

# Environmental Impact Assessment (Final)

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Project Number: 51274-001  
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## THA: Bangkok Mass Rapid Transit (Yellow Line) (Part 1 of 6)

Prepared by The Mass Rapid Transit Authority of Thailand.

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# Chapter 1

## Introduction

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### 1.1 Background of the Project

The Cabinet, in a meeting on 9 March 2010, resolved to acknowledge the results of a meeting held on 8 February, 2010 by the Commission for the Management of Road Traffic. The meeting on 8 February, 2010 resolved to approve the Master Plan for the Mass Rapid Transit Master Plan for the Bangkok Metropolitan Region. The Master Plan includes the MRT Yellow Line Project: Lat Phrao - Phatthanakan - Samrong Section, which has been defined as an additional network scheduled to be in service by 2029. However, the policy (Item 3.4.5) of Ms. Yingluck Shinawatra's administration that was presented to the Parliament on 24 August, 2011 identified the acceleration of 10 MRT line projects to start construction within four years (2015), which included the MRT Yellow Line Project. Hence, the Ministry of Transport assigned the Mass Rapid Transit Authority of Thailand (MRTA) to accelerate the implementation of the project to ensure that the project construction can start within the timeframe defined in the government policy.

Based on the economic and environmental feasibility study and preliminary detailed design for the MRT Yellow Line Project, which was conducted by the Office of Transport and Traffic Policy and Planning (OTP) from 2007-2011, the MRT Yellow Line Project has been divided into two sections. The two sections consist of the Ratchada/Lat Phrao - Phatthanakan Section and the Phatthanakan-Samrong Section, and they are detailed as follows:

**1) Ratchada/Lat Phrao - Phatthanakan Section :** This section is elevated monorail system. Its starting point connects to the MRT Chaloem Ratchamongkol Line (first phase of the Blue Line) at the Ratchada - Lat Phrao Intersection, and it will follow along Lat Phrao Road to the Bang Kapi Intersection. After that, the section will veer to the south along Srinagarindra Road, and it will connect to the MRT Orange Line at the Lam Sali Intersection. Ending at the Rama 9 Interchange, this section will connect to the Airport Rail Link and the MRT Yellow Line: Phatthanakan - Samrong Section. Its total planned distance is 12.6 km (10 stations).

**2) Phatthanakan - Samrong Section :** This section is elevated heavy rail system. Its starting point connects to the Airport Rail Link at the Rama 9 Intersection along Srinagarindra Road. It will run from the Phatthanakan Intersection, to the Si Nut Intersection, the Si Udomsuk Intersection, the Si lam Intersection, and the Si Thepha Intersection. After that, it will veer to the west along Thepharak Road and pass through the connectivity point with the MRT Green Line: Bearing-Samut Prakan Section at the Samrong station. Its ending point will be situated along Pu Chao Saming Phrai Road. The total planned length of the section is 17.8 km (11 stations).

Currently, both projects are in the process of detailed design, which is the MRTA's responsibility. Previous actions were reviewed, and some changes were made to the project details. The changes consisted of changes in some sections, including: a change in the location and number of stations, the Park & Ride Building, and Depot; and the adjustment of the entire MRT system from Lat Phrao to Samrong to be merged into the same system. Thus, it was necessary to

adjust the project details that had been presented in those two original EIA reports. Here is the report on the changes of the project details included in both EIA reports, under the title: **The Report on Changes in Project Details in the EIA Reports on the Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong**. The project implementation is characterized as being a project that is required to prepare an EIA report to be submitted to the Office of Natural Resources and Environmental Policy and Planning (ONEP) for consideration.

The MRTA Committee's meeting on 24 January, 2013 approved the MRTA's consideration about reducing the scope of the project work. It assigned the MRTA to conduct a feasibility study of the monorail design for the Phatthanakan - Samrong Section. The MRTA carried out the feasibility study of MRT system alternatives for the Project, and it presented the study results to the MRTA Committee at the meeting on 21 February, 2013. The meeting participants resolved that the MRT Yellow Line Project should be entirely integrated into the monorail system. The map of the project location is illustrated in **Figure 1.1 - 1**. In this regard, the MRTA had to review details about the feasibility of the project and study its impacts on the environment. This aimed to improve drawings to be used in bidding for construction, prepare tender documents, and comply with the Public-Private Partnership Act, B.E. 2535 (1992) (in the case where the private sector is involved in the implementation of the project or its investment).

The MRTA has designated a group of consulting firms, which consist of Asian Engineering Consultants Co., Ltd., Hamburg-Consult GmbH, D2 Consult Asia Co., Ltd, Wisit Engineering Consultants Co., Ltd., Prime Street Advisory Co., Ltd. (Thailand), as well as Enrich Consultant Co., Ltd. to conduct a study and prepare the Report on Changes in Project Details in the EIA Reports on the Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong. *This report consolidated the EIA Report for the MRT Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan) and the EIA Report for the MRT Dark Yellow Line Project (Phatthanakan - Samrong) of the OTP. This is a single report on the changes in project details in the EIA Reports for the Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong.* This report will be submitted to the Office of Natural Resources and Environmental Policy and Planning (ONEP). The ONEP will present the report to a Specialist Committee for approval before presenting it to the National Environment Board for further consideration.

