Consultants have analysed the Financial Returns of the Investment and Risks of the Project. To obtain the overview, the followings data have been included: The Investment Cost Estimate (excluding the State subsidy), Direct Benefit which includes Vehicle Operating Costs, Time Costs and Accident Costs. The collected data have been used in the finding of the Economic Indicator for Net Present Value: NPV, Benefit Cost Ratio: B/C Ratio and Economic Internal Rate of Returns: EIRR.

### 3.5.4 The Results of The Financial Feasibility Study of the Project

From the Results of the Financial Feasibility Study of the Electrified Train Project (**Table 3.5-5**) it was found that the Project is financially feasible with EIRR of 18.89% NPV of 4,365.30 million baht (Discount Rate of 12%) and B/C Ratio of 1.72 and for the Diesel Train project, EIRR is 18.50% NPV of 3,392.87 million baht (Discount Rate of 12%) and B/B Ratio of 1.65 (**Table 3.5-6**)

**Table 3.5-5**  
**The Results of the Financial Feasibility Study of the Electrified Train Project**

EIRR 18.78 %  
NPV 3,446.10 million baht  
B/C Ratio 1.71

Unit: million baht

| Year | Year of Operation | Capital Investment |                             |            |                  | Capital Investment | Benefit       |          |        |                |       |                   | Total Benefit | Net Value |
|------|-------------------|--------------------|-----------------------------|------------|------------------|--------------------|---------------|----------|--------|----------------|-------|-------------------|---------------|-----------|
|      |                   | Construction Cost  | Operation& Maintenance Cost | Fleet cost | Environment Cost |                    | Salvage Value | VOC      | VOT    | Pollution Cost | ACC   | Time Saving Value |               |           |
| 2016 | 0                 | 0.00               | 0.00                        | 0.00       | 0.00             | 0.00               | 0.00          | 0.00     | 0.00   | 0.00           | 0.00  | 0.00              | 0.00          | 0.00      |
| 2017 | 0                 | 0.00               | 0.00                        | 0.00       | 0.00             | 0.00               | 0.00          | 0.00     | 0.00   | 0.00           | 0.00  | 0.00              | 0.00          | 0.00      |
| 2018 | Constr 1.         | 1,409.17           | 0.00                        | 0.00       | 3.97             | 1,413.14           | 0.00          | 0.00     | 0.00   | 0.00           | 0.00  | 0.00              | 0.00          | -1,413.14 |
| 2019 | Constr 2.         | 2,717.05           | 0.00                        | 0.00       | 2.70             | 2,719.76           | 0.00          | 0.00     | 0.00   | 0.00           | 0.00  | 0.00              | 0.00          | -2,719.76 |
| 2020 | Constr 3.         | 2,717.05           | 0.00                        | 0.00       | 2.70             | 2,719.76           | 0.00          | 0.00     | 0.00   | 0.00           | 0.00  | 0.00              | 0.00          | -2,719.76 |
| 2021 | 1                 | 0.00               | 99.85                       | 0.00       | 0.82             | 100.67             | 0.00          | 513.76   | 252.13 | 374.31         | 6.15  | 50.34             | 1,196.69      | 1,096.02  |
| 2022 | 2                 | 0.00               | 102.79                      | 0.00       | 0.54             | 103.34             | 0.00          | 545.36   | 269.47 | 390.25         | 6.41  | 51.51             | 1,263.00      | 1,159.66  |
| 2023 | 3                 | 0.00               | 105.82                      | 0.00       | 0.54             | 106.36             | 0.00          | 578.91   | 288.00 | 406.82         | 6.68  | 52.70             | 1,333.11      | 1,226.75  |
| 2024 | 4                 | 0.00               | 108.94                      | 0.00       | 0.00             | 108.94             | 0.00          | 614.52   | 307.81 | 424.05         | 6.96  | 53.93             | 1,407.27      | 1,298.33  |
| 2025 | 5                 | 0.00               | 112.15                      | 0.00       | 0.00             | 112.15             | 0.00          | 652.32   | 328.98 | 441.98         | 7.25  | 55.18             | 1,485.71      | 1,373.56  |
| 2026 | 6                 | 0.00               | 115.45                      | 0.00       | 0.37             | 115.82             | 0.00          | 692.45   | 351.60 | 460.61         | 7.56  | 56.46             | 1,568.68      | 1,452.86  |
| 2027 | 7                 | 0.00               | 118.85                      | 0.00       | 0.00             | 118.85             | 0.00          | 735.04   | 375.79 | 479.99         | 7.87  | 57.77             | 1,656.46      | 1,537.61  |
| 2028 | 8                 | 0.00               | 122.35                      | 0.00       | 0.00             | 122.35             | 0.00          | 780.26   | 401.63 | 500.14         | 8.21  | 59.11             | 1,749.35      | 1,626.99  |
| 2029 | 9                 | 0.00               | 125.96                      | 0.00       | 0.00             | 125.96             | 0.00          | 828.25   | 429.25 | 521.10         | 8.55  | 60.48             | 1,847.63      | 1,721.67  |
| 2030 | 10                | 0.00               | 129.67                      | 0.00       | 0.00             | 129.67             | 0.00          | 879.20   | 458.78 | 542.88         | 8.91  | 61.88             | 1,951.65      | 1,821.98  |
| 2031 | 11                | 0.00               | 132.58                      | 0.00       | 0.37             | 132.95             | 0.00          | 933.28   | 490.33 | 565.52         | 9.29  | 63.31             | 2,061.74      | 1,928.79  |
| 2032 | 12                | 0.00               | 135.55                      | 0.00       | 0.00             | 135.55             | 0.00          | 971.91   | 508.30 | 585.60         | 9.61  | 64.25             | 2,139.67      | 2,004.12  |
| 2033 | 13                | 0.00               | 138.59                      | 0.00       | 0.00             | 138.59             | 0.00          | 1,012.14 | 526.93 | 606.24         | 9.94  | 65.21             | 2,220.45      | 2,081.86  |
| 2034 | 14                | 0.00               | 141.70                      | 0.00       | 0.00             | 141.70             | 0.00          | 1,054.03 | 546.23 | 627.45         | 10.28 | 66.18             | 2,304.18      | 2,162.48  |
| 2035 | 15                | 0.00               | 144.88                      | 0.00       | 0.00             | 144.88             | 0.00          | 1,097.65 | 566.25 | 649.25         | 10.63 | 67.16             | 2,390.95      | 2,246.07  |
| 2036 | 16                | 0.00               | 148.13                      | 0.00       | 0.37             | 148.50             | 0.00          | 1,143.08 | 587.00 | 671.65         | 11.00 | 68.16             | 2,480.89      | 2,332.40  |
| 2037 | 17                | 0.00               | 151.45                      | 0.00       | 0.00             | 151.45             | 0.00          | 1,190.39 | 608.51 | 694.66         | 11.38 | 69.18             | 2,574.12      | 2,422.67  |
| 2038 | 18                | 0.00               | 154.85                      | 0.00       | 0.00             | 154.85             | 0.00          | 1,239.66 | 630.81 | 718.30         | 11.77 | 70.20             | 2,670.75      | 2,515.90  |
| 2039 | 19                | 0.00               | 158.32                      | 0.00       | 0.00             | 158.32             | 0.00          | 1,290.97 | 653.93 | 742.58         | 12.17 | 71.25             | 2,770.91      | 2,612.59  |
| 2040 | 20                | 0.00               | 161.87                      | 0.00       | 0.00             | 161.87             | 0.00          | 1,344.40 | 677.89 | 767.53         | 12.59 | 72.31             | 2,874.73      | 2,712.86  |
| 2041 | 21                | 0.00               | 165.93                      | 0.00       | 0.37             | 166.29             | 0.00          | 1,400.05 | 702.74 | 793.16         | 13.03 | 73.38             | 2,982.35      | 2,816.06  |
| 2042 | 22                | 0.00               | 170.08                      | 0.00       | 0.00             | 170.08             | 0.00          | 1,446.34 | 719.73 | 819.45         | 13.45 | 75.61             | 3,074.58      | 2,904.49  |
| 2043 | 23                | 0.00               | 174.34                      | 0.00       | 0.00             | 174.34             | 0.00          | 1,494.17 | 737.13 | 846.47         | 13.89 | 77.91             | 3,169.55      | 2,995.21  |
| 2044 | 24                | 0.00               | 178.71                      | 0.00       | 0.00             | 178.71             | 0.00          | 1,543.57 | 754.95 | 874.24         | 14.34 | 80.27             | 3,267.37      | 3,088.66  |
| 2045 | 25                | 0.00               | 183.18                      | 0.00       | 0.00             | 183.18             | 0.00          | 1,594.61 | 773.21 | 902.78         | 14.80 | 82.71             | 3,368.11      | 3,184.93  |
| 2046 | 26                | 0.00               | 187.77                      | 0.00       | 0.37             | 188.14             | 0.00          | 1,647.34 | 791.90 | 932.11         | 15.28 | 85.22             | 3,471.86      | 3,283.72  |
| 2047 | 27                | 0.00               | 192.47                      | 0.00       | 0.00             | 192.47             | 0.00          | 1,701.81 | 811.05 | 962.25         | 15.78 | 87.81             | 3,578.70      | 3,386.23  |
| 2048 | 28                | 0.00               | 197.30                      | 0.00       | 0.00             | 197.30             | 0.00          | 1,758.09 | 830.66 | 993.23         | 16.29 | 90.48             | 3,688.74      | 3,491.45  |
| 2049 | 29                | 0.00               | 202.24                      | 0.00       | 0.00             | 202.24             | 0.00          | 1,816.22 | 850.74 | 1,025.06       | 16.82 | 93.23             | 3,802.06      | 3,599.82  |
| 2050 | 30                | 0.00               | 207.30                      | 0.00       | 0.00             | 207.30             | 1,272.53      | 1,876.27 | 871.31 | 1,057.76       | 17.36 | 96.06             | 5,191.30      | 4,983.99  |

Source: The Consultants

**Table 3.5-6**  
**The Results of the Financial Feasibility Study of the Diesel Train Project**

EIRR 18.24%  
NPV 2,575.33 million baht  
B/C Ratio 1.62

Unit: million baht

| Year | Year of Operation | Capital Investment |                              |            |                  | Capital Investment | Benefit       |          |        |                |       |                   | Total Benefit | Net Value |
|------|-------------------|--------------------|------------------------------|------------|------------------|--------------------|---------------|----------|--------|----------------|-------|-------------------|---------------|-----------|
|      |                   | Construction Cost  | Operation & Maintenance Cost | Fleet cost | Environment Cost |                    | Salvage Value | VOC      | VOT    | Pollution Cost | ACC   | Time Saving Value |               |           |
| 2016 | 0                 | 0.00               | 0.00                         | 0.00       | 0.00             | 0.00               | 0.00          | 0.00     | 0.00   | 0.00           | 0.00  | 0.00              | 0.00          | 0.00      |
| 2017 | 0                 | 0.00               | 0.00                         | 0.00       | 0.00             | 0.00               | 0.00          | 0.00     | 0.00   | 0.00           | 0.00  | 0.00              | 0.00          | 0.00      |
| 2018 | Constr 1.         | 1,146.56           | 0.00                         | 0.00       | 3.97             | 1,150.53           | 0.00          | 0.00     | 0.00   | 0.00           | 0.00  | 0.00              | 0.00          | -1,150.53 |
| 2019 | Constr 2.         | 2,249.78           | 0.00                         | 0.00       | 2.70             | 2,252.48           | 0.00          | 0.00     | 0.00   | 0.00           | 0.00  | 0.00              | 0.00          | -2,252.48 |
| 2020 | Constr 3.         | 2,249.78           | 0.00                         | 0.00       | 2.70             | 2,252.48           | 0.00          | 0.00     | 0.00   | 0.00           | 0.00  | 0.00              | 0.00          | -2,252.48 |
| 2021 | 1                 | 0.00               | 106.31                       | 0.00       | 0.82             | 107.12             | 0.00          | 418.15   | 202.72 | 305.55         | 5.02  | 40.67             | 972.11        | 864.99    |
| 2022 | 2                 | 0.00               | 110.28                       | 0.00       | 0.54             | 110.83             | 0.00          | 443.64   | 216.64 | 338.31         | 5.23  | 41.85             | 1,045.67      | 934.84    |
| 2023 | 3                 | 0.00               | 114.41                       | 0.00       | 0.54             | 114.95             | 0.00          | 470.69   | 231.51 | 348.61         | 5.45  | 43.06             | 1,099.32      | 984.36    |
| 2024 | 4                 | 0.00               | 118.69                       | 0.00       | 0.00             | 118.69             | 0.00          | 499.39   | 247.41 | 358.91         | 5.68  | 44.31             | 1,155.68      | 1,036.99  |
| 2025 | 5                 | 0.00               | 123.13                       | 0.00       | 0.00             | 123.13             | 0.00          | 529.83   | 264.39 | 369.21         | 5.92  | 45.59             | 1,214.94      | 1,091.80  |
| 2026 | 6                 | 0.00               | 127.74                       | 0.00       | 0.37             | 128.11             | 0.00          | 562.13   | 282.55 | 379.51         | 6.16  | 46.91             | 1,277.26      | 1,149.15  |
| 2027 | 7                 | 0.00               | 132.52                       | 0.00       | 0.00             | 132.52             | 0.00          | 596.41   | 301.95 | 389.81         | 6.42  | 48.26             | 1,342.84      | 1,210.32  |
| 2028 | 8                 | 0.00               | 137.48                       | 0.00       | 0.00             | 137.48             | 0.00          | 632.77   | 322.68 | 400.11         | 6.69  | 49.66             | 1,411.90      | 1,274.42  |
| 2029 | 9                 | 0.00               | 142.63                       | 0.00       | 0.00             | 142.63             | 0.00          | 671.34   | 344.83 | 410.41         | 6.97  | 51.09             | 1,484.65      | 1,342.02  |
| 2030 | 10                | 0.00               | 147.96                       | 0.00       | 0.00             | 147.96             | 0.00          | 712.27   | 368.51 | 475.27         | 7.27  | 52.57             | 1,615.89      | 1,467.92  |
| 2031 | 11                | 0.00               | 150.95                       | 0.00       | 0.37             | 151.31             | 0.00          | 755.69   | 393.81 | 461.12         | 7.57  | 54.09             | 1,672.29      | 1,520.97  |
| 2032 | 12                | 0.00               | 153.99                       | 0.00       | 0.00             | 153.99             | 0.00          | 786.42   | 406.99 | 496.47         | 7.81  | 54.94             | 1,752.63      | 1,598.65  |
| 2033 | 13                | 0.00               | 157.09                       | 0.00       | 0.00             | 157.09             | 0.00          | 818.40   | 420.62 | 507.07         | 8.05  | 55.80             | 1,809.94      | 1,652.85  |
| 2034 | 14                | 0.00               | 160.26                       | 0.00       | 0.00             | 160.26             | 0.00          | 851.68   | 434.70 | 517.67         | 8.31  | 56.67             | 1,869.03      | 1,708.77  |
| 2035 | 15                | 0.00               | 163.49                       | 0.00       | 0.00             | 163.49             | 0.00          | 886.31   | 449.26 | 528.27         | 8.57  | 57.56             | 1,929.96      | 1,766.47  |
| 2036 | 16                | 0.00               | 166.79                       | 0.00       | 0.37             | 167.16             | 0.00          | 922.34   | 464.30 | 538.87         | 8.83  | 58.46             | 1,992.81      | 1,825.65  |
| 2037 | 17                | 0.00               | 170.15                       | 0.00       | 0.00             | 170.15             | 0.00          | 959.85   | 479.85 | 544.47         | 9.11  | 59.37             | 2,052.65      | 1,882.50  |
| 2038 | 18                | 0.00               | 173.58                       | 0.00       | 0.00             | 173.58             | 0.00          | 998.88   | 495.91 | 550.07         | 9.39  | 60.30             | 2,114.55      | 1,940.97  |
| 2039 | 19                | 0.00               | 177.08                       | 0.00       | 0.00             | 177.08             | 0.00          | 1,039.49 | 512.51 | 555.67         | 9.69  | 61.25             | 2,178.61      | 2,001.53  |
| 2040 | 20                | 0.00               | 180.65                       | 0.00       | 0.00             | 180.65             | 0.00          | 1,081.76 | 529.67 | 554.68         | 9.99  | 62.21             | 2,338.31      | 2,157.66  |
| 2041 | 21                | 0.00               | 185.87                       | 0.00       | 0.37             | 186.24             | 0.00          | 1,125.74 | 547.41 | 627.25         | 10.30 | 63.18             | 2,373.89      | 2,187.65  |
| 2042 | 22                | 0.00               | 191.24                       | 0.00       | 0.00             | 191.24             | 0.00          | 1,160.14 | 560.68 | 686.08         | 10.64 | 65.21             | 2,482.75      | 2,291.51  |
| 2043 | 23                | 0.00               | 196.76                       | 0.00       | 0.00             | 196.76             | 0.00          | 1,195.59 | 574.27 | 701.78         | 10.98 | 67.31             | 2,549.93      | 2,353.17  |
| 2044 | 24                | 0.00               | 202.45                       | 0.00       | 0.00             | 202.45             | 0.00          | 1,232.12 | 588.19 | 717.48         | 11.34 | 69.48             | 2,618.61      | 2,416.16  |
| 2045 | 25                | 0.00               | 208.30                       | 0.00       | 0.00             | 208.30             | 0.00          | 1,269.76 | 602.45 | 738.18         | 11.71 | 71.71             | 2,693.81      | 2,485.52  |
| 2046 | 26                | 0.00               | 214.32                       | 0.00       | 0.37             | 214.69             | 0.00          | 1,308.56 | 617.05 | 758.88         | 12.09 | 74.02             | 2,770.60      | 2,555.92  |
| 2047 | 27                | 0.00               | 220.51                       | 0.00       | 0.00             | 220.51             | 0.00          | 1,348.54 | 632.01 | 779.58         | 12.48 | 76.40             | 2,849.02      | 2,628.51  |
| 2048 | 28                | 0.00               | 226.88                       | 0.00       | 0.00             | 226.88             | 0.00          | 1,389.74 | 647.33 | 800.28         | 12.89 | 78.86             | 2,929.11      | 2,702.23  |
| 2049 | 29                | 0.00               | 233.44                       | 0.00       | 0.00             | 233.44             | 0.00          | 1,432.21 | 663.03 | 820.98         | 13.30 | 81.40             | 3,010.92      | 2,777.48  |
| 2050 | 30                | 0.00               | 240.18                       | 0.00       | 0.00             | 240.18             | 1,189.56      | 1,475.97 | 679.10 | 836.97         | 13.74 | 84.02             | 4,279.35      | 4,039.17  |

Source: The Consultants

### 3.5.5 Summary of the Economic Feasibility Study of the Project

From the Economic Feasibility Study of the Project, it was found that:

- From the Study of the Electrified Train Project and the Diesel Train Project, the Economic Feasibility of the Project can be summed up as follow **Table 3.5-7**

**Table 3.5-7**  
**Summary of the Economic Feasibility Study of the Project**

| Feasibility Indicator | The Results of the Feasibility Indicators |                  | The Results of the Feasibility Study                   |
|-----------------------|-------------------------------------------|------------------|--------------------------------------------------------|
|                       | Case 1                                    | Case 2           |                                                        |
| EIRR                  | 18.78%                                    | 18.24%           | Feasible because EIRR is higher than Discount Rate 12% |
| NPV                   | 3,446.10 m. baht                          | 2,575.33 m. baht | Feasible because NPV has a Positive Value              |
| B/C                   | 1.71                                      | 1.62             | Feasible because B/C is higher than 1                  |

Source: The Consultants

1. The Electrified Train System
2. The Diesel train System

- From the Analysis, it was found that the Double Tracks Electric Train Project and the Diesel Train Project, both are highly feasible
- In terms of Financial Investment. The Projects will yield economic benefit to the society and Thailand as they will give Positive NPV and Higher B/C than 1 including EIRR higher than Discount Rate 12%. When analyzing both Projects, it was found that the Electrified Train Project will yield higher EIRR than the Diesel Train Project. Therefore, the Electrified Train project will be highly feasible in terms of investment.
- When considering the Sensitivity of the Project, it was found that in case the Project has the most negative impact with 20% increase of the capital investment and decrease of 20% profit, EIRR of the Electrified Train Project will be 13.48 % while EIRR of the Diesel Train Project will be 12.89% This will make the Electrified Train project have EIRR higher than 12%. This shows that the project with low risk of investment will be more attractive in terms of investment.



### 3.6 The Financial Analysis

The Financial Analysis has been conducted according to the Regulations of Office of Public Debt Management, Ministry of Finance, for the Special Project with the State Investment. The timeframe of the analysis has been set at 30 years after the Project operation begins. The Consultants have conducted the Financial Analysis of the Project in 6 steps:

- Various sources of investment fund for the Project by considering the most suitable form of investment in determining the investment source and the feasibility of the Project
- Revenue and Expenditures of the Project. This will be studied in terms of Cash Flow Stream throughout the Project
- Determination of reasonable Economic Factor to be used in the Financial Analysis for suitable forms of investment
- Determination of the Financial Hypothesis necessary for the Financial Analysis
- Applying suitable Financial Model in the Financial Analysis to look for suitable form of investment
- Conducting the Financial Sensitivity of the Project to analyse the sensitivity factor of the most suitable form of investment from the uncertainty of financial factors

#### 3.6.1 The Preparation of the Projection of Expenses of the Project Investment and operation

In the Financial Analysis, the Investment Cost of the Project is divided into 2 groups:

##### (1) The Project Capital Investment

- Land costs –Major expense on the Capital Investment besides the construction cost; study and estimate of the cost details will be conducted
- Building compensations – Part of the expenses on land procurement; quite expensive as the property is already developed and there are a large number of buildings on the property
- Construction of the Project – Expenses include construction materials, labor hire, miscellaneous and other engineering works such as drainage work, electrical system, etc.
- Monitoring and assessment of environmental impact during construction

##### (2) The Project Operation Costs

- The Project Operation costs – These will begin when the Project starts its operation so the estimates will be calculated subject to future value with inflation rate as conversion factor

- Maintenance Costs – Yearly and periodic maintenance after the Project Operation begins. The estimates will be calculated subjected to future value with inflation rate as conversion factor.
- Monitoring of Environmental Impact during the Project Operation.
- Depreciation Costs – expenses to be calculated with Corporate Income Tax to be submitted to Treasury Department for State-funded projects, private investment and management, and including joint-stock companies.

The details of the Financial Costs of the Project Investment for the Electrified Train Project as in **Table 3.6-1** and Diesel-Powered Train Project as and **Table 3.6-2** and the Financial Estimates as in **Table 3.6-3**

Table 3.6-1

## The Economic value of the Investment Cost on the Electrified Train Project

Unit: million baht

| Year  | Land Rights and Building Compensations | Civil Works | Signalling & Telecom. | Power Supply | O&M      | Environmental Cost | Total Investment Costs |
|-------|----------------------------------------|-------------|-----------------------|--------------|----------|--------------------|------------------------|
| 2018  | 54.54                                  | 1,237.86    | 138.71                | 285.91       |          | 4.64               | 1,721.66               |
| 2019  |                                        | 2,537.62    | 284.35                | 586.12       |          | 3.25               | 3,411.33               |
| 2020  |                                        | 2,601.06    | 291.46                | 600.77       |          | 3.33               | 3,496.62               |
| 2021  |                                        |             |                       |              | 125.87   | 1.03               | 126.90                 |
| 2022  |                                        |             |                       |              | 132.81   | 0.70               | 133.51                 |
| 2023  |                                        |             |                       |              | 140.14   | 0.72               | 140.86                 |
| 2024  |                                        |             |                       |              | 147.88   | 0.00               | 147.88                 |
| 2025  |                                        |             |                       |              | 156.04   | 0.00               | 156.04                 |
| 2026  |                                        |             |                       |              | 164.66   | 0.52               | 165.18                 |
| 2027  |                                        |             |                       |              | 173.74   | 0.00               | 173.74                 |
| 2028  |                                        |             |                       |              | 183.33   | 0.00               | 183.33                 |
| 2029  |                                        |             |                       |              | 193.45   | 0.00               | 193.45                 |
| 2030  |                                        |             |                       |              | 204.13   | 0.00               | 204.13                 |
| 2031  |                                        |             |                       |              | 213.93   | 0.59               | 214.52                 |
| 2032  |                                        |             |                       |              | 224.19   | 0.00               | 224.19                 |
| 2033  |                                        |             |                       |              | 234.95   | 0.00               | 234.95                 |
| 2034  |                                        |             |                       |              | 246.23   | 0.00               | 246.23                 |
| 2035  |                                        |             |                       |              | 258.04   | 0.00               | 258.04                 |
| 2036  |                                        |             |                       |              | 270.43   | 0.67               | 271.10                 |
| 2037  |                                        |             |                       |              | 283.41   | 0.00               | 283.41                 |
| 2038  |                                        |             |                       |              | 297.01   | 0.00               | 297.01                 |
| 2039  |                                        |             |                       |              | 311.26   | 0.00               | 311.26                 |
| 2040  |                                        |             |                       |              | 326.20   | 0.00               | 326.20                 |
| 2041  |                                        |             |                       |              | 342.72   | 0.76               | 343.48                 |
| 2042  |                                        |             |                       |              | 360.09   | 0.00               | 360.09                 |
| 2043  |                                        |             |                       |              | 378.34   | 0.00               | 378.34                 |
| 2044  |                                        |             |                       |              | 397.51   | 0.00               | 397.51                 |
| 2045  |                                        |             |                       |              | 417.65   | 0.00               | 417.65                 |
| 2046  |                                        |             |                       |              | 438.82   | 0.86               | 439.68                 |
| 2047  |                                        |             |                       |              | 461.05   | 0.00               | 461.05                 |
| 2048  |                                        |             |                       |              | 484.41   | 0.00               | 484.41                 |
| 2049  |                                        |             |                       |              | 508.96   | 0.00               | 508.96                 |
| 2050  |                                        |             |                       |              | 534.75   | 0.00               | 534.75                 |
| Total | 54.54                                  | 6,376.54    | 714.52                | 1,472.81     | 8,612.01 | 17.08              | 17,247.48              |

**Table 3.6-2**  
**The Economic value of the Investment Cost on the Diesel Train Project**

Unit: million baht

| Year         | Land Rights and Building Compensations | Civil Works     | Signalling & Telecom. | Power Supply | O&M             | Environmental Cost | Total Investment Costs |
|--------------|----------------------------------------|-----------------|-----------------------|--------------|-----------------|--------------------|------------------------|
| 2018         | 54.54                                  | 1,237.86        | 138.71                | 0.00         |                 | 4.64               | 1,435.75               |
| 2019         |                                        | 2,537.62        | 284.35                | 0.00         |                 | 3.25               | 2,825.21               |
| 2020         |                                        | 2,601.06        | 291.46                | 0.00         |                 | 3.33               | 2,895.84               |
| 2021         |                                        |                 |                       |              | 134.00          | 1.03               | 135.03                 |
| 2022         |                                        |                 |                       |              | 142.49          | 0.70               | 143.19                 |
| 2023         |                                        |                 |                       |              | 151.52          | 0.72               | 152.24                 |
| 2024         |                                        |                 |                       |              | 161.12          | 0.00               | 161.12                 |
| 2025         |                                        |                 |                       |              | 171.33          | 0.00               | 171.33                 |
| 2026         |                                        |                 |                       |              | 182.18          | 0.52               | 182.71                 |
| 2027         |                                        |                 |                       |              | 193.73          | 0.00               | 193.73                 |
| 2028         |                                        |                 |                       |              | 206.00          | 0.00               | 206.00                 |
| 2029         |                                        |                 |                       |              | 219.05          | 0.00               | 219.05                 |
| 2030         |                                        |                 |                       |              | 232.93          | 0.00               | 232.93                 |
| 2031         |                                        |                 |                       |              | 243.56          | 0.59               | 244.16                 |
| 2032         |                                        |                 |                       |              | 254.69          | 0.00               | 254.69                 |
| 2033         |                                        |                 |                       |              | 266.32          | 0.00               | 266.32                 |
| 2034         |                                        |                 |                       |              | 278.48          | 0.00               | 278.48                 |
| 2035         |                                        |                 |                       |              | 291.20          | 0.00               | 291.20                 |
| 2036         |                                        |                 |                       |              | 304.49          | 0.67               | 305.16                 |
| 2037         |                                        |                 |                       |              | 318.40          | 0.00               | 318.40                 |
| 2038         |                                        |                 |                       |              | 332.94          | 0.00               | 332.94                 |
| 2039         |                                        |                 |                       |              | 348.14          | 0.00               | 348.14                 |
| 2040         |                                        |                 |                       |              | 358.11          | 0.00               | 358.11                 |
| 2041         |                                        |                 |                       |              | 377.66          | 0.76               | 378.42                 |
| 2042         |                                        |                 |                       |              | 398.29          | 0.00               | 398.29                 |
| 2043         |                                        |                 |                       |              | 420.04          | 0.00               | 420.04                 |
| 2044         |                                        |                 |                       |              | 442.98          | 0.00               | 442.98                 |
| 2045         |                                        |                 |                       |              | 467.18          | 0.00               | 467.18                 |
| 2046         |                                        |                 |                       |              | 492.69          | 0.86               | 493.55                 |
| 2047         |                                        |                 |                       |              | 519.60          | 0.00               | 519.60                 |
| 2048         |                                        |                 |                       |              | 547.98          | 0.00               | 547.98                 |
| 2049         |                                        |                 |                       |              | 577.90          | 0.00               | 577.90                 |
| 2050         |                                        |                 |                       |              | 603.55          | 0.00               | 603.55                 |
| <b>Total</b> | <b>54.54</b>                           | <b>6,376.54</b> | <b>714.52</b>         | <b>0.00</b>  | <b>9,638.54</b> | <b>17.08</b>       | <b>16,801.21</b>       |