## 1.2 Rationale for the Report on Changes in Project Details

### 1) The OTP's EIA Report on the MRT Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan), with a total distance of 12.60 km

- On 5 April, 2011, the Specialist Committee for Consideration of EIA Reports for Transport Projects of the Government or State-enterprise Sectors or Private-Public Projects, in the meeting No. 5/2554, resolved to approve the EIA Report for the MRT Yellow Line Project (Ratchada/Lat Phrao - Phatthanakan).

- On 16 January, 2012, the National Environmental Board, at the meeting No. 1/2555, resolved to approve the EIA Report for the MRT Yellow Line Project. The OTP was asked to take into account the remarks made by the National Environmental Board for project implementation.

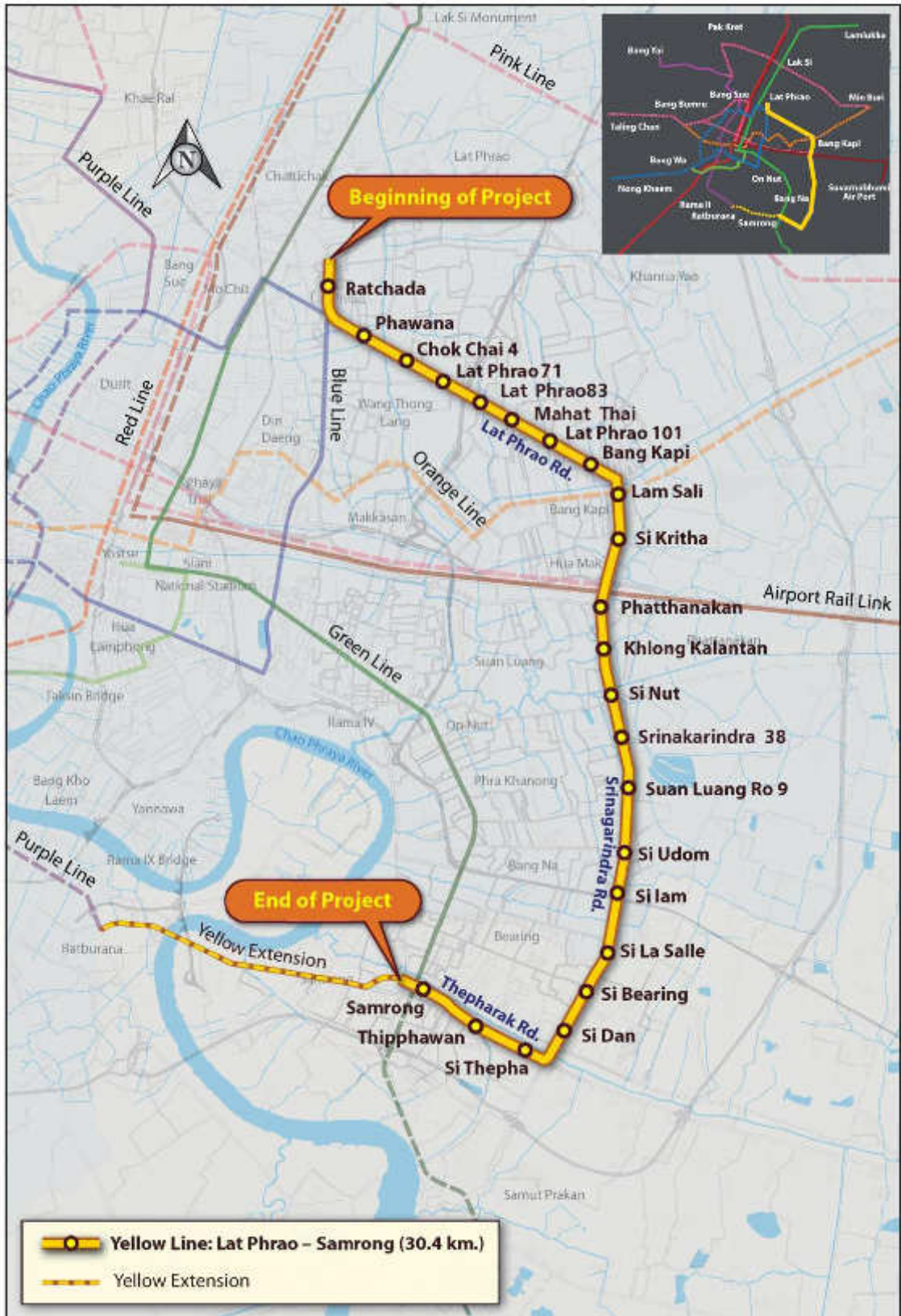


Figure 1.1 – 1 The Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section location map

## 2) The OTP's EIA Report on the MRT Dark Yellow Line Project (Phatthanakan-Samrong Section), for a total distance of 17.90 km

- On 23 March, 2011, the Specialist Committee for the Consideration of EIA Reports for Transport Projects of the Government or State-enterprise Sectors and Private-Public Projects, in the meeting no. 2/2554, resolved to approve the EIA Report for the MRT Dark Yellow Line Project (Phatthanakan-Samrong).