**Table 3.6-3**  
**The Hypothesis in the Financial Feasibility of the Project**

| Details s                                                                                                                                           | Hypothesis                                                                                                                               | Notes                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 1. Inflation rate<br>1.1 Construction Cost<br>1.2 Operation Cost<br>1.3 Revenue<br>1.4 Year in the Project Cost Assessment                          | 2.5 %/year<br>2.5 %/year<br>2.5 %/year<br>2015                                                                                           | Office of Public Debt Management |
| 2. Revenue<br>2.1 Passenger Fare<br>- First Class Car<br>- Second Class Car<br>- Third Class Car<br>2.2 Fee from Fares<br>2.3 Freight Transport Fee | 0.86 baht/person/km<br>0.42 baht/person/km<br>0.18 baht/person/km<br>53.48 % of Revenues from Passenger fares & Fees<br>1.83 baht/ton-km | SRT                              |
| 3. Asset Life<br>3.1 Civil Works<br>3.2 Signaling & Telecom                                                                                         | 40 years<br>32 years                                                                                                                     |                                  |
| 4. Timeframe in the Analysis<br>4.1 Project Analysis<br>4.2 Land Rights<br>4.3 Construction<br>4.4 Operation Period                                 | 30 years + construction period<br>1 year<br>3 years<br>30 years                                                                          | Office of Public debt Management |
| 5. First Year of Construction                                                                                                                       | 2018                                                                                                                                     |                                  |
| 6. First Year of Operation                                                                                                                          | 2021                                                                                                                                     |                                  |
| 7. Reduction rate                                                                                                                                   | 5%                                                                                                                                       |                                  |
| 8. Tax<br>8.1 Tax Revenue to the Ministry of Finance                                                                                                | 35 % from Net Profit                                                                                                                     |                                  |

### 3.6.2 The Projection of the Project Revenue

In the Study, the Consultants have prepared the Projection of the Project Revenue. The annual revenue will be calculated from the projected volume of passengers and freight multiplied by Passenger Fares and Freight Transport Fees in the target years. In the Study, the Consultants have set an assumption of the fixed increasing rate of the volume of passengers and freight during the target years using Linear Interpolation Method. This will yield the same volume of passengers and freight matched with the Line Load. The summary of the Projection of the Revenue on the Electrified Train Project (**Table 3.6-4**) and the Diesel Train Project (**Table 3.6-5**)

**Table 3.6-4**  
**The Project Revenue of the Electrified Train Project**

Unit: million baht

| Year | Passenger Fare | Transportation Fee | Freight Transport Fee | Total |
|------|----------------|--------------------|-----------------------|-------|
| 2021 | 70             | 80                 | 54                    | 204   |
| 2030 | 146            | 167                | 89                    | 401   |
| 2040 | 274            | 313                | 142                   | 729   |
| 2050 | 479            | 548                | 215                   | 1,243 |

Source: The Consultants

**Table 3.6-5**  
**The Project Revenue of the Diesel Train Project**

Unit: million baht

| Year | Passenger Fare | Transportation Fee | Freight Transport Fee | Total |
|------|----------------|--------------------|-----------------------|-------|
| 2021 | 50             | 57                 | 45                    | 151   |
| 2030 | 106            | 121                | 77                    | 304   |
| 2040 | 204            | 234                | 125                   | 563   |
| 2050 | 363            | 415                | 191                   | 968   |

Source: The Consultants

### 3.6.3 The Results of the Financial Feasibility Study of the Project

From the Financial Feasibility Study of the Project, it was found that the Electrified Train Project has NPV of -4,188.00 million baht (5% Discount Rate) and B/C Ratio of 0.58 while the Diesel Train Project has NPV of -4,683.19 million baht (5% Discount Rate) and B/C Ratio of 0.48 as shown in **Table 3.6-6**

**Table 3.6-6**  
**The Results of the Financial Feasibility Study of the Project**

| Case                         | NPV              | B/C Ratio | FIRR    |
|------------------------------|------------------|-----------|---------|
| The Electrified Train System | -4,188.00 m.baht | 0.58      | 0.30%   |
| The Diesel Train System      | -4,683.19 m.baht | 0.48      | -2.43%* |

Note: \*The Return Rate has a negative From thvalue consecutively because the Investment Capital of the Project includes investment on Infrastructure, Signaling & Telecommunication System and Power Supply which has high investment cost while the Returns are low.

From the Results of the Financial Feasibility Study of the Project, it was found that:

- From the Financial Analysis, both Projects have been found to have low Financial Feasibility with Negative NPV. Moreover, FIRR of both Projects is lower than the Investment Capital Gains and the B/C ration is lower than 1. This shows that both Projects will not be feasible in terms of investment.
- When considering the Sensitivity of the Project which has the most Positive impact : the Investment Capital decreases to 20% and the Financial Returns increases to 20%, the Electrified Train Project will have NPV of -1,105.58 million baht and -2,141.57 million baht for the Diesel Train Project with both Projects still have Negative NPV. Although the investment of this Project may be very beneficial to the society and the country, the Financial returns will not be worth the investment. Therefore, the Project may require additional government financial support.





## Chapter 4

### The Impact of the Project

#### 4.1 The Environment, the Community and Service Users including Preventions and Solutions Measures of the Impact of the Project

The Environmental Impact Assessment (EIA) of the Study and Design of the Hat Yai-Padang Bezar Double Tracks Train Project Development has been conducted to study and assess the level of physical and biological impact from the Project, benefit on human resources and quality of life during the preparation steps of the construction, the construction period and the operation period. Analysis has been from secondary source of data and selected significant environmental issues. The projected EIA of the Project will apply the data and details from the Project and present environmental conditions in the analysis. The summary of the main aspects are shown in **Table 4.1-1**

**Table 4.1-1**

**Summary of the Present Environmental Conditions along the Hat Yai-Padang Bezar Train Route**

| Environmental Factors                 | Summary of Present Conditions                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Physical Conditions                |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| (1.1) Topography and Geography        | General topographical conditions along the Train Project: Lowland area in the north, coastal plain in the east and mountains and highland in the south and west, original source of many important water sources                                                                                                                                                                                                                 |
| (1.2) Geology and Earthquake          | Geological conditions along the Train Project: Plain structure, riverbed sediments: sand, powdered sand and clay, collected around the water channel and inundated area, with some sandstone. The project area is located in the earthquake-sensitive zone 1 with possible strength of III-IV Mercalli but not found in the Fault area of Thailand. Overall condition of the Project will not be affected from earthquake risks. |
| (1.4) Soil Resource                   | Types of Soil Sets along the Project Route: 26B, 32B, 34B, 39B, 42B, 45B, 45C, 17, 17B, 22 and 6. Soil Set 34B was found the most from the area with loose soil mixed with sand, low nutrients, high acidity, good to medium drainage capacity. At present, the area is used in rubber plantation, coconuts, fruit trees and some other farming plants                                                                           |
| (1.5) Surface Hydrological Conditions | Along the Project route, 26 crossing points with the water courses: Wa canal, No name canal, No name canal, No name canal, No name canal, Poh Mor canal, Rian canal, No name canal, Pom canal, Tang mae canal, Tong canal, No name canal, No name canal, No name canal, No name canal, Pratu canal, No name canal, U Tapao canal, No name canal, Suan Yai canal, Lang Suan canal, Wa Noi canal, No name canal                    |

Table 4.1-1 (Cont'd)

## Summary of the Present Environmental Conditions along the Hat Yai-Padang Besar Train Route

| Environmental Factors             | Summary of Present Conditions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.6) Surface Hydrological Quality | Samples were collected from 6 stations: Hin Lek fai canal, Poh Mor canal, Tang Mae canal, U Tapao canal, Nga canal, Rangka canal. The water quality found was Type 5 with BOD but with DO higher than standard in some area where there are found industrial factories which might have contaminated the water.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| (1.7) Air and Atmosphere          | <p>Sensitive Area within 200m.:</p> <ul style="list-style-type: none"> <li>- 3 villages: Khlong Wa, Khlong Ram, Tha Khoi</li> <li>- 5 religious sites: Sagkharatanaram Temple, Kopkulratanaram Temple, Phra Bat Temple, Tong Sia Siang Tang Cemetary, Budhikaram Temple</li> <li>- 7 schools: Charttrakankosol School, Thepchoomnoom School, Kittiwit (Ban Phru) School, Songsangwittaya School, Udomthong Municipal School, Patongwittaya Foundation School, Patongwittaya Prathankhiritwat School</li> <li>- Health stations: Tha Khoi Hospital, Chalerm Phrakiat Health Station, Patong Sub-district</li> </ul> <p>Samples collected from 4 stations: Choomchom Padang School, Patongwittaya School, Buddhikaram temple, Khlong Ngae Station</p> <p>From the results, every Parameter is within the Building Vibration Impact Standard.</p> |
| (1.8) Noise level                 | <p>Sensitive Area within 200m.:</p> <ul style="list-style-type: none"> <li>- 3 villages: Khlong Wa, Khlong Ram, Tha Khoi</li> <li>- 5 religious sites: Sagkharatanaram Temple, Kopkulratanaram Temple, Phra Bat Temple, Tong Sia Siang Tang Cemetary, Budhikaram Temple</li> <li>- 7 schools: Charttrakankosol School, Thepchoomnoom School, Kittiwit (Ban Phru) School, Songsangwittaya School, Udomthong Municipal School, Patongwittaya Foundation School, Patongwittaya Prathankhiritwat School</li> <li>- Health stations: Tha Khoi Hospital, Chalerm Phrakiat Health Station, Patong Sub-district</li> </ul> <p>Samples collected from 4 stations: Choomchom Padang School, Patongwittaya School, Buddhikaram temple, Khlong Ngae Station</p> <p>From the results, every Parameter is within the Building Vibration Impact Standard.</p> |
| (1.9) Vibration                   | <p>Sensitive Area within 200m.:</p> <ul style="list-style-type: none"> <li>- 3 villages: Khlong Wa, Khlong Ram, Tha Khoi</li> <li>- 5 religious sites: Sagkharatanaram Temple, Kopkulratanaram Temple, Phra Bat Temple, Tong Sia Siang Tang Cemetary, Budhikaram Temple</li> <li>- 7 schools: Charttrakankosol School, Thepchoomnoom School, Kittiwit (Ban Phru) School, Songsangwittaya School, Udomthong Municipal School, Patongwittaya Foundation School, Patongwittaya Prathankhiritwat School</li> <li>- Health stations: Tha Khoi Hospital, Chalerm Phrakiat Health Station, Patong Sub-district</li> </ul>                                                                                                                                                                                                                             |

Table 4.1-1 (Cont'd)

## Summary of the Present Environmental Conditions along the Hat Yai-Padang Bezar Train Route

| Environmental Factors       | Summary of Present Conditions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <p>Samples collected from 4 stations: Choomchom Padang School, Patongwittaya School, Buddhikaram temple, Khlong Ngae Station</p> <p>From the results, every Parameter is within the Building Vibration Impact Standard.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 2. Biological Environment   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| (2.1) Aquatic Ecosystem     | <p>Along the Project route, 26 crossing points with the water course: Wa canal, No name canal, No name canal, No name canal, No name canal, Poh Mor canal, Rian canal, No name canal, Pom canal, Tang mae canal, Tong canal, No name canal, No name canal, No name canal, No name canal, Pratu canal, No name canal, U Tapao canal, No name canal, Suan Yai canal, Lang Suan canal, Wa Noi canal, No name canal.</p> <p>In the Study of planktons and ground living organism in the hydrological conditions along the Project Route, samples were collected from 6 stations where use of the water sources was found in the ecosystem, fishery, and aquatic animals nursery: Hin Lekfai canal, Poh canal, Tang Mae canal, U Tapao canal, Nga canal, Rangka canal. From the collected samples, it was found that the diversity factor will be higher in the rainy season than in the dry season.</p>                                                                                                                                                                                                                                                                                                                                                             |
| (2.2) Terrestrial Ecosystem | <p>Forestry resource and land use: Most area is used in agricultural farming of rice, corn, vegetables, fruits; economic plantation of palm oil and rubber trees; decorative plants and other fruit trees around the residential area such as teak, eucalyptus, acacia, Apocynaceae, Pterocarpus Macrocarpus, Lagerstroemia , etc. Forest habitat was no longer found but some trees of various heights still exist along the Train route. None of the economic nor endangered trees were found and those under protection are commonly found.</p> <p>Animals: Many species of wild animals, particularly common local birds, were found living in the Project area. Some of the birds are migrant birds while some birds were found in high number reflecting high adaptability to the environment. Not all animals have been registered under protection by any organizations, national or international, or classified as "Least Concerned". No big animals, rare animals or endangered animals have been found. From the survey, the land use has been for agriculture, residential community, industrial area and water sources. Many species of animals found in this area have high adaptability in co-existing with the new habitat and environment</p> |

Table 4.1-1 (Cont'd)

## Summary of the Present Environmental Conditions along the Hat Yai-Padang Bezar Train Route

| Environmental Factors                   | Summary of Present Conditions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3. Benefit to human use                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| (3.1) Water for consumption             | Use of water in the area has been supplied by 6 local public departments under the Provincial Water Authority Region 5: Songkhla, Hat Yai, Sadao, Phang Nga, Na Thawee and Ranote                                                                                                                                                                                                                                                                                                                                                                                 |
| (3.2) Transportation                    | Overall transportation in the area around the Project, both in Hat Yai and to Malaysian Border, during the weekdays, transport by cars was found to be the highest with lower than or about 7 people, while travel by motorcycles and tricycles over a short distance was the second most. From the field survey, 33 crossing points with the train tracks were found.                                                                                                                                                                                            |
| (3.3) Public Facilities                 | The area along the Train Project was mostly residential community with existing electricity, water and telephone facilities.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| (3.5) Flood Control and Drainage        | The Project runs through the lowland by Songkhla Lake with Khlong U Tapao as a major branch. The Consultants will conduct a field survey of the water retaining area, building blocking the drainage, flooding situation and will conduct a Hydrological Study to assess the existing drainage capacity in order to adjust the system for better suitability with the Project. From the review of the data from Department of Irrigation, it was found that after the construction of Khlong Ror 1 in 2001-2010, flooding problems and damages have been reduced. |
| (3.6) Agriculture                       | The land and water resources along the Train project has been found to be rich and suitable for agriculture. Most local people do farming: rice, fruits, perennial trees, vegetables, flowers and decorative plants. The area is mostly the plain suitable for agriculture.                                                                                                                                                                                                                                                                                       |
| (3.10) Land use                         | 54.64% of the land is used in agriculture, 25.58% residential community particularly in Hat Yai, and 8.96% grassland and fields                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4. Benefit to Quality of Life           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| (4.1) Economy and Society               | With the area along the Train Project suitable for agriculture, most local people do farming with considerable income                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| (4.2) Relocation and Land Expropriation | Land expropriation of 21.3 rai 91.6 sq.wa will take place around Thung Mor Sub-district, Sadao District from 966+200 km to 967+325 km from the total amount of 2,637,480 baht. The area has no building or construction.                                                                                                                                                                                                                                                                                                                                          |
| (4.4) Public Health                     | Within 200 m. along the Project, 2 health stations are found: Tha Khoi Hospital, Chalerm Prakit Health Station, Patong Sub-district                                                                                                                                                                                                                                                                                                                                                                                                                               |

Table 4.1-1 (Cont'd)

## Summary of the Present Environmental Conditions along the Hat Yai-Padang Bezar Train Route

| Environmental Factors          | Summary of Present Conditions                                                                                                                  |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| (4.7) Accidents and safety     | From the records of accidents from the National Police Bureau, Songkhla which covers the whole Project area has 202 speed accidents (2013)     |
| (4.9) Sanitation               | With residential community along the Project route, local garbage collecting is outsourced to private companies according to the set standard. |
| (4.13) History and Archaeology | Within 2 km. of the Project, 2 historical sites are found..                                                                                    |
| (4.14) Aesthetics              | In the Project area, 11 tourist attraction sites are found.                                                                                    |

The details of the environmental impact, prevention and solutions measures are as follow:

#### 4.1.1 Topographical Conditions

**Impact from the Project:** During the Construction Period As the construction of the new Train Route will be on the same ground level as that of the existing one, the topographical conditions will not be affected while the construction on the high slope, adjustment of the gradient slope might affect some topographical conditions. However, the Project Design of the route has already avoided the high slope area and the new route is only 6 meters away from the present tracks, the existing slope area will remain the same and the impact will then be of a low

The Operation Period The Project will not have any activities that may affect the topographical conditions.

**Prevention and Solutions to the Environmental Impact:** Concrete Specifications of the construction area and supervision of the contractors will be clearly made in the construction area.

#### 4.1.2 Soil Resources

**The Impact from the Project:** During the Construction Period The construction activities particularly top soil striping, digging, land filling and the construction of the elevated carriageway, will reduce soil clumping so in case of rain, soil will be easily dispersed. With the nature of soil being loose or mixed with sand, it can be washed down into the surrounding area or nearby water sources. At the construction of the bridge across the water course, the train bridge or the drainage system, land digging may be needed to widen the water course thus causing loss of soil resource. For example, without effective planning and management, leaving the pile of soil too near the water course which can be then easily washed into the waterway. However, these are temporary impact and can be controlled, the erosion impact on the soil resource is considered low.

The Operation Period the completion of the construction, the station area will be found with buildings and landscape such as trees and small park, that can prevent more soil collapse. On the slope of the carriageway, prevention of erosion and land collapse will be made. For the construction activities of the bridge piling near the waterway that may require land digging or land filling, concrete

will be used to Applied to the area to prevent erosion and soil collapse. Therefore the Project Operation will not have any impact on the soil resource or soil collapse.

**Prevention and Solutions to the Environmental Impact:** During the Construction Period In general, stripping of top soil will not be operated at the same time but only sectional as needed and land compressing will be used to prevent erosion particularly during the rainy season. If necessarily needed, trees are allowed to be cut down to reduce the rain affected area. The open area must be covered with gravel or ground covering plants, trees and green area as set in the Landscape Design.

The Operation Period Regular inspection and maintenance of the slope structure, the planted trees at the Station and replanting if needed.

#### 4.1.3 Surface Hydrological Conditions and Drainage

**Impact from the Project:** The Construction Period In the construction of the new carriageway with new curve radius and the construction of the train bridge and the drainage system in the water source or running stream with all year flow, detours of the main course will be needed and could block the running stream. This could affect the hydrological conditions and cause flooding in the area and nearby in case of heavy rain during the monsoon season. This will only be temporary during the construction so the impact will be low.

The Operation Period In the Design of the Train Route, considerations have been made on the train track parallel with the existing one with 6 m. apart. In the design of the bridge and the drainage structure for the new Train Route, the drainage area will not be smaller than at present. For the piling structure of the bridge, the Project has positioned the new piles not far from the existing ones with no impact on the surface hydrological conditions of the Project and nearby area.

**Prevention and Solutions to the Environmental Impact:** The Construction Period If land preparation causes changes in the existing drainage conditions, a new drainage system must be constructed so the drainage conditions will not be affected. Piling of construction materials, equipment or machinery must be orderly managed to prevent blocking the draining. In transporting debris or construction materials out of the location, prevention of any fall into the water course must be made. After the completion of th construction, the contractor must work with related units in clearing the water course into the original condition. If flooding occurs around the construction site, the contractor must be responsible in promptly pumping the water out of the area and paying compensation for their damage from flooding.

The Operation Period Regular inspection and clearing of the drainage system so not to have blocked the drainage condition. Monitoring of the collected sediments and weed in the drainage furrow along the tracks and in the pipes and removal of the sediment and weed must be promptly made by setting up a Sump for the pipes in the easily flooded area and coordinating with the local administrative unit in locating and setting up pumps to drain the water out promptly in the case of rain. The local administrative unit should be responsible for the management and maintenance of the



water pumps in cooperation with Songkhla Irrigation Unit, Songkhla Civil Works and City Planning and Local Disaster Prevention and Relief Unit. These units should be informed of the Project operation and can plan Flood Prevention Measures effectively. RAT must coordinate with Local Administrative units and related offices such as Provincial Irrigation Project, Provincial Civil Works and City Planning, etc. in moving with solutions and planning measures for long term solutions.

#### 4.1.4 Quality of Surface Water and Aquatic Ecosystem

**Impact from the Project:** The Construction Period The surface water source along the Train Route and nearby area may be affected by the construction in the following ways: murkiness of the water from the construction of the bridge and sediments washed into the water course, falling of debris and construction materials into the water particularly when there is land digging to widen the water channel. Contamination could occur from equipment and machine oil or sewage from the construction workers' sheds. This impact is temporary during the construction of the Project and can be prevented and solved. So, the impact level is considered Low.

The Operation Period The surface water source along the Route and its vicinity may be affected as follow: impact on the quality of water from sewage discharge from the trains and garbage thrown out into the water source, impact on the quality of water from sewage discharge from toilets at the stations. Although the draining might not be directly discharged in to the water course but into public drainage system, the quality of water can still affected from washed sediments from the old carriageway and repair and maintenance of the carriageway and tracks. The impact can be short-term and quite rare so the impact level is considered Low.

**Prevention and Solutions to the Environmental Impact:** The Construction Period Any construction that takes place over the water course must have protective nets to prevent falling objects. No disposal of rubbish or construction materials and cleaning of equipment and tools in the water course. Piles of construction materials such as soil, sand, etc. must be fully covered and placed at least 10m away from the water source. Activities near the water source should be conducted in the dry season and within a minimal period to prevent sediment getting washed into the water. Sufficient sanitary toilets must be set up for the workers at a ratio of 20 persons:1 toilet and they must be places at least 20 m. from the water source. Proper sewage treatment from the office and workers' sheds must be set up before discharge. Wastewater tanks and sediment pools must be provided to collect sediments from wastewater from construction activities on location, the workers; sheds and the office before discharge into drainage system or water source.

The Operation Period Sanitary toilets must be provided for staff at the Station including passengers. The ON Site System and the Septic and Contact Aeration System must be sufficiently set up at every station with efficiency and standard according to Standards of Wastewater Drainage System from the Building Type C. Provision of staff knowledgeable of the Wastewater Drainage System must be set to inspect and maintain the system regularly. If found with damage, repairs must be promptly made. Pumping of septic tanks must be regularly made to ensure the efficiency of the drainage system. Signs

must be posted by SRT on “No toilet use during train parking”. Sufficient water supply on the train must be provided throughout the train service.

SRT must improve waste disposal and waste treatment system on the train. SRT must consider obtaining or improving the sewage disposal system for the train toilets according to the sanitation measures.

#### 4.1.5 Air Quality

**Impact from the Project: The Construction Period** From the assessment using the Box Model, it was found that the construction activities that cause disperse of dust particles of 0.0077 mg./cub m. which could increase small dust particles in the atmosphere up to 0.0327-0.0740 mg/cub m. which is still not higher than the safety standard of 0.12 mg/cub m over an average of 24 hours. As the area is mostly agricultural farming or unoccupied, the impact is considered Low. However, the area within and nearby the Project is still prone to dust disperse.

**The Operation Period** When the Train Operation starts, the number of trips of the Diesel Trains will increase and more exhaust pollution will also be increased from the trains and the vehicles going to the train station with more passengers and freight transport. However, as the station is in the open area with good ventilation, the impact on the local community along the train route will be Low. As the Project will provide convenience, speed and punctuality of travel and transport, more passengers will change their travel mode to rail transport and this will reduce road transport. Pollution from car exhaust will be reduced and boost the quality of air. The impact from the Project is considered Low.

**Prevention and Solutions to the Environmental Impact: The Construction Period** Solid fencing of a minimal height of 2 m. must be built around the construction area to prevent disperse of dust from top soil stripping, dismantling of buildings, digging, concrete mixing, etc. into the community or impact-sensitive area. Spraying water is required two times a day on the dust-prone area and piles of construction materials and trucks transporting construction materials must be fully covered with canvas. Truck wheels must be washed daily before leaving the site. Machinery and engine must be regularly checked for efficiency and not emitting toxic pollution above the allowed standard. Road conditions must be in good condition during the construction. Information of the Project and the construction activities, transport routes of construction materials and complaint channel must be provided to the public with responsible officers at the Office on site or the station handling the complaints of any problem from the construction and processing solutions promptly.

**The Operation Period** Cleaning staff must be regularly provided at the Station and the compound to prevent collection of dust and provide facilities at the station. Speed and traffic signs and ample parking must be set up including pick-up /send-off area for passengers not blocking traffic and also a sign “Stop engine running while parking” to ask for cooperation. Maintenance and repair of the locomotive must be regularly inspected to reduce exhaust pollution.

#### 4.1.6 Noise

**Impact from the Project:** The Construction Period On the noise from machinery and equipment, the worst level has been found from the piling process. The sensitive area of 20-100 m. from the construction site includes schools, temples and local community. The highest noise level was found at 84.6-98.6 decibels which is not higher than the standard of 11.5 decibels. The construction of the piling structure for elevated tracks and U Turns road over the train tracks will require at most 15 days. So, the noise impact will be considered Low. To prevent and reduce the impact, the project will build solid wall of at least 2 meters around the site and nearby sensitive areas.

The Operation Period With the Project development, more trains will be passing the area. From the assessment of noise level from the trains according to the Federal Transit Administration, it was found that in 2037, those within 20-300 m. from the train tracks will be exposed to 43,7-65.3 decibels (on an average of 24 hours). When considering the noise level from the Project at present, it was found that in an average of 24 hours, the increase is minimal with 49.4-65.8 decibels which is not above the standard allowed.

**Prevention and Solutions to the Environmental Impact:** The Construction Period The construction activities that create noise such as drilling, digging, piling, etc. must be operated during the daytime only. Solid walls of at least 2 m. must be built to block the site from the community or impact-sensitive area during the construction period. Maintenance and repair of the machinery and engine must be regularly checked for efficiency and not causing noise. In case there will be noise from the construction activities affecting the nearby sensitive area of the construction of the elevated road or U Turns, the contractors must do the following:

- Reducing the noise level by keeping the equipment in good conditions; choosing machinery, equipment and construction methods that cause the least noise such as installing noise reduction equipment with the equipment
- For the machinery making constant noise such as electricity generator, the machinery must be covered or set up in a location furthest from the sensitive area or build temporary wall
- In case of complaints, investigation must be conducted and temporary solid walls of at least 2 m. with noise absorption materials must be built to block the site from the sensitive area . If the site is close to schools, contact and time arrangement with the school should be sought after to avoid causing noise during class hours. Information of the Project and the construction activities, transport routes of construction materials and complaint channel must be provided to the public with responsible officers at the Office on site or the station handling the complaints of any problem from the construction and processing solutions promptly.

The Operation Period Solid walls must be built to allow only the noise level of 10 decibels to reach the areas of Chartrakankosol School, Kittiwit (Ban Phru) School, Songsang wittaya School, Songsang Panitchayakan School, Udomthong Municipal School, Patongwittaya Foundation School.

#### 4.1.7 Vibration

**Impact from the Project:** The Construction Period Vibration during the piling construction (the worst case) could cause damage to the building within 15 km from the construction site. However, the impact will be short term so the impact is expected to be Low.

The Operation Period With the train project development, the number of trains passing the area will be increasing, From the assessment of vibration according to FTA, the level of vibration from the trains will not affect any building or property but will impact the residents within 50 m, from the train line. Songkhla residents feel concerned of the impact of vibration from the train might affect the Viharn at Don Tang Temple. The impact is considered Low.

**Prevention and Solutions to the Environmental Impact:** The Construction Period The construction activities that create vibration such as drilling, digging, piling, etc. must be operated during the daytime only. Reduction of vibration can be made by using low vibration machinery and equipment or installing vibration-reduction equipment as recommended by the manufacturers of each equipment. The construction activities such as piling, ground breaking with large machinery, dismantling building structures, etc. must be operated at least 15 m. away from the nearby buildings and 50 m. from the historical sites. In case work operation is needed within the allowed distance, equipment and building methods with low vibration should be used under close supervision, for example; drilling the piles instead of hammering, etc. If metal sheets are needed to cover road surface, thick metal sheets will be used and laid on the road surface without bump and supported with noise and vibration absorption rubber. Any activity that may cause vibration such as pouring materials, transporting materials, concrete mixing process or any other construction activity must be operated at least 10 m. away from the buildings and 15m. from the historical sites. If the activity causes lower vibration level, it can be operated within the shorter specified distance. If the site is close to schools, contact and time arrangement with the school should be sought after to avoid causing vibration during class hours. If close to the religious sites, vibration-causing activities should stop on religious days. Information of the Project and the construction activities, transport routes of construction materials and complaint channel must be provided to the public particularly those who live near the Project site, road users and train passengers.

The Operation Period Regular inspection and maintenance of the train tracks and road surface at the Station to avoid causing vibration from the train operation and other vehicles and specify weight limit for vehicles using the station compound.

#### 4.1.8 Transportation

**Impact from the Project :** The Construction Period Transport od construction materials into the site will cause more traffic on the road. Construction of the underpass/elevated road over the crossing point of the tracks could create traffic inconvenience and accidents but the local public can still use the route connecting both sides of the tracks. The impact is considered Low.

The Operation Period The Project Development will increase traffic on the connecting roads of the Station particularly at the Station with Container Yard. The impact on the transportation around the area is considered to be Low and besides, it will be positive as the Project will solve crossing points between the roads and the tracks. The Project Development will provide more options in transportation and freight transport resulting on less traffic on the roads. As for traffic condition at the stations and the stops, the Design of the Project has planned a clockwise traffic circulation for effective exit out of the station. Areas for passenger pick-up and send-off will be provided along with parking for public transportation. This will ease traffic congestion at the Station and the surrounding area.

**Prevention and Solutions to the Environmental Impact:** The Construction Period For the construction of the track system, the number of the construction team of the track infrastructure must be sufficient so the work continues smoothly and continuously as planned and will not pose problem to the rail transport.

Co-operation must be made with Local Administration, local Police Station and other related offices to plan effective transportation of construction materials and traffic plan near the Project site and also facilitation in case of accidents.

Traffic system at the construction and the entrance/exit area must be effectively managed with posting of signs and warning lights for safety of the road users and accident prevention. In case of the new positioning of the underpass or overpass coincides with the current one, a nearby temporary detour must be provided and listed in the Contract Appendix. In case closing or blocking of the roadway is needed, a temporary detour and clear “Detour” signs must be set up daytime and nighttime for convenience of travel and safety. The detour and signs must be regularly maintained for effective use. All signs and warning lights must meet the Travel Safety Standards by Office of Policy and Planning of Transportation and Traffic. Information on the construction activities and detours must be provided publicly in advance. Truck drivers must receive proper training and follow traffic regulations strictly. Weight control limit to prevent road damage must be enforced and officers or representatives from the local community must monitor the activities along the project Route. If any truck is found with overweight load, Highway Police or local police must be informed to issue warning and coordinate with the related units to repair the road surface damage.