- On 16 January, 2012, the National Environmental Board, at the meeting no. 1/2555, resolved to approve the EIA Report for the MRT Dark Yellow Line Project.

The environmental impact assessment for the MRT Yellow Line Project: Ratchada/Lat Phrao-Phatthanakan Section and the environmental impact assessment for the MRT Dark Yellow Line Project: Phatthanakan-Samrong were conducted in compliance with the conditions for the approval of the EIA Report for the MRT Yellow Line Project of the National Environment Board at the meeting No. 1/2555, on 16 January 2012. It is stated that in the event that it is necessary to change the project details or environmental impact prevention and mitigation measures, or the environmental impact monitoring measures in the EIA Report for the OTP's MRT Yellow Line Project, as approved by the Specialist Committee, the agency authorized to grant approval or permission for the Project must be informed of this. If the authorized agency realizes that the changes in project details or environmental impact prevention and mitigation measures, or the environmental impact monitoring measures, do not affect the substantive matters of environmental impact assessment in the EIA Report and are effective measures that have been approved by the Specialist Committee, it shall consider these changes in compliance with the criteria and conditions specified in the law and shall make a copy of the notice to submit to the Office of Natural Resources and Environmental Policy and Planning. *If the agency with the authority for such approval or permission is of the opinion that such changes may affect the substantive matters of the environmental impact assessment in the EIA Report, the report on changes for the project details or environmental impact prevention and mitigation measures, or environmental impact monitoring measures, shall be submitted to the Office of Natural Resources and Environmental Policy and Planning for approval by the Specialist Committee before any changes are made.*

### 1.3 Objectives of the Study

1.3.1 To study and analyze the project details and activities which contain changes, such as changes in the location of stations, an increase in the number of stations, changes in route alignments, and changes in the details of depots and the Park and Ride Buildings.

1.3.2 To study the existing environmental conditions which are affected by changes in the project features.

1.3.3 To assess potential environmental impacts during the pre-construction, construction, and operational periods.

1.3.4 To formulate measures for preventing and mitigating environmental impacts during the pre-construction, construction, and operational periods, as well as measures for monitoring environmental quality during the construction and operational periods.

## 1.4 Scope of the Study

The environmental impact assessment in the report involved an analysis and assessment of the significant environmental impacts, in line with the guidelines for the preparation of an EIA Report by the Office of Natural Resources and Environmental Policy and Planning (ONEP). The study consisted of areas along the project route alignment, within a radius of 500 m from the center of the route alignment. At the depot areas, the study will be conducted within a radius of 1 km around the proposed areas. The EIA study of the Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong (BMTY Project : Lat Phrao – Samrong) are consist of:

- 1) Physical environment resources
  - (1) Topography
  - (2) Soil resources
  - (3) Geology and earthquake
  - (4) Surface water quality
  - (5) Air quality
  - (6) Noise
  - (7) Vibration
- 2) Biological environment resources
  - (1) Aquatic ecology
  - (2) Terrestrial ecology
- 3) Human use values
  - (1) Land use
  - (2) Transportation
  - (3) Public Utilities
  - (4) Flood control and drainage
- 4) Quality of life values
  - (1) Socio-Economic
  - (2) Property compensation
  - (3) Public health and health
  - (4) Occupational health and safety
  - (5) Historical site and archaeology
  - (6) Aesthetics and tourism

## 1.5 Procedures and Methods of Environmental Impact Assessment

The procedures and methods of environmental impact assessment are as follows:

1) Collect secondary data and review the EIA Report for the MRT Yellow Line Project, and the EIA Report for the MRT Dark Yellow Line Project of the OTP, which were approved by the National Environment Board on 16 January, 2012.

2) Investigate changes in project details, as well as the project construction plan and procedures, which will serve as data for the environmental impact assessment.

3) Collect data on current environmental conditions; and study and analyze the conditions of environmental resources in the study areas, using secondary data in the form of documents, reports, maps and plans, as well as data from the computer network of agencies/organizations.

4) Survey/measure and collect samples of environmental resources in the field to serve as basic data about current environmental conditions, which were as follows:

(1) The survey of the project route alignment on 8 April, 2013.

(2) The measurement of air quality, noise and vibration at each of the individual 10 stations consecutively, 24 hours a day, for five days a week, between 14 June, 2013 and 2 July, 2013.

(3) The collection of surface water samples to measure the quality and aquatic ecology at six stations on 1 July, 2013.

(4) The survey and monitoring of land use conditions in August, 2013.

(5) Attitudinal surveys conducted on 1,200 samples along the project route alignment, between 27 and 30 July, 2013.

5) A public participation program with people along the project route alignment.

(1) The providing of project data during the project study period for the target group and stakeholders.

(2) The gathering of opinions and suggestions from the target group and stakeholders.