The Operation Period Traffic around the Station must be effectively managed for traffic flow along with provision of ample parking for station users.

Staff must be assigned to facilitate station users at the entrance/exit area and parking area especially at the large and extra- large stations such as Khlong Ngae Station and Padang Bezar 2 Station, and the station with Container Yard.

#### 4.1.9 Public Utilities and Facilities

**Impact from the Project:** The Construction Period In the construction of the Project, removal of the existing public utilities from the Project site or nearby area may be required such as telephone

lines, water pipelines, etc. Co-ordination with the related offices must be contact for the removal. The impact is considered Low. As for the power supply used in the Project activities, the Project will ask permit from the related PEA office. For the heavy machinery and equipment that needs high power voltage, mobile electricity generators will be used. Therefore, the impact of the power supply use on the community is considered Low. The water supply mostly needed is for use and consumption: 16 cub.m/day at the workers' shed with a maximum of 80 workers and other construction activities, 5 cub.m/day at the Construction Office with 34 staff, and 6.48 cub.m/day at the rest area for the workers. The contractor will apply for water service from PWA and the use of the water supply will not have any impact on the local community.

The Operation Period The use of electricity at the station and the setting of lighting system at the underpass or overpass pedestrian bridge in the community or risk area at night may cause more demand of the electricity. However, the impact is considered Low. The Train Project Development will increase train passengers resulting in more use of water at the station but the PWA is highly capable with sufficient service so there is no impact on the local community from the Project use of the water except at Ban Krud Station which is expected to receive Medium impact. At the station, the Design has provided facilities for the disabled and the elderly with slopes, toilets and parking area with proper signs.

**Prevention and Solutions to the Environmental Impact:** The Construction Period Before the construction begins, coordination with the related offices of Public Utilities and Facilities concerning the removal or installing of the system.

The local community must be informed of the impact from the removal of public utilities at least one week in advance.

Use of sanitation appliances with water saving technology is recommended and the workers are encouraged to save water by installing water tanks for 3 days use at the workers' sheds and the Office.

Regular inspection and maintenance of the water keeping system, pipes and sanitation appliances. If leaking or damage is found prompt repair is needed.

The Operation Period Energy saving campaigns should be set up with the staff at the station in turning off the unused lights and unplugging the electrical appliances not in use, choosing water-saving sanitation appliances. The campaign should be extended to the passengers and the staff at the station to use water economically.

Regular inspection and maintenance of the water collecting system, pipes and appliances. If leaking or damage is found prompt repair is needed. Water Tanks enough for 3 days use should be provided at the Station.

#### 4.1.10 Land Use

**Impact from the Project: The Construction Period** Most construction will be carried out along the current train tracks except the area for curve radius adjustment which needs additional land for the new track. Besides, the construction of the overpass crossing point will need additional land expropriation and change in the use of land into the roadway. The impact is expected to be Low.

**The Operation Period** The Development of the road network connecting with the Train Station may affect the use of land around the old station from local residential community and semi-urban community to higher residential density. Commercial and facilities area will be needed to accommodate and service the public and train users. As for the fenced area along the train tracks, there will not be much use of land so the impact will be Low. However, there will be changes in the use of land along the train route between stations, particularly large stations and tourism-based stations and the station with Container Yard. More residential and commercial use will be found along the road.

**Prevention and Solutions to the Environmental Impact: The Construction Period** Specific construction area must be clearly set and construction activities must be confined only within the set compound to decrease use of land next to the construction area.

**The Operation Period** Local Administration must be informed of the Project Development so planning of the development of land around the station will be effectively set in accordance with Land Use Planning under Department of Civil Works and City Planning. SRT should assign officers to monitor encroachment of SRT property. If any trespassing is found, legal charges must be made according to Code 12 (2) in 6th SRT Act (1992) which authorizes SRT Director or the Assigned to order evacuation or dismantling of the building from the SRT premise within a reasonable time period, of anybody who has illegally built any structure within 40 m. on both sides of the train tracks, inside the SRT property. If the order is not complied with, the Director or the Assigned with the legal rights, can dismantle or demolish such building or structure and that person does not have any right to file claim but in fact, has to be responsible for the dismantling costs.

#### 4.1.11 The Economic and Social Conditions

**Impact from the Project: The Pre- Construction Period** Those affected from the adjustment of the curve radius of the new Train Tracks are concerned with land expropriation, dismantling of the building and crop harvesting. Those who have used the SRT land, with or without the lease, are concerned with the relocation of their property and residence, particularly the low income group who has no other housing or land and with no relatives nearby. The impact on the worry factor will be considered Low and of short term.

**The Construction Period** Disturbances from noise, dust and vibration from the construction which has been expected to be negative were found to be of a medium level and temporary. The impact, expected to be negative, on travel on the construction-related roads especially at the crossing points with the tracks in the densely populated area were found in the low level and

temporary. As there will be a large number of hired labor and mostly from the local community, this will help boost economy and local employment and will yield positive impact in the macro-economics aspect at a medium level and temporary. However, employment of non-local and alien labor may cause social problem. However, the Project will draw Terms and Conditions in the Employment Contract that close supervision of the labor will be administered. Therefore, the impact will be Low and temporary. The workers' spending in the area will have a positive impact on the local retail shops near the Project site. The impact will be Low and temporary.

The Operation Period With the Project Development, there will be a development of Transport Network around the station resulting in expense saving, energy saving from other modes of transport and solving traffic congestion. This benefits the overall quality of life of the people around the Project and nearby area. The impact is expected to be Positive at a Medium level and long term. The Project Development will boost Freight Transport Network between major centers in the South to other regions and provide freight transport option to target groups in other regions. This will help with transport cost saving and yield Positive impact at a Medium level and long term. The Project has solved problems from track crossing points suitable with the location and function for the local residents for travel safety and reducing accidents. The impact is expected to be Positive at a Medium level and long term. The Project Development will give travel and transport more flexibility helping with growth of business, tourism and investment in the area. The impact is expected to be Positive at a Medium level and long term.

The Project Development will affect the use of land and the land cost near the Project Train Route. The land with high potential may change into residential property, business, services and commercial sites particularly around the Station compound. This will benefit the economic development so the impact is expected to be Positive at a Medium level and long term. Fencing and closing of the same level crossing points will make the local commuters change their route. Transport of agricultural produce may lose transport time and cost more from increased fuel as it has to go through the designed underpass tunnel of 2.5 m. height. The impact is expected to be Negative and at a Low level.

**Prevention and Solutions to the Environmental Impact:** The Construction Period Continuous Press release of the Project through various media to the concerned public, information on the construction plan and transport routes of the construction materials, environmental measures so they will be informed of the facts which will help reduce their worry and concern. Local Administration and related local offices must be informed of the construction plan and activities particularly the transport routes of the construction materials so they may help in the PR work. In case of the new positioning of the underpass or overpass coincides with the current one, a nearby temporary detour must be provided and listed in the Contract Appendix. In the Employment Contract, local labor should be hired at a reasonable proportion and if local labor is qualified for the job, total hiring should be made from the local labor. Hiring of alien labor should be screened and legally checked for their records.



Rules must be set for labor control at their accommodation and punishment be made if violations occur. Staff responsible for handling complaints on problems for impact from the construction of the Project must be assigned and stationed at the Office or at the nearby Train station. Prompt action must be made to solve the problems. Different channel may be provided to the community to voice their complaints; for example, names and telephone number of the responsible people for direct contact, complaint box can be set in front of the construction site or other important places such as the Local Administrative Office, local government offices or shopping center, etc. Website or Hot Line can be set up to receive complaints and to report them to the public.

Committee should be set up comprising of representatives from various sectors such as the public, the Press, Independent Organization, etc. to monitor the actions according to the measures. Strict and clear punishment must be enforced if measures are not met. Monitoring of complaints must be regularly checked to identify problem or damage that needs prompt action in handling the problem.

The Operation Period Complaint Boxes should be set up at the Information Counter at the station to receive problems and suggestions for further action or improvement.

Committee must be set up comprising of various sectors such as representative from SRT, Office of Policy and Planning on Traffic and Transport, Office of Policy and Planning on Natural resources and Environment, Department of Pollution Control, NGO on the environment, Private development Organization and several Honorary members, etc. including representatives from the Public Sector and the Press. The Committee will monitor and inspect any activity abided by the Measures and will enforce punishment if violation is found. They will also monitor complaints and if damage is detected, prompt action must be followed.

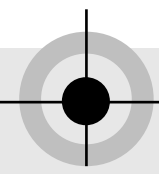
#### 4.1.12 Relocation and Property Compensations

**Impact from the Project:** The Pre-Construction Period The new Route may need property expropriation (land, building structures, crop), however, in specifying the Project Route and structure of the underpasses and overpasses at the track crossing points, the Project has fully avoided expropriation. As a result, a small number of expropriation will occur and reasonable compensations will be legally made resulting in Low impact. Dismantling of the building structure or removal of the crop on the SRT property has already been made so the impact is considered Low.

**Prevention and Solutions to the Environmental Impact:** The Pre-Construction Period

##### - Expropriation Measures

The expropriation process has been conducted under the Property Expropriation Act 1987 and compensations are justly made according to the legal requirements fair to the concerned party.



Information must be publicly dispersed to those concerned of expropriation steps and their legal rights.

Provision of information, complaints or appeals and time period of compensation payment must be made to the concerned party including the case when compensations cannot be made within the time limit.

Notification of the time for evacuation must be sent to the evacuees at least one year in advance so they can find new residential location. Notifications must be periodically and clearly made to the residents in the area.

#### - Relocation and Dismantling of Building Structures on the Premise

The renters of the SRT property must be informed of the Planning, expropriation steps and dismantling of the building structures including scheduled evacuation time at least 6 months in advance.

Considerations should be made on the previous renters if new rent will be offered along with new renters to prevent monopoly.

Prevention and Solution Measures to the Impact from Relocation and Compensations.

#### The Area under the Operation:

- The Train route where the curve radius needs to be made out of the Train boundary
- The area where an overpass will be built over the tracks to solve the same level crossing points
- The area along the Project Train Route belonging to SRT property

#### The Operation Steps:

1) For the land and building structures subjected to expropriation as a result of the new route adjustment and construction of an overpass over the train tracks crossing points, compensations must be fully made according to Property Expropriation Act 1987, Property Management for Mass Transportation Act 1997 and Guidelines on Property Expropriation, Ministry of Transportation. The main coverage includes: land compensations, building/structures compensations, and compensations on trees.

For buildings/structures, the co-ordination steps in the relocation are:

- (1) Survey of the number of buildings to be relocated
- (2) Survey of the needs and assistance the property occupants may seek
- (3) Survey of the types of the building structures whether they are for residential or commercial use
- (4) In case the property occupants may require compensations from expropriation, compensation payment must be fully made according to Property Expropriation Act 1987, Property

Management for Mass Transportation Act 1997 and Guidelines on Property Expropriation, Ministry of Transportation. In case the property occupant is a government office, negotiations may be made with the land owner to continue using the land and paying a substantial amount of compensations. SRT, as the Project owner, will make negotiations with the land owner while compensations of the building structure will be made with reference to Property Expropriation Guidelines on Compensations but the starting amount of compensations will not be required to be officially set by the Committee.

2) Inspection must be made if the building structures located on the SRT property have lease agreements. If there is a lease, SRT must make compensations according to Code 18 (5), Property Expropriation Act 1987 but if there is no lease, dismantling of the building structures will be made and the property occupants will not be legally compensated. However, for humanity consideration, SRT may propose to SRT Committee asking for some relocation financial support and act in accordance with Property Expropriation Guidelines, Ministry of Transportation.

#### 4.1.13 Separation

**Impact from the Project:** The Construction Period During the construction, the local residents can still commute between the two sides of the train tracks and continue their business by using the road parallel to the tracks and the current same-level crossing points. The impact will be considered Low.

The Operation Period The Project will close all existing track crossing points and put up fencing along the train route for safety of the train operation by providing new underpasses or overpasses near the previous locations so the local residents can continue their commuting and business as usual but with some inconvenience. The impact will be Low.

**Prevention and Solutions to the Environmental Impact:** The Construction Period Piling and storing of equipment and materials must not block public traffic particularly at the construction site of the present track crossing points.

Signs and signaling lights of the construction site and the construction at the track crossing points must be clearly set up daytime and nighttime.ตัว

In case of the new positioning of the underpass or overpass coincides with the current crossing points, a nearby temporary detour must be provided and added in the Contract Appendix.

The Operation Period Overpass pedestrian bridge must be provided at a suitable location. At the station and highly populated community area along the Train Route, overpass bridges and slope must be provided for pedestrians and motorcyclists with lightings and CCTV (if necessary) for safety. Information of the track crossing roadways must be publicized to the public for travel convenience between the two sides of the train tracks.

#### 4.1.14 Public Health/ Sanitation and Safety

##### **Impact from the Project: The Construction Period**

Impact on the local residents near the Project area

Dust from the construction may affect respiratory system while noise and vibration may cause upsetting disturbance and stress. The local residents may be infected with the disease from the workers who come into the area such as diarrhea or disease associated with alien workers. This could affect public health services of the local health units. The impact is considered to be Low.

Impact on the construction workers

The impact could be from sanitation and safety: hazard from unsafe work operation and work conditions such as loud noise at the work site and heat could cause certain diseases. The impact could be from food safety, environmental care at the work site. However, measures have been planned so the impact is expected to be Low.

##### **The Operation Period**

Impact on the local residents near the Project area

Impact can be from noise and vibration from the high speed trains and the increased running frequency. The Project also cause increasing traffic on the road network with the station particularly the stations with Container Yard. The impact is expected to be Low.

Impact on the train staff

The Project has planned for the improvement and development of the train operation, public utilities, facilities, safety system and other related systems at the train station so, the train staff and the station staff should not be affected.

##### **Prevention and Solutions to the Environmental Impact : The Construction Period**

Safety measures at the work site

The employee must strictly follow Preventions and Solutions Measures of Quality of Air, Noise and Vibration during the construction period.

The employee must act in accordance with related Law of Sanitation Health and Safety such as Announcement of Welfare and Labor Protection, Ministerial regulations under Safety, sanitation and Work Environment Act 2011, and Labor Protection Act 1998:

- Ministerial Code on Standards of Management of Safety, Sanitation Health and Workplace Environment related to Construction Operation 2008

- Ministerial Code Standards of Management of Safety, Sanitation Health and Workplace Environment related to Working with Machinery, Cranes and Boilers 2009
- Ministerial Code Standards of Management of Safety, Sanitation Health and Workplace Environment related to Electrical Operation 2011
- Ministerial Code Standards of Management of Safety, Sanitation Health and Workplace Environment related to Workplace 2006
- Ministerial Code Standards of Management of Safety, Sanitation Health and Workplace Environment related to Working with Heat, Lights and Noise 2006
- Announcement of Welfare and Labor Protection Department on Standards of Personal Protective Equipment 2011
- Announcement of Welfare and Labor Protection Department on Hazards Warning Signs, Safety Signs. Sanitation Health and Workplace Environment and Clauses listing Rights and Responsibilities of Employers and Employees 2011
- Announcement of Welfare and Labor Protection Department on Criteria on Safety Plan for the Construction Workers 2009

The contractor must provide sanitation health at the construction site, the workers' lodge and the Office in the followings:

- Providing clean drinking water and water for use sufficient for the staff and workers (average of 5 liters/person/day for drinking water, 200 liters/person/day for usable water for the workers at their sheds, 5 liters/person/day for the workers during day break at the Office rest area, and 70 liters/person/day for the staff at the Office)
- Water storing tanks for at least 3 days of use incase of water shortage
- Sanitary toilets (not flushing toilets) enough for the staff and construction workers (20 person: 1 toilet) to prevent spreading disease
- Sufficient garbage collectibles of good conditions with lids and regular garbage disposal to prevent breeding of insects and other carriers
- Effective wastewater management to prevent breeding of disease carriers.

The contractors must build shelters for the construction workers and the Construction Supervision Office according to the Standards and Plan of Temporary Shelter for Construction Workers, Thailand Association of Engineering (TAE Standard 1010-34).

The contractors must provide a covered rest area during the day break for the workers at the Office por near the construction site and if located at the construction site, mobile toilet units must be provided at least 8 toilets/location.

The contractors must check the condition of the fire extinguishers to be ready for us and if damaged or not working, repair or replacement must be done promptly,

The contractors must post use instruction of use of the fire extinguishers where the equipment is placed

The contractors must organize training for the construction workers on the use and maintenance of machinery and equipment. Responsible officers must be assigned to monitor and inspect the machinery and equipment for work efficiency. If damage is found, repair must be immediately made to prevent accident.

The contractors must provide personal hazard protective equipment and require the workers to wear it at all time on their job.

#### Safety Measures for road users and nearby community

The contractors must strictly follow Preventions and Solutions Measures of Quality of Air, Noise and Vibration during the construction.

The contractors must ensure that the drivers strictly follow traffic regulations and speed limit of not higher than 30 km/hr is enforced when passing the residential community.

The contractors must provide traffic facilitation officers around the highly populated community, schools or any accident-risk area.

The contractors must post clear signs indicating the construction site and inform the road users in advance if road closing is necessary and prepare detour route to prevent accident.

#### Safety Measures for The Station Users

For the construction of a new train station if it is not located where the existing one is, the Project will complete the construction of the new station before canceling the use of the old one and finding new activities for it. In some case, the old station may be relocated to a new location with new activities. If the new station is built where the old one is, the Project will have to build a temporary station building nearby before the dismantling of the old one takes place and then the new station can then be built.

Fencing around the construction site must be built with clear sign of “Construction Site: No Trespassing”

At the hazardous area at the construction site, signs must be posted: “Hazardous Construction Area” along with red signal lights clearly seen at nighttime and any one entering the site must wear protective helmet.

No entry to the construction site or hazardous area is allowed to people with no business or duty concerned.

The Operation Period Prevention and Solution Measures of Quality of Air, Noise, Vibration and Transportation must be strictly observed. Training related with safety operations must be organized for responsible officers and the staff must strictly follow Safety Measures.

#### 4.1.15 Safety of the Society

**Impact from the Project: Construction Period** Hiring of alien workers may cause risk to safety of the community as the alien workers may cause disturbances to the local residents. As the Project will break the construction into 2 sections (in the Contract), each of which will be found with two workers’ shelters and a maximum of 80 workers at each shelter. This number is still manageable for orderliness. The contractors are required to hire local labor of a reasonable number. Rules and regulations must be set for the workers at their shelter. The impact is expected to be Low.

The Operation Period With the Project Development, more people will be traveling into the area and safety of the society may be reduced. However, local offices responsible for safety in the area and local Police stations have been informed of the Project Development, so the impact is expected to be Low.

**Prevention and Solutions to the Environmental Impact: The Construction Period** Prevention and Solution Measures of the Economic and Social Impact must be strictly followed.

The Operation Period Safety surveillance at the Train Station must be provided for the train users to ease concern of their safety and security. Efficient CCTV system must be set up at the station and if found damaged, repair must be promptly made.

Complaints/Suggestion Box should be set at the Information counter at the Station for further action and improvement.

Local Police units must be informed of the Project development so action plans and preparation will be made to handle changes or problems.

Coordination with Local Administration Unit is needed to install lights at the underpass or overpass with a large number of people, the residential area and risk areas for crime.

Request for cooperation from local Police unit should be made for patrol unit around the station and underpass in the risk areas for crime.

#### 4.1.16 Sanitation

##### Impact from the Project: The Construction Period

###### Garbage Management

Garbage from the construction activities will be sorted and some will be saved for reuse or sold. Garbage that cannot be reused will be stored to be removed for disposal. Garbage and waste from the workers' shelter amounts to about 68 kg./day/location and garbage from the staff and workers at the Office amounts to 46.5 kg.day/location. All garbage will be collected in receptacle containers to be taken out by local responsible unit with no garbage remaining on site or let out outside the Project site. The impact is considered to be Low.

###### Wastewater Management

Wastewater from the workers' shelter amounts to 12,8 cub.m/day /location and wastewater from the Office is 2.6 cub.m/day/location. This will be treated in a prefab wastewater treatment tank big enough for the amount of wastewater. The impact is considered Low.

The Operation Period With the Project development, more people is expected to use the train station resulting in increasing garbage and wastewater.



## Garbage Management

If not properly managed, garbage from the construction site may spill out and contaminate the environment or turn into breeding ground for disease carriers. There is no unit responsible for garbage collection at Thung Lung Station and Padang Bezar 2 Station. Some local Administrative Unit may not have the capacity to do so. The impact is expected to be Medium.

## Wastewater Treatment

Wastewater from toilets at the station may affect sanitation at a low level as the Project will provide ready-made wastewater treatment vacuum tank for wastewater treatment before discharge or reuse, from toilets at the station according to Standards of Wastewater Treatment in the Building Type C.

**Prevention and Solutions to the Environmental Impact:** The Construction Period Strict observation of Prevention and Solution Measures on Quality of Surface Hydrological Conditions and Aquatic Ecosystem and Public Health/Sanitation Health.ⓐ

The contractors must require the construction workers to sort garbage by keeping some for reuse and collect garbage that cannot be reused for further disposal.

The contractors must provide garbage receptacles with lids at various points at the construction site, the workers' shelter and the Office and maintain the conditions for efficiency.

Sanitary garbage collecting area must be provided at the workers' shelter and the Office with sufficient space for 3 days of garbage and located where garbage collecting vehicles can have easy access.

Coordination with local units must be made on regular garbage collecting and disposal and the contractors must store collected garbage at a location with easy access for garbage trucks.

Regular care and maintenance must be made on the sanitation of toilets. Septic tanks when full must be emptied by requesting responsible local units to undertake the task promptly. Wastewater treatment from the Office and the workers' shelter must be properly done before discharge to the outside.

The Operation Period Publicize and promote among the business operators/sellers the use of natural materials and not using foam or plastic food containers, both on the train and at the station to reduce non-biodegradable garbage.

Provide sufficient garbage receptacles at the station and on the train and inform the passengers to dispose garbage at the prepared location. Garbage collectibles for sorted types of garbage should be used at the station in the early stage of the Project Operation.

Regular garbage collecting from the stations and the trains must be done.

Provision of garbage collecting area at each station with sanitation standards and sufficient space for 3 days of garbage with easy access to garbage trucks.

Coordination with local garbage disposal unit to collect and dispose garbage from the station on a daily basis before transferring to setting pond and discharge to the public draining channel.

SRT must post a sign “No toilet use during train parking”

SRT should provide sufficient water for use in the toilets on the train throughout the trip.

#### 4.1.17 Aesthetics and Tourism

##### **Impact of the Project:** The Construction Period

##### Impact on Scenery

The construction site may not look orderly or clean especially from the high perspective but the impact will be temporary during the construction and can be managed. The impact is considered Low.

##### Impact on Tourism

The construction of the train and the track crossing points will affect tourism. Traffic route o tourist destinations may be blocked and the unpleasant view of the construction site and nearby may ruin the aesthetic beauty of the tourist places. However, the impact will be temporary and considered Low.

##### Operation Period

##### Impact on Scenery

The new subgrade will be on the same level with the old one with clear fences along both sides of the train tracks not to block the scenery and view. The station building has been designed to preserve the original architectural design with improved attractive landscape. However, the Project Development will change the use of land with development potentials for tourism and service. The impact could be negative toward th scenery if not properly managed. In sum, the impact will be Low.

##### **Impact on Tourism**

The Project Operation will yield positive impact of a Medium level on tourism as transportation will be faster and give incentives to tourists in traveling to the tourist destinations.

**Prevention and Solutions to the Environmental Impact:** The Construction Period As written in the Contract, the contractors must follow Prevention and Solution Measures of the Environmental Impact such as cleanliness, orderliness at the construction site, spraying water to suppress dust disperse, piling of construction materials not blocking traffic, garbage management, construction of detours to reach tourist destinations, etc.

## 4.2 Impact on Politics and the National Security

The Double Tracks Electric Train Project promotes development factors of the manufacturing sector and boosts competitiveness and economic strength in the manufacturing sector to be ready for changes and external threats which can affect the national security. As found In the 11th National Economic and Social Development Plan (2012-2016), Guidelines on Infrastructure Development have been set. In the past, the State has played a leading role in the development of Infrastructure to boost the competitiveness of the country. The Development has been focused on the infrastructure of land, water and air transportation with a ratio of 78.0% of domestic passenger road transport, 21.0% rail transport and 3.0% air transport. As for freight transport, 82.0% has been via road transport, 15.0% via water transport and 3.0 via rail transport. Although the infrastructure development has been successful in terms of quantity in the past, improvement of quality and more participation from other sectors must be made. Moreover, limitations and regulations of Ministry of Finance are still not conforming or suitable with the present situation resulting in slow Infrastructure development and pose as obstacle to the national economic growth in the long run. At present, the need for use of energy in Thailand has been increasing and depending on large import of energy from overseas.

- Boosting Multi-Modal Transportation development by changing to other transport modes with low transport cost and effective use of energy; development of infrastructure and multi-modal transportation management linking with road, rail, water and air transportation domestically and internationally to boost efficiency and standards of freight transport in terms of time, safety and punctuality; promotion of economic development under the regional framework and development of efficient freight management to lower logistics cost of the country.
- Improvement of logistics management by producing professional logistics personnel, developing freight transport network and logistics to cover the demand chain and revising related law and regulations; development of logistics innovations and facilitation of trading and freight transport across the border such as development of national Single Window, Cargo Distribution Center and border trading checking points, etc.; improvement of the efficiency of transport management and the roles and functions of Airport Authority of Thailand and major seaports to reduce freight transport cost and to boost Thailand long term competitiveness.
- Development of Rail Transport by improving the train tracks and crossing points between the tracks and the roads for safety and service; improvement of signaling system to increase the capacity of passenger and freight transport service; improvement of the train route.
- Promoting the private sector's participation in the investment of Infrastructure Development and Basic Services by improving related law and regulations, procedures and forms of joint investment in the infrastructure and public service projects such as education and public

health, etc. with appropriate forms to each enterprise; commitment to transparency of the operation; clear distribution of risk between the State and private sector

To reach the objectives and goals of networking with the neighboring countries in the region and for the National security of economics and society as set in the 5 years Plan in the 11th National Development Plan, the best benefit should be reaped from the AEC merge in 2015 which will move forward with the Master Plan on ASEAN Networking and the sub-region co-operation. This will provide dynamics to all related aspects resulting in the expansion of trading and investment, within the sub-region, between the sub-region and ASEAN, and the networking Potentials with other nearby sub-regions and extended to other regions such as Asia-Pacific region. The operation guidelines on Economic and Social Networking Development with the sub-region, the region and Asia-Pacific are:

- 1) Networking with the countries in the region for the National economic and social security by setting up transport and logistics network under the Sub-Region Cooperation Framework particularly the Economic Development Plan of the Greater Mekhong Sub-Region (GMS) , Strategies on Economic Cooperation of Irawaddi-Chao Phraya-Mekhong (ACMES), Trilateral Economic Development Plan between Indonesia, Malaysia and Thailand (IMT-GT). Potentials to networking with other countries out of ASEAN such as South Asia as in Cooperation Framework of Bengal on Academics and Economics (BIMSTEC). Thailand-Malaysia on Joint Development Strategy for Border Areas (JDS). These will provide facilitations convenience and lower logistics cost by:
  - 1.1) Developing transport and logistics service up to the International Standard especially the transport by road, rail, double tracks train, high speed train and water/coastal transport; developing customs border check points, Border Trading Center and efficient process which will help increase energy; developing transport and logistics business network and the supply chain in the region to share resources and knowledge to lower business cost and to increase transport network efficiency and convenience in travel and transport across borders; effective integration of strategies and basic infrastructure along the economic zone in the country and those in the sub-region and between the sub-regions in ASEAN according to the ASEAN Transport and Logistics Development Master Plan; investment initiated by the State in strategic development projects in the economic zone and promoting joint investment between the State and private sector.
  - 1.2) Training staff and personnel in transport and logistics business to boost the potentials of Thai private sector in foreign language skills and logistics management to help the business operators to be able to run their transport and logistics business and the supply chain both domestically and internationally; developing the business potentials of the medium and small business owners to connect with the neighboring countries, to benefit from export business along the economic zone and to develop their business into international level; as development partners, providing academic cooperation to the neighboring countries in development projects for their personnel and staff in transport and logistics business.

- 1.3) Linking the economic development along the border and the economic zone; linking the manufacturing sector in Thailand with the transport network to efficiently connect the supply chain with the export Gateway; building economic network with the large economic development area in the neighboring countries with the economic zone in Thailand through the main Coordinating Centers between Thailand and the neighboring countries along the border.
- 1.4) The development of the investment base by boosting competitiveness among the sub-regions and the ASEAN region should focus on cooperation among the countries in setting up manufacturing base along the potential economic development zone as planned in the Development Strategies; linking and developing the areas in the regions in Thailand with the neighboring countries and ASEAN as a manufacturing base of agricultural industry and processed produce, and as tourist destinations with awareness of the Superpower nations' foreign investment policy in this region; focusing on the GMS and IMT-GT development zones with high potentials in diverse networking channels and options; discussions between related government offices and private sector in setting the national investment plan and discussions with the State and private sector in the neighboring countries within the State/Private Cooperation Framework with consideration of the economic and social impact of every country ; setting mutual prevention and solution measures and fair benefit to all countries while keeping their cultural identity for future competition; Sufficient Economy Policy must be adhered to with development of local agricultural produce for its quality and acceptance into the regional market; developing the border economic zones, both old and new, into the economic Gateway linking with the neighboring countries; developing transportation and logistics system with standards of service and convenience at border crossing points; developing business ability potentials of the personnel and local business operators to support trading, investment and tourism with concern of overall impact from migrant workers, drug trafficking across the borders; sensitivity to the potentials in physical, economic, social and cultural aspects of the location; integration of management and development of labor among the countries under the Cooperation Framework of the Sub-Regions and conformity to the Infrastructure Development Plan between the neighboring countries according to the ASEAN Master Plan and Strategies.

**Conclusion** From the Study of Impact from the Hat Yai- Padang Bezar Double Tracks Electric Train Project, it was found that the Project Operation will promote economic growth and stability, increase competitive potentials of the country economic strength and prepare for changes and external threats. Moreover, the Project will support the National Policy on Infrastructure Development for improved quality of life and competitive edge of the country and also support the policy on energy conservation. So, this Project will yield Positive impact to the country politics and security.