(3) The organization of activities to listen to the opinions of people along the project route alignment, which consisted of two public participation meeting and two focus groups meeting:

- 1<sup>st</sup> public participation meeting: Friday 23 August, 2013, 08.30-12.00 hrs., at the Grand Ballroom, Maple Hotel, Bang Na District, Bangkok.

- 1<sup>st</sup> focus-group meeting: Saturday 21-Sunday 22 September, 2013.

- 2<sup>nd</sup> focus-group meeting: Saturday 26-Sunday 27 October, 2013.

- 2<sup>nd</sup> public participation meeting: Thursday 28 August, 2013, 08.30-12.00 hrs., at the Grand Ballroom, Maple Hotel, Bang Na District, Bangkok

5) Assess environmental impacts whose details changed, which covered all environmental factors that may be affected by the project implementation.

6) Propose measures for preventing and mitigating environmental impacts and measures for monitoring environmental quality that are suitable for the Project.

7) Prepare an EIA Report (details that changed).

## 1.6 EIA report presentation

The chapter of EIA of the Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong (BMTY Project : Lat Phrao - Samrong) consist of:

- Chapter 1 Introduction
  - 1.1 Project background
  - 1.2 Project details change reasons
  - 1.3 Objectives
  - 1.4 Scope of study
  - 1.5 Environmental impact analysis method and steps
  - 1.6 EIA report presentation
- Chapter 2 The Changes in Project Details
  - 2.1 The of project descriptions to be change
    - 2.1.1 MRT system
    - 2.1.2 The changes of number of stations and their locations
    - 2.1.3 Change of route alignment
  - 2.2 Summary of project description change
- Chapter 3 Project Description
- Chapter 4 Environmental Existing Condition
- Chapter 5 Environmental Impact Assessment
- Chapter 6 Health Impact Assessment
- Chapter 7 Environmental Mitigation Measures
- Chapter 8 Environmental Monitoring Programs
- Chapter 9 Public Participation
- Chapter 10 Environmental Economics
- References
- Appendices



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## Chapter 2

### The Changes in Project Details

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#### 2.1 The details to be changed

##### 2.1.1 MRT system

###### 2.1.1.1 The studies on the MRT Yellow Line

The studies on the MRT Yellow Line Project indicate some different ideas of choosing the MRT system for this route alignment. A result of studying the M - MAP project (2009) suggests that the MRT system on Lat Phrao Road route would be the light rail (monorail) and the MRT system on Srinagarindra route would be the heavy rail. Even though now the traffic volume on Srinagarindra Road is less than the one on Lat Phrao Road. For the idea of developing the middle ring road before connecting to the outer ring road, if it happens the MRT system on this road would be developed together. However the idea of developing the middle ring road was changed by a reason of the reduced population because of the immigration of population that left Bangkok Metropolitan Region. Then there is no need of the middle ring road in the short term.

However the office of Transport and Traffic Policy and Planning (OTP) feasibility study result of the economic, environment and preliminary design of the MRT Yellow Line, the MRT Brown Line and the MRT Pink Line project, confirms there are two MRT systems in this project, these are the monorail on Lat Phrao Road and the heavy rail on Srinagarindra Road. The public acceptance is a key reason and issue for this study. The preliminary study concludes that the whole line should be the heavy rail system by the reasons that there is a considerable number of passengers and this system has been developed the operation for nearly 10 years in Thailand so the operation team is already the expert on the construction and train operation management including the maintenance, signaling system, electrical system, communication etc. It would be a similar way to operate like the existing project. However people who live along the Lat Phrao Road do not agree because the area of designed railway (viaduct or concrete box girder) for the heavy rail is totally closed structure but the Right of way (Row) of Lat Phrao Road is narrow then the rail structure may totally cover the road under and block the sun light including air ventilation. In the opposite way the monorail guideway, the railway with beam structure, has a gap between the tracks and looks more breathable area.

So during 2007-2011 (B.E. 2550 – 2554) OTP did two EIA reports. One is for the MRT yellow Line Project (Ratchada/Lat Phrao-Phatthanakan section) which is the monorail system with the total distance of 12.60 km. The other is for the MRT dark yellow line (Phatthanakan-Samrong section) which is the Heavy Rail with the total distance of 17.90 km. Currently both reports are already approved by the National Environment Board at the meeting No. 1/2556 on 16 January, 2012.

The later MRTA study review of the MRT system for total distance, considering the forecasted number of passengers referred to the meeting on 21 February, 2013 that MRTA board resolved to approve the study result which concludes that the monorail system should be involved in the total distance of the MRT line beginning at Ratchada/Lat Phrao, passing Bang Kapi, Lam sali, Phatthanakan, until Samrong. Considering this review the project needs to prepare the report on changes in project details in EIA report on the Bangkok Mass Transit Yellow Line Project : Lat Phrao-Samrong, to submit it to the Specialist Environment Committee and the National Environment Board for consideration.

#### **2.1.1.2 To change the MRT system to the monorail system for total line**

Because the OTP original study defines the elevated monorail system involved in the MRT yellow line project: Ratchada/Lat Phrao-Phatthanakan, total 12.6 km distance (10 stations) and the elevated heavy rail system involved in the MRT dark yellow line project: Phatthanakan-Samrong section (11 stations), so there are 2 systems of train control and passengers must do a transit at the Phatthanakan station. The design of station, depot and train parking station must be double because the 2 different rail systems cannot run the operation in the same facility. Considering the double cost, MRTA has reviewed and compared which of the rail systems would be suitable for the Bangkok Mass Transit Yellow Line Project : Lat Phrao-Samrong.

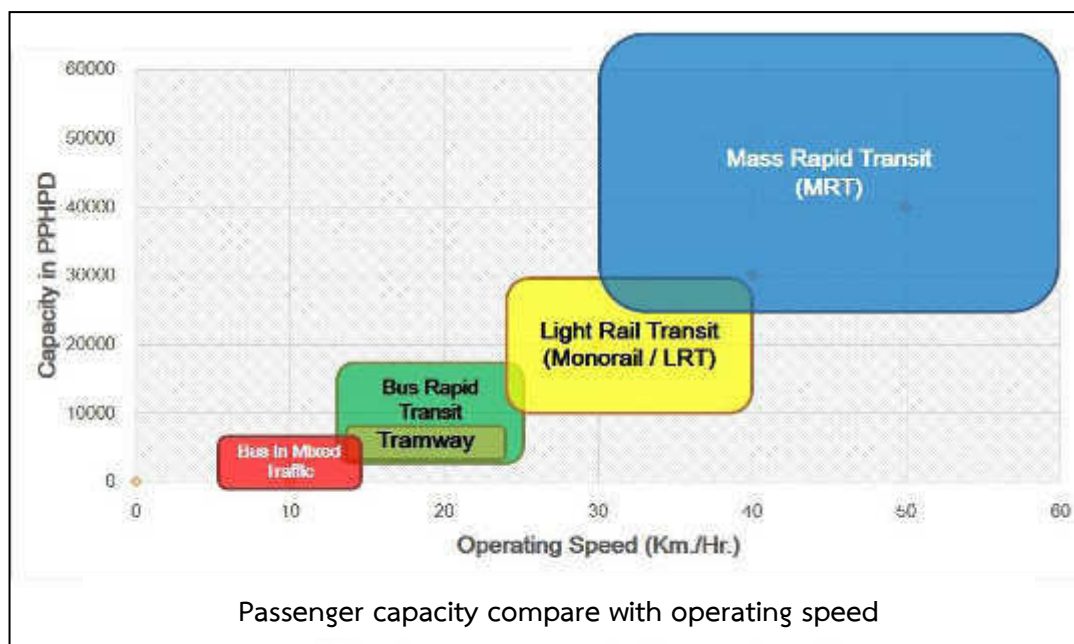
The feasibility study of the MRT system alternatives for the project is the most complex study because there are many factors to be integrated for consideration. The topics to be studied are listed below.

- The comparison of the number of passengers and loading capacity of the rail system at present
- The comparison of performance of the MRT systems
- The comparison of expenditures of the primary development and system operation
- The consideration of the operation impact on the environmental conditions

The considered factors can be concluded as the following details.

##### **1) The comparison of the number of passengers and loading capacity of the rail system at present**

Considering the collected data of each MRT system's capacity to carry passengers during rush hour, it is found that the monorail system (large size) and the larger system can service the 23,000 passengers – train during rush hour (rush time). The comparison of the performance of the MRT system and the number of passengers are shown in the **Figure 2.1.1 - 1**.



Source : Result from Alternative of Mass Rapid Transit System for MRTA Yellow Line Project. MRTA, 2013.

Figure 2.1.1 - 1 Mass Rapid Transit System performance comparison of MRT and passenger

Considering the ability of service and loading capacity, the monorail system can fulfil the MRT yellow line service without any transit to another system in between the distance.

Its noticeable higher loading capacity of the modern monorail system can accommodate more passengers who want to use rail service. In general studies the monorail system is known that it can be classified in 2 types, the large monorail system with the same loading capacity as the heavy rail system and the compact monorail system with the same loading capacity as the light rail system. To compare their different feature, the monorail runs on guideway but the Heavy Rail and Light Rail run on track. Additionally the monorail, heavy rail and light rail also differ about the performance of system which is detailed in the next topic.

## 2) The comparison of performance of the MRT systems

To compare the attributes of the monorail system and the heavy rail system, they have only difference in the efficiency of size and loading capacity which do not make a big difference of passenger loading capacity at the same length of the train. For the performance of system, the monorail system has developed its competency to be equal to the heavy rail system. Comparing among the group of the monorail system, the large monorail system may have a difference of passenger loading capacity if they have different size of cabin, design of the train configuration such as the number of seats, the door size, the number of doors, etc. The attributes of the large monorail system, compact monorail system and Heavy Rail system are compared in the **Table 2.1.1 - 1**.

**Table 2.1.1 – 1 Summary comparison of Monorail (large and small sizes), Light Rail and Heavy Rail**

Items	Unit	Monorail		Light Rail	Heavy Rail
		Large size	Small size		
<b>1. Physical characteristic</b>					
<b>1.1 Dimension</b>					
Driven cabin car (widthxlength); M <sub>c</sub>	m.xm.	3.0x16.4	3.1x13.4	2.4x20.1	3.2x21.8
Passenger cabin car (widthxlength); M	m.xm.	3.0x15.2	3.1x11.8	2.4x20.1	3.2x21.5
Height (from roof to guideway)	m.	3.0	3.0	3.5	3.9
<b>1.2 Physical characteristic of structure</b>					
Min. horizontal curve radius	m.	100	46	100	190
Max. recommendation gradient	%	6	6	3.5	3.5
Max. gradient	%	10	6	6	5
Width of Viaduct	m.	7.3	5.7	8	9
<b>1.3 Train performance</b>					
Speed	m./s	80	80	80	80
Accelerate rate	m./s <sup>2</sup>	1.0	1.0	1.0	1.0
Delay rate (normal operation)	m./s <sup>2</sup>	1.0	1.0	1.0	1.0
Headway	S	90	90	90	90
<b>2. Train system capacity</b>					
<b>2.1 Capacity per car train (average from powered car and passenger cabin car)</b>					
Comfortable area	sq. m.	23.7	18.5	21.1	40.7
Standing passengers	person/car	142	111	127	208
Seated passengers	person/car	37	16	30	42
Total passengers	person/car	179	127	157	250
<b>2.2 Capacity per train (at same train length)</b>					
Train length	m.	63.2	62.2	80	86
Number of cabin car per train	Car	4	5	4	4
Passenger capacity	person/train	716	635	628	1,000
<b>2.3 System passenger transport capacity</b>					
@ Headway 90 sec	person/hr/direction	28,640	25,400	25,120	40,000
@ Headway 120 sec	person/hr/direction	21,480	19,050	18,840	30,000

Source : Result from Alternative of Mass Rapid Transit System for MRTA Yellow Line Project. MRTA, 2013.

For better understanding these differences of two system better, the example of the implemented system for a period of time will be explained.

- **The general information about monorail**








Monorail system is a kind of public railway transportation, the rubber-tyred train travels on the single track. The structures may be at grade, elevated and underground. The monorail can be classified by the structure into two types, the suspended monorail and the straddle monorail.

Now there are 4 world-class agent companies of the monorail manufacturing system, they are Hitachi monorail (Japan), Bombardier Incorporation (Canada), Scmi Rail BHD (Malaysia) and Changchun Rail Vehicles (PRC)

This study has studied the straddle monorail system which is widely used now. The rubber-tyred train runs on the beam 0.6-0.9 m wide. At the early time the track was

concrete (Alweg type) and has been developed to the steel beam (Japanese type). The details of Monorail system in many countries are listed in the **Table 2.1.1 - 2**. The large monorail system of the agent companies are also shown in the **Photo 2.1.1 - 1**. The large monorail systems of the agent companies

Table 2.1.1 – 2 Monorail systems in other countries

City/Country	Operation year	Distance (km.)	No. of station	Passenger (person/day)	No. of cabin car (car/train)	
<b>Operated project</b>						
	Tokyo	1964	17.8	11	300,000	24-6 car/train
	Kuala Lumpur	2003	8.6	11	45,000	10-2 car/train
	Moscow	2008	4.7	6	12,000	6 car/train
	Dubai	2009	5.45	4	40,000	4-3 car/train
	Chongqing (Line3)	2011	38.1	29	383,000	6 car/train
<b>During construction period of project</b>						
	Mumbai	2012	20	18	125,000 (Forecasts)	
	Sao Paulo	2012	24	17	500,000 (Forecasts)	54-7 car/train



(a) Series 2000, Hitachi Monorail



(b) Innovia Monorail 300, Bombardier Inc.

### Large Monorail

Photo 2.1.1 – 1 Large Monorail type from supplier companies

- **The General Information about Heavy Rail**

Heavy rail, the large rail system, is a kind of the public railway transportation, the train travels on the track. The structures may be elevated, underground and at grade. It can carry more than 40,000 passengers/hr./direction and be suitable for the cities of high-density population.

This study has studied the Heavy Rail system which has the equal quality and performance to the BTS system and the MRT system. The Heavy Rail system is shown in the

Photo 2.1.1 - 2



(a) Elevated



(b) Underground








(c) At Grade

Photo 2.1.1 – 2 : Heavy Rail types

The Heavy Rail system has been used widely in the big cities such as UK, France, Japan, People's Republic of China, Singapore etc. The Heavy Rail systems in many countries are listed in the **Table 2.1.1 - 3**.

Table 2.1.1 – 3 Heavy Rail systems in other countries

City/Country	Operation year	No. of route	Distance (km.)	No. of station	Passenger (million person /day)
 London	1863	11	402.0	270	3.0
 Paris	1900	16	214.0	301	4.5
 Tokyo	1927	9	203.4	168	6.3
 Beijing	1972	15	372.0	218	7.6
 Singapore	1987	4	148.9	102	2.4

3) The comparison of expenditures of the primary development and system operation

For the estimation of the rail system's construction cost and operation cost, the other countries' cost comparison under the same basic features especially the civil construction cost are used as reference for instance. See the **Table 2.1.1 – 4**. The comparison of unit cost of the train operation cost between the monorail system and the heavy rail system are shown in the **Table 2.1.1 - 5**.

Table 2.1.1 - 4 Civil work Construction Cost of Mass Rapid Transit System comparison

Item	Unit	Cost per unit (million baht)		
		Monorail <sup>(1)</sup>	Heavy Rail <sup>(2)</sup>	Monorail <sup>(3)</sup>
1. Preparation work	per km.	16.09	278.45	10.42
2. Design cost	% of civil work cost	1.75	5	1.50
3. Civil work and drainage work	per km.	2.69	18.8	2.31
4. Elevated structure	per km.	110.69	347	171.88
5. Guide way beam (elevated)	per km.	43.24	-	52.50
6. Guide way beam (depot)	per area	321	-	275
7. Track work	per km.	-	235.96	-
8. Station work	per station	329.86	527.62	313.04
9. Relocation of infrastructure cost	per km.	61.97	153.8	53.51
10. Depot	per area	756.4	3094.75	2,181.33
11. Park and Ride	per area	1,284.94	485.07	

**Source :** (1) Feasibility Study Review, Preliminary Design Plan Modification, and Preparation of Tender document for Pink Line Project (Khae Rai-Min Buri Section)

(2) Feasibility Study Review, Preliminary Design Plan Modification, and Preparation of Tender document for Orange Line Project (Taling Chan-Min Buri Section)

(3) Feasibility Study Review, Preliminary Design Plan Modification, and Preparation of Tender document for Yellow Line Project (Lat Phrao-Samrong Section)

**Table 2.1.1 - 5 The Unit Cost Comparison Between Monorail and Heavy Rail system**

Item	Unit	Cost per unit (million baht)		
		Monorail <sup>(1)</sup>	Heavy Rail <sup>(2)</sup>	Monorail <sup>(3)</sup>
1. General works	per km.	12.41	including preparation work of civil work	including preparation work of civil work
2. Electrical train cost	per car	49.75	73.52	61.95
3. Signaling and telecommunication	per km.	132.82	67.8	138.91
4. Power supply and distribution	per km.	107.71	177.91	103.91
5. Automatic fare collection system	per station	48.27	54.79	41.37
6. Platform screen door	per station	9.90	41.45	8.49
7. Lift and escalator	per station	43.55	78.6	37.33
8. Depot equipment	per area	514.67	927.58	630.00
9. Maintenance vehicle	per car/year	155*	141**	133
10. Track switch (elevated)	per set	50.18	-	including guide way beam (elevated)
11. Track Switch (depot)	per area	913.14	-	including guide way beam (depot)

**Remark:** \* On track maintenance vehicle 4 cars and On road track crane 3 cars

\*\* Maintenance Vehicle 4 cars

**Source :** (1) Feasibility Study Review, Preliminary Design Plan Modification, and Preparation of Tender document for Pink Line Project (Khae Rai-Min Buri Section)

(2) Feasibility Study Review, Preliminary Design Plan Modification, and Preparation of Tender document for Orange Line Project (Taling Chan-Min Buri Section)

(3) Feasibility Study Review, Preliminary Design Plan Modification, and Preparation of Tender document for Yellow Line Project (Lat Phrao-Samrong Section)

### - The comparison of total limited of capital expenditure

The estimated capital expenditure, in case of choosing the Monorail system or the heavy rail system in the Bangkok Mass Transit Yellow Line Project : Lat Phrao-Samrong. The comparison of the total limited of capital expenditure between the monorail system and heavy rail system is shown in the **Table 2.1.1 - 6**.

**Table 2.1.1 - 6 The Investment Comparison Between Monorail and Heavy Rail system**

Item	Cost per unit (million baht)			
	Heavy Rail <sup>(1)</sup>	Monorail <sup>(2)</sup>	Monorail <sup>(3)</sup>	Monorail <sup>(4)</sup>
1. Land expropriation	3,300	1,999	2,150	8,736
2. Civil work	17,077	8,654	9,751	18,304
3. Rolling stock and M&E work	9,688	8,503	11,067	16,731
4. Construction supervision and consultancy service	742	413	807	1,419
<b>รวม</b>	<b>30,807</b>	<b>19,569</b>	<b>23,775</b>	<b>45,190</b>

**Remark :** (1) Construction cost of Heavy Rail according to the former study in 2009

(2) Construction cost of Monorail (cost per unit) according to the former study in 2009

(3) Construction cost of Monorail (cost per unit) according to the study of Pink Line Project (Khae Rai-Min Buri Section)

(4) Feasibility Study Review, Preliminary Design Plan Modification, and Preparation of Tender document for Yellow Line Project (Lat Phrao-Samrong Section)



Considering the project’s estimated construction cost, the total limited of capital expenditure for the Phatthanakan-Samrong section, in case of changing system to the Monorail system, is 19,569 mb. This is 36.5% (saving 11,239 mb.) cheaper than the former study of using the heavy rail system in the project with the total limited of capital expenditure of 30,808 mb. When using the same unit cost as the latest study of the MRT pink line project: Khaerai-Minburi, the total limited of capital expenditure is 23,775 mb. This is also cheaper than the heavy rail system as the former study in 2009 (B.E.2552).

The study also includes the estimated expenditure of the Bangkok Mass Transit Yellow Line Project development: Lat Phrao-Samrong section. This project investment would be 45,190 mb. Considering the proportion of investment capital, in case of the Monorail system, the investment cost per km is lower.

- **Economic benefits**

The consultant compares the investment value of all projects and economic benefits between the OTP’s original study and the present study by MRTA’s consultants. See details in the **Table 2.1.1 - 7** to **Table 2.1.1 - 9**.

**Table 2.1.1 - 7 The former investment cost of project compare with MRTA Yellow Line Project**

Item	Investment cost (million baht)			
	The former project (OTP study)			MRTA Yellow line project (Lat Phrao – Samrong) (MRTA study)
	Light Yellow Line Project (Lat Phrao - Phatthanakan)	Dark Yellow Line Project (Phatthanakan - Samrong)	Total	
Land expropriation	1,415	3,300	4,715	6,013
consultancy service (project management civil work construction supervision + electrical train system construction supervision)	370	742	1,112	1,479
Construction cost	8,478	17,080	25,558	21,259
Electrical and mechanical work	2,828	5,608	8,436	13,290
Electrical train procurement	3,008	4,080	7,088	6,439
Contingency	-	-	-	6,164
Total	16,099	30,810	46,909	54,644
<b>Total</b>		<b>46,909</b>		<b>54,644</b>

**Remark :** The investment cost of project was studied in Year 2007 as estimated cost. For present, the investment cost was estimated in Year 2015 and also included the present value of expenditures for Public Private Partnership’s Project

**Table 2.1.1 - 8 Economic internal rate of return of Light Yellow Line project and Dark Yellow Line Project : baseline case**

Project route	Preliminary economic index		
	EIRR	NPV (million baht) discount rate 12%	B/C
Light Yellow Line Project (Lat Phrao - Phatthanakan) (Monorail system)	27.32%	25,918.3	3.08
Dark Yellow Line Project (Phatthanakan - Samrong) (Heavy rail system)	25.94%	33,176.9	2.61

**Table 2.1.1 - 9 Economic internal rate of return of MRTA Yellow line project (Lat Phrao – Samrong section)**

Economic index	Distance-base fare	20 baht flat fare(1)	20 baht flat fare (2)	20 baht fare
EIRR	15.65%	21.67%	16.83%	16.03%
NPV (Million Baht)	19,620	63,177	27,081	21,932
B/C	1.42	2.36	1.58	1.47

**Remark:** Modified the unit (million bath) by inflation rate 2.5%

*Distance-base fare* means distance-base fare and free all MRTA transfer

*20 baht Flat fare<sup>(1)</sup>* means 20 baht flat fare

*20 baht flat fare<sup>(2)</sup>* means 20 baht flat fare and free transfer except Blue line and ARL

*20 baht fare* means 20 baht fare and No Free Transfer

To consider the comparison of investment value and economic benefits of both projects, the construction expenditures by both studies are totally different and cannot directly be compared to each other. However both of them return the economic benefits with good value investment. The assessment of economic return of both projects excludes the benefit of travel time savings among groups of the bus passengers or car users who will spend less time for travel. So the return of economic benefits of the metro system is quite “higher” than the value presented in the above 3 mentioned tables.

#### 4) The consideration of environmental impact of project operation

The EIA report of the project from the OTP’s primary study and design, was approved by the national environment board on 16 January 2012 (B.E.2555). The result of this study and design resolves that the Monorail system will be involved in the Bangkok Mass Transit Yellow Line Project : Lat Phrao-Samrong and the heavy rail system will be involved in the Phatthanakan-Samrong section.

The EIA comparison of changing the MRT system to the Monorail system for the Phatthanakan-Samrong section is explained in the **Table 2.1.1 - 10**.

**Table 2.1.1 - 10 Consideration of environmental impacts between heavy rail system and monorail system on Phatthanakan - Samrong section**

Environmental Factors	Monorail System	Heavy Rail System
<b>Construction Phase</b>		
Expropriation land	Due to the Monorail system need the minimum curve radius than heavy rail system. The monorail system has the impact on the expropriation less than heavy rail.	The heavy rail system has the impact on the expropriation more than heavy rail.
Air Quality	The impact of construction activities, including dust and exhaust from vehicles. Transportation equipment and machinery Thus resulting in the accumulation of pollutants.	Not difference
Noise Level and Vibration	Activity that causes noise is piling. But the activity is carried out in the short term	Not difference
Disruption During Construction	During the construction phase, two -lane traffic areas that need to be used in the construction activity. But the activity is carried out in the short term.	During the construction phase, two -lane traffic areas that need to be used in the construction activity throughout the construction Phase.
<b>Operation Phase</b>		
Air Quality	The structure looks very clear and short span. Thus, the circulation of air pollution from the exhaust of vehicles on the main road along the route alignment is better.	The circulation of air pollution is worst because of big structure