## 4.3 Long Term Impact on the Project Operation of the Project Operator

### 4.3.1 Financial Status

To conduct the Study of Long Term Impact on the Project Operation of the Project Operator, the Consultants will collect previous financial data from SRT and analyse the financial status of SRT whether there will be any problems or obstacles in the Project operation. Moreover, the Study will look into SRT's policy and measures towards solving problems. Studies of operation plans, solution measures of the financial problem will be conducted along with the study of financial impact of the Project.

#### 1) The Results of SRT Operation

The Results of SRT operation from the 2010 Accounting Period to 2013 Accounting Period are shown in **Table 4.3-1** below:

Table 4.3-1 The Results of the Operation and the Financial Status

Unit: million baht

| Details                            | 2010              | 2011              | 2012              | 2013              |
|------------------------------------|-------------------|-------------------|-------------------|-------------------|
| <b>1. Operation Results Report</b> |                   |                   |                   |                   |
| <b>Revenue</b>                     | <b>13,318.07</b>  | <b>13,412.34</b>  | <b>13,753.18</b>  | <b>15,871.86</b>  |
| Revenue from the Operation         | 8,944.72          | 9,223.41          | 8,701.04          | 9,937.67          |
| Support from the State Budget      | 3,742.28          | 3,726.82          | 4,596.84          | 5,474.19          |
| Other revenues                     | 631.07            | 462.11            | 455.3             | 460               |
| <b>Expenses</b>                    | <b>21,176.29</b>  | <b>22,506.79</b>  | <b>25,226.37</b>  | <b>27,057.22</b>  |
| Operation costs                    | 11,974.98         | 12,998.84         | 14,094.49         | 14,872.10         |
| Depreciation costs                 | 2,017.33          | 1,991.99          | 1,992.02          | 2,178.82          |
| Loan interests                     | 2,201.83          | 2,345.74          | 2,697.31          | 2,889.04          |
| Others                             | 4,982.15          | 5,170.22          | 6,442.55          | 7,117.26          |
| <b>Net Profit (Loss)</b>           | <b>-7,858.22</b>  | <b>-9,094.45</b>  | <b>-11,473.19</b> | <b>-11,185.36</b> |
| <b>2. Financial Status Report</b>  |                   |                   |                   |                   |
| <b>Total Assets</b>                | <b>124,890.04</b> | <b>134,393.06</b> | <b>133,158.18</b> | <b>173,733.80</b> |
| Current Assets                     | 7,305.53          | 9,724.21          | 6,732.71          | 7,840.54          |
| Land, Buildings, Equipment         | 82,915.84         | 88,395.62         | 90,159.29         | 129,627.07        |
| Others                             | 34,668.67         | 36,273.23         | 36,266.18         | 36,266.19         |
| <b>Total Liabilities</b>           | <b>85,838.88</b>  | <b>88,916.42</b>  | <b>89,676.21</b>  | <b>106,373.22</b> |
| Current Liabilities                | 11,590.01         | 13,546.33         | 7,601.48          | 5,687.31          |
| Long-Term Loan                     | 49,835.97         | 49,753.91         | 58,077.28         | 76,678.46         |
| Others                             | 24,412.90         | 25,616.18         | 23,997.45         | 24,007.45         |
| <b>Shareholders</b>                | <b>39,051.16</b>  | <b>45,476.64</b>  | <b>43,481.97</b>  | <b>67,360.58</b>  |

Source: The National Budget Bureau, Office of the Prime Minister

From the Results of SRT Operations and the fund support from the State budget as shown above, it could be seen that SRT has been facing a continuous loss from SRT financial responsibilities in the costs of development and maintenance of the train network across the country, which requires a substantial amount of budget. At the same time, as SRT is socially committed to serving train passengers, financial losses have been constant over the past years. Although the State may have to legally compensate and support for the losses, the reimbursement takes a long time resulting in cash flow shortage. SRT has been taking out investment loans for the Infrastructure Development and cash flow solution. As the accumulated debts and continuous loss have aggravated the financial situations, SRT has to develop a long term solution plan to handle financial problems. This will be discussed later in this report.

#### 4.3.2 The Business Plan of Passenger and Freight Transport Service

According to the Business Plan of SRT 2013-2016 on Passenger and Freight Transport and Services, the goals are:

1. Increasing revenue from freight transport as follow:
 

|                                      |            |
|--------------------------------------|------------|
| Commercial passenger service         | 5.35%/year |
| Socially-committed passenger service | 4.65%/year |
| All types of freight transport       | 4.75%/year |
2. Better service (Users' satisfaction, speed of travel and transport, punctuality, accidents)

From the advantage of lower cost of fuel than other transport modes and fixed routes, SRT has used these strengths as

incentives to increase passengers and freight transport to meet the set Revenue goal. This could be a new direction in increasing the revenue. The Business Plan in Passengers and Freight Transport and Service has become very significant in restoring the financial status of SRT in the next 5 years.

At the same time, although increasing revenue is a significant target, in order to reach that target, SRT has to consider variables and factors in increasing number of passengers which are: safety, punctuality and customers; satisfaction. Efficient and prompt strategies to restore confidence from customers must be planned.

The 3 main objectives in following the Business Plan are:

1. To increase service efficiency to serve more travel and transportation in the future
2. To increase revenue from train service
3. To provide linkage of passengers and freight transport

**Objective 1: To improve service efficiency and safety to serve future increase of transportation** The strategies are:

- Strategy on increasing punctuality and safety of passenger trains and freight trains according to types of service
- Strategy on increasing efficiency in service and safety to serve future increase of transportation

**Objective 2: To increase revenue from train service**

- To improve and increase train fleet to serve various types of transport: commercial passenger transport, freight trains
- To keep current group of customers
- To open new market
- To adjust an increase of fare and fees in relation to higher cost



- More customer relations work
- Concrete marketing development to identify service needs
- To support and increase cargo transfer (ICD, CY)

**Objective 3: To provide transit linkage and network for passengers and freight domestically and with the neighboring Countries**

- Efficient linkage and networking of passenger and freight transport domestically and with the neighboring countries

At present, as SRT has planned transit linkage with the neighboring countries particularly for freight transport, Marketing plan must be mutually laid out among our allies. Besides, there are also Plan in Facilities Development towards Multi-Modal Transportation at the train stations and freight transfer. To reach the set goals in the next 5 years, the Business Department must have an effective marketing plan to serve future service. Under these strategies, the service work is at the end of the line while the development of the tracks and the locomotives and the infrastructure are crucially at the starting point of the strategies. The plan must consider the efficiency of the maintenance and repair personnel along with sufficient number of trains and tracks to accommodate future transport service. At the same time, in the next 5 years when future construction and improvement of the new tracks will take place, to follow the set Strategies, assessment of the target customers and adjustment of the marketing plan must be considered. The main aspects for considerations are:

1. Short-Term Planning: To gain revenues of train service from current and old customers, incentives must be planned to keep those customers and freight transport with better quality and service before the new locomotives will be operated.
2. Mid-term Planning: SRT must be able to cut loss of market share and retain the customer base by improving service quality and train operation to meet the customers' needs of train scheduling and cancelling overlapping train routes.
3. Long-Term Planning: After the Double Tracks Train Project and the renovation of Bang Sue Station are completed, the train operation will be more punctual and the service quality will be much improved. Particularly with the new station conveniently linking with public transportation, this will be SRT strength in its competition with other transport modes.

The indicators for Planning/Project achievement of the three Objectives can be classified into 4 indicators as follow:

1. Punctuality classified by types of service
2. Revenue growth rate
3. Volume of passengers and freight transport classified by types
4. Ability to complete Transit Point Construction Planning as planned

From the Study of Business Plan of Passenger and Freight Train Service, Objectives, Strategies and Indicators, it can be seen that the Double Tracks Train Development Project has Positive impact on the financial status of SRT because the Project Development will support the Objective in increasing the efficiency of service to serve future increase of transportation. This will result in the increase of revenue from train service and convenient linkage of travel and transport will also bring more revenue to SRT in the future.

### 4.3.3 Long-Term Impact on Management of the Organization and Personnel of SRT

(Source: The Business Plan, SRT 2013-2016)

#### 4.3.3.1 Long-Term Planning of SRT Management and Development

Increasing capability and efficiency of the organization is one significant objective to be committed to as the working environment is always dynamic and continuously changing such as the competition in the industry, behavior of the consumers, the State policy, expectations from the public or outside units or organization. The organization will therefore have to step up with their adaptation to the situation and be alert and ready to seize an opportunity or any benefit from the situation, and even take up any challenge from internal or external factor.

To achieve the above, SRT must immediately improve their capability in development and management, both quantitatively and qualitatively, using the following aspects as direction indicators:

- 1) Overall production of the Organization has been at a low level continuously and over a long period of time
- 2) Several rules, regulations and operation process have not been beneficial to the Organization
- 3) Problems and obstacles in integration of work from several departments
- 4) Ability to apply new technology in management to increase productivity of the Organization
- 5) Restructuring of the Organization according to the State Policy and re-engineering the management suitable to the new structure
- 6) Building up confidence to stakeholders
- 7) Management of Organizational Behavior to meet the short-term and long-term changes

The main goals of the Organization are crucial in determining the strategies and action plan and they must be related to and synchronized with the internal and external environment to move the Organization forward to the right direction.

1) The Organization must have flexibility to adapt and change toward business competition.

The strategies are:

1.1 Develop the management system and work process up to international standard focusing on continuously improving operation.

1.2 Create unity, flexibility and integration of work for success of the 176,808 m. baht Project

2) Promote new technology of management suitable with the needs of the Organization to reduce redundancy and to increase overall efficiency of work and management system. The strategies are:

2.1 Strategies on Information Technology and Telecommunications Development of SRT

3) Support the Organization in setting up business units with suitable management system so the units can integrate work and build unity among themselves to move forward toward the same direction as set in the Strategies.

3.1 Promotion of the development of the management system and operation process that support the concept of business units consistent with the mission of the Organization

4) Build up the Organization image of transparency, accountability and confidence for stakeholders with the following strategies:

4.1 Build up Good Governance of the Organization

4.2 Promote progressive PR to improve the image and understanding of the Organization to target groups, offices or the public

4.3 Develop the integrated risk management system for the Organization

5) Ability to receive and understand the role of participation and acceptance of the personnel at all levels of the Organization so they can be the dynamic force to move the Organization toward the goals by:

5.1 Build up leadership and promote development of organizational behavior

#### 4.3.3.2 Management and Development Plan of SRT Personnel

From SRT Business Plan, it was found that at present SRT is facing with employee shortage and SRT must set guidelines in solving this problem, short-term and long-term solutions, to increase efficiency of their operation as listed as the main objective. As a result of the work environment which is changing continuously in competition in the industry, behavior of the customers, the State Policy and expectations from the outsiders, public or organizations, personnel who are the key factor of success of the Organization must be able to adapt themselves with the changing situation and be alert for any opportunity or benefit, and be able to take up new challenges from internal or external factors. To be able to achieve the above, SRT must immediately improve their capability in development and management, both quantitatively and qualitatively, using the following aspects as direction indicators:

- 1) Overall production of the Organization has been at a low level continuously and over a long period of time
- 2) The Organization is facing personnel shortage now and in the near future, both quantitatively and qualitatively.
- 3) The main reason for the problem above is in the next 5 years, there will be a number of retirees who are of high caliber in both knowledge and capacity of great benefit to the Organization. Besides, according to the Cabinet's decision as of 28th July 1998, the Organization cannot hire sufficient number of staff for its needs causing great impact to all sections of the Organization
- 4) Increasing the capacity in the management and development of personnel in all aspects to meet the restructuring of the business Unit and to increase their capacity for competition
- 5) The ability to apply new technology in work management to increase productivity of personnel development and management

The main objectives are crucial in determining Strategies and Action Plan so they must be related and synchronized with the internal and external environment of the personnel management and development so the Organization can move forward in the right direction. They are:

1) Increasing the capacity of the Personnel Management Department so they become Strategic Partners of the Organization with the following Strategies:

1.1 Promoting change of the image and repositioning of the unit focusing on strategic operation

2) Increasing or extending new and efficient technology to personnel development and management with the following strategies:

2.1 Creating or promoting the use of Information Technological system to increase the efficiency of personnel development and management

3) To be able to place qualified personnel suitable with the need of each business unit considering both quantity and quality aspect, the strategy is:

3.1 Planning of the personnel placement with precision, balance and suitability

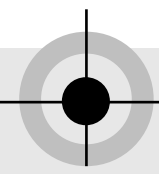
4) To develop personnel to be the sustainable force for the Organization and to encourage the personnel to seek knowledge and continuously develop their organization, the strategies are:

4.1 Promote the ability of each personnel in relevance to the Organization's needs

4.2 Promote Knowledge Management

5) To create incentives and keep quality personnel, the strategy is:

5.1 Support management of the operation achievement with remunerations, promotion and other incentives based on ability and work achievement.



#### 4.3.3.3 Impact on Management of the Organization and Personnel

From the study of the Structure of the Organization and Personnel of SRT as discussed above, it was found that although SRT is having personnel shortage problem, SRT has already laid out solutions plan, both short-term and long-term, and included them in the planning guidelines of all projects in terms of management development, restructuring of the Organization and personnel development.

The Double Tracks Train Project, if operated with the business system that has effective management , accounting system and assessment of operation results that meet the customers' needs and satisfaction with efficiency and speed, the operation will substantially increase SRT Revenue and reduce the State expenses. Therefore, This Project will provide a significant incentive to restructure the Organization as set in the related projects and plans. It can then be concluded that the long-term impact of the Project on the Organization and Personnel Management of SRT will be Positive because of the integrated Objectives that yield effective achievements.

#### 4.3.4 Long-Term Operation Plan

##### 4.3.4.1 SRT Continuous Investment Plans

1. Mass Rail Transit Project in Bangkok and its suburb: Bang Sue – Talingchan 2013-2016 of 15,551.38 million baht
2. Mass Rail Transit Project in Bangkok and its suburb: Bang Sue - Rangsit 2009-2016 of 69,305 million baht
3. Route Improvement Project: 5th Phase 2011-2014 of 8,264.70 million baht
4. Route Improvement Project: 6th Phase 2011-2014 of 6,717.45 million baht

##### New Projects

1. The Double Tracks Train Project along the Eastern Coastline: Chachoengsao - Khlong Sip Kao- Kang Khoi 2013-2015 of 11,348.35 million baht
2. The Double Tracks Train Project: Lopburi-Pak Nam Pho 2013-2017 of 19,332 million baht
3. The Double Tracks Train Project: Map Kabao-Jira Depot 2013-2017 of 27,974 million baht
4. The Double Tracks Train Project: Nakhon Pathom-Hua Hin 2013-2017 of 27,223 million baht
5. The Double Tracks Train Project: Nakhon ratchasima (Jira Road)-Khon Kaen 2013-2016 of 28,290 million baht
6. The Double Tracks Train Project: Prachuap Khirikhan-Choomporn 2013-2016 of 16,545 million baht
7. Mass Rail Transit Project in Bangkok and its suburb: Talingchan-Siriraj 2013-2015 of 4,290 million baht
8. Mass Rail Transit Project in Bangkok and its suburb: Bang Sue-Phya Thai – Makkasan 2013-2016 of 39,885 million baht
9. The Extended Suvarnaphumi Airport Rail Link Project: Phya Thai-Don Muang 2013-2017 of

40,216 million baht

10. Mass Rail Transit Project in Bangkok and its suburb: Rangsit-Thammasat (Rangsit) 2013-2015 of 3,896 million baht

11. Mass Rail Transit Project in Bangkok and its suburb: Talingchan-Salaya 2013-2015 Of 3,363.20 million baht

12. The Construction of the Denchai-Chiangrai-Chiang Khong Train Route 2013-2015 of 47,755 million baht

13. The Telecommunication Network across the Country Project 2013-2014 of 2,144 million baht

14. The High Speed Rail Project: Bangkok-Chiang Mai 2013-2016 of 208,499 million baht

15. The High Speed rail Project: Bangkok- Nakhon Ratchasima 2013-2016 of 92,916 million baht

16. The High Speed rail Project: Bangkok-Hua Hin 2013-2016 of 55,071 million baht

#### 4.3.4.2 Summary of The Impact on Long-Term Operation Plan of SRT

From the Study of the Long-Term Operation Plan of SRT including the Investment Plan of Rail Infrastructure Development approved by the Cabinet on April 27th 2010 and the Rail Network Plan of SRT, the impact has been found to be Positive to the long-term operation of SRT. With the support and green light from the State, the Project will generate a substantial increase in SRT revenue from passenger and freight transport. Moreover, in the development of the Project, funding resource has been provided by the State. With the Cabinet's approval of the Project, Ministry of Transportation will discuss with Ministry of Finance in allocating budget or funding resource for the Project development. Besides, if SRT intends to seek joint investment with the private sector, this could be done by following the procedures under Private Partnership Act 2013.

### 4.4 Impact from Complying with Law and Regulations besides Private Partnership in the State Enterprise Act 2013 and other related Law and Regulations

#### 4.4.1 The operation under Private Partnership in the State Enterprise Act 1992

#### 4.4.2 Complying with other related Law and regulations

The Double Tracks Train Project is linked with other Projects under several organizations which have to act upon Law and regulations suitable for each type of work. Therefore, the operation of this Project will act in relevance with the Law and regulation to achieve efficiency in its operation. The related Law and Regulations are:

- 1) Ministerial Code (1994) under Private Partnership in the State Enterprise 1992

In the Ministerial Code (1994) under Private Partnership in the State Enterprise 1992 issued by Ministry of Finance, it has stated the main issues to be included in the Bidding Announcement asking the interested entrepreneurs to propose terms and conditions in forming partnership with the State. The

rationale behind this Ministerial Code is that in Code 15 of Private Partnership Act 1992, it has been stated that calls for partnership must be announced along with the screening methods and in this case bidding process will be used with bank guarantee and collateral requirement. These have to be provided as required in the Ministerial Code so the Project owner and the Screening Committee can proceed accordingly.

2) National Economic and Social development Act issued on August 14th 1978 The rationale for the issuing of this Act was: there is a need to revise the law on the National Committee of Economic Development in order to move forward with the economic and social development of the country. In this Act, it has specified the definition of the economic and social development project, development of planning and state enterprise, etc. Moreover, it has specified the composition of the National Economic and Social development Committee, and the responsibilities of the Committee members and the Committee's.

### 3) Legal Act and Related Law

The Operation of this Project must conform with Promotion and Conservation of National Environment Act (1992) including other related law and regulations:

- Ministry of Science and Technology Announcement on Types and Sizes of the Project and other activities under the State, the State Enterprise or Private Sector that requires EIA Report (24 August 1992)
- Ministry of Science and Technology Announcement on Criteria, Requirements and Guidelines on EIA Report Preparation (24 August 1992)

According to Act of Expressway or other similar systems with the nature of an expressway or mass rail transit system, the Expressway system has been included in the Announcement of Ministry of Science and Technology as mentioned above and it requires submission of EIA Report to Office of Policy and Planning of the Environment. The Report must include the component of the environment, the main impact, preventions and solutions measures of the environmental impact and monitoring measures of the impact during the construction period, and the operation period of the responsible organization, public or private. The Committee on Economic and Social Development has also specified the main topics of the presentation of the results of Report and Analysis focusing on the analysis of the impact on the environment, the community and the service users. The Report of the Study and the Analysis of the Project must be prepared according to Clause 2 Section 7 of Private Partnership Act 1992 which requires the submission of the Report for the Cabinet approval on Private Partnership and Operation in the State Enterprise.

4) Announcement of the National Economic and Social Development Committee on topics for presentation of the Study and Analysis Results of the Project, 13 January 1993.

In relevance to Section 6 of Private Partnership in the State Enterprise 1992, the National Economic and Social Development Committee has specified that the responsible Project operator who requests

private partnership in any project must conduct the Preliminary Study and Analysis on the following topics:

- (1) The Conformity of the Project
  - (2) The Feasibility of the Project
  - (3) The Impact from the Project
  - (4) The Role of Private Sector
- 5) Other Law and Regulations Related to the Project Development

As this Project Development will concern architectural work, civil engineering and structural engineering work, the operations mentioned earlier must act complying with the rules and regulations under the Law such as:

- (1) City Planning Act (1975)
- (2) Building Control Act (1979)

Besides, the procedures must follow all rules and regulations later revised and any regulations of Bangkok Metropolitan Administration (1982) issued on 22 July 1982.

- 6) Assets Expropriation Act (1987)

From the Study and Analysis of the Project, it was found that some land expropriation is needed and that must be in accordance with Assets Expropriation Act (1987) and any other revised rules and regulations. Moreover, the procedures must be legally bound under “Assets Expropriation Act (1987) which comprises of 4 sections:

- Section 1 Assets Expropriation
- Section 2 Compensations
- Section 3 Assets Expropriation
- Section 4 Miscellaneous

The rationale in the Enactment of Assets Expropriation Act (1987) is that most Assets Expropriation Law has been used for a long time and some of the regulations have become obsolete and thus need revision to facilitate expropriation of assets more efficiently and fairly.





## Chapter 5

### The Role of the Private Sector

#### 5.1 The Comparative Study of Investment Types between the State and the Private Sector

In considering the suitable type of investment, it has been found that each type of investment has different strengths and weaknesses. The investment by the State had been the type used in the early stages of mega projects and public utilities projects while Public Private Partnership (PPP) has been conducted for a long time overseas. PPP has still been considered new in Thailand. In fact, PPP is a crucial tool in promoting economic growth and achievement of the State's social development objectives.

As a tool of investment, PPP can cover a varieties of investment types and participation from the State and the private sector in the acquisition process, the construction operation and the Project management after the completion of the Project construction.

The Consultants have conducted the Feasibility Study and Limitations of the PPP investment and three types of investment have been analysed:

1) The State is responsible for the construction of the Infrastructure including Signaling and Telecom System, while SRT is responsible for investment on the train fleet and for being the Project Operator including maintenance throughout the Project life

2) SRT is responsible for the construction of the Infrastructure while the Private sector is responsible for Signaling and Telecom System, the train fleet, maintenance and being the Project Operator. SRT will collect revenues from the operation and passenger and freight trains and pay the private investor in a form of wage payment.

3) SRT is responsible for the construction of the Infrastructure while the Private sector is responsible for Track System, Signaling and Telecom System, the train fleet, maintenance and being the Project Operator while SRT receives concession rights compensations or tracks use compensations from the private investor. The 3 types of investment are shown in **Table 5.1-1** and the Hypothesis for the Analysis is shown in **Table 5.1-2**

**Table 5.1-1 Investment Guidelines for the Project**

| Type | Infrastructure | Track System | Signaling & Telecom System | Power Supply | Train Fleet | Operation & Maintenance | Revenues |
|------|----------------|--------------|----------------------------|--------------|-------------|-------------------------|----------|
| 1    | State          | State        | State                      | State        | SRT         | SRT                     | SRT      |
| 2    | SRT            | SRT          | Private                    | Private      | Private     | Private                 | SRT      |
| 3    | SRT            | SRT          | Private                    | Private      | Private     | Private                 | Private  |

Source <sup>1</sup> SRT pays operation fees to the Private investor

<sup>2</sup> SRT receives concession rights compensations from the private investor

In so doing, the financial returns from the investment for the private investor is set at a minimal of 7.27% obtained from  $WACC_{(private)}$  and in case of cash flow shortage, the State must provide support funding or pay the private investor as train operation fees so the financial returns will be 7.27% or higher. This will prove attractive to the in private investor.

**Table 5.1-2**  
**Hypothesis and Financial Indicators in the Analysis of Investment Types**

| No. | Details                                                                                                                                        | Hypothesis                                                                                                                                                 | Notes                                                   |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| 1.  | Inflation Rate<br>1.1 Construction Cost<br>1.2 Revenues<br>1.3 Year of Cost Appraisal                                                          | 2.5 %/year<br>2.5 %/year<br>2015                                                                                                                           | Office of Public debts<br>Management                    |
| 2.  | Revenues<br>2.1 Passengers Fares<br>- 1st Class car<br>- 2nd Class car<br>- 3rd Class car<br>2.2 Passengers Fees<br>2.3 Freight transport fees | 0.86 baht/person/km.<br>0.42 baht/person/km.<br>0.18 baht/person/km.<br>53.48 % of the Revenues including<br>passenger fares and fees<br>1.83 baht/ton/km. | SRT                                                     |
| 3.  | Assets Use Life<br>3.1 Civil works<br>3.2 Signaling &Telecom system<br>3.3 Track system<br>3.4 Train fleet                                     | 40 years<br>32 years<br>30 years<br>33 years                                                                                                               |                                                         |
| 4.  | The Analysis Timeframe<br>4.1 The Project Analysis<br>4.2 Land rights management<br>4.3 Construction<br>4.4 Project Operation                  | 30 years+construction period<br>1 year<br>3 year<br>30 year                                                                                                | Office of Public debts<br>Management                    |
| 5.  | Starting year of construction                                                                                                                  | 2018                                                                                                                                                       |                                                         |
| 6.  | Starting year of operation                                                                                                                     | 2021                                                                                                                                                       |                                                         |
| 7.  | Reduction rate                                                                                                                                 | 5%                                                                                                                                                         | Office of Public debts<br>Management                    |
| 8.  | Interest rate<br>8.1 Domestic Loans (the State)<br>8.2 Commercial banks (Private)                                                              | 3.30%/ 15 years of payback<br>7.13%/15 years of payback                                                                                                    | The Thai Bond Market<br>Association<br>Bank of Thailand |
| 9.  | D/E Ratio<br>9.1 The State<br>9.2 Private                                                                                                      | 3:1<br>2.5:1                                                                                                                                               |                                                         |
| 10. | Tax<br>10.1 Corporate Income tax<br>10.2 Returns to Ministry of Finance                                                                        | 20% /2013-2044 from Net Profit<br>35% from Net Profit                                                                                                      |                                                         |

## 5.2 Assessment of the Financial Indicators of the Analysis of the Investment Types

- NPV for SRT and Private Investor: Current NPV is an indicator reflecting the difference between the current revenue or the Project profit and investment value of the Project investment. From the comparative study, any type of investment with higher NPV is considered a better investment type.
- FIRR of SRT and Private Investor: FIRR is an indicator reflecting the financial returns in percentage value turning the current NPV or the Project profit to be equivalent to NPV of the Project. From the comparative study of different types of investment, any type of investment with higher FIRR is considered a better investment type.

## 5.3 The Results of the PPP Analysis

The results of the Analysis will be shown with FIRR and NPV of both SRT and Private Investor from the joint cooperation between the State and the Private Sector for the Electrified Train Project in **Table 5.3-1** and the Diesel Train Project in **Table 5.3-2**

**Table 5.3-1**  
**The Financial Returns from PPP for the Electrified Train Project**

| Type | SRT           |          | Private       |          |
|------|---------------|----------|---------------|----------|
|      | NPV (m. baht) | FIRR (%) | NPV (m. baht) | FIRR (%) |
| 1    | -883.37       | N/A*     | -             | -        |
| 2    | -9,966.44     | N/A*     | 1,016..24     | 12.00    |
| 3    | -15,658.41    | N/A*     | 3,422.48      | 12.00    |

Note: \* Unable to obtain the value as the State invests on the Infrastructure, Signaling & Telecom system and Power Supply while SRT has to pay subsidy to maintain FIRR of the private investor to be higher than WACC as investment incentive.

From **Table 5.3-1**, it could be seen that Type 1 with total Infrastructure investment undertaken by the State including Signaling & telecom System and Power Supply System and SRT invests on the train fleet and life-time maintenance and runs the Project, NPV is -883.37 m. baht which is in the lower red than when SRT has to undertake the total investment. This indicates that the State should merge as a partial investor of the Infrastructure including Signaling & Telecom System so the Project can operate with efficiency.

As for the study of Type 2 with PPP when SRT collects revenues from fares and fees from passenger from passenger and freight trains and freight trains and pays operation fees to the private investor and Type 3 with the private investor collects revenues from fares and fees and SRT receives compensations from concession rights and use of tracks, it was found that for Type 2, SRT will have NPV of -9,966.44 m. baht which yields less negative value than that of Type 3. Therefore SRT should move with Type 2 in which SRT will pay operation fees to the private investor and maintaining a better NPV.

From the analysis of the three types of investment, it was found that Type 1 when the State is the sole investor of the Infrastructure is the most appropriate type of investment because of the lowest negative NPV. When considering the Results of the Financial Analysis of the Double Tracks Train Project, it was found that the Project is worthy of economic and social investment in terms of increasing Transportation System potentials and quality of life of the public.

**Table 5.3-2**  
**The Financial Returns from PPP for the Diesel Train Project**

| Type | SRT           |          | Private       |          |
|------|---------------|----------|---------------|----------|
|      | NPV (m. baht) | FIRR (%) | NPV (m. baht) | FIRR (%) |
| 1    | -3,435.03     | N/A*     | -             | -        |
| 2    | -10,806.91    | N/A*     | 284.35        | 12.00    |
| 3    | -15,201.75    | N/A*     | 2,411.64      | 12.00    |

Note: \* Unable to obtain the value as the State invests on the Infrastructure, Signaling & Telecom system and Power Supply while SRT has to pay subsidy to maintain FIRR of the private investor to be higher than WACC as investment incentive.

From **Table 5.3-2**, it was found that Type 1 with total Infrastructure investment undertaken by the State including Signaling & telecom System and Power Supply System and SRT invests on the train fleet and life-time maintenance and runs the Project, NPV is -3,435.03 m. baht which is in the lower red than when SRT has to undertake the total investment. This indicates that the State should merge as a partial investor of the Infrastructure including Signaling & Telecom System so the Project can operate with efficiency

As for the study of Type 2 with PPP when SRT collects revenues from fares and fees from passenger from passenger and freight trains and freight trains and pays operation fees to the private investor and Type 3 with the private investor collects revenues from fares and fees and SRT receives compensations from concession rights and use of tracks, it was found that for Type 2, SRT will have NPV of -10,806.91 m. baht which yields less negative value than that of Type 3. Therefore SRT should operate as a collector of revenues and pay operation fees to the private investor and this will yield a better NPV .

From the Analysis of the three types, it can be seen that in Type 1 when the State invests on the total Infrastructure is the most suitable form of investment as NPV has the lowest negative value compared with the other two types. And when considering the Results of the Financial Analysis of the Double Track Diesel Train Project, it was found that the Project is worthy of economic and social investment in terms of increasing Transportation System potentials and quality of life of the public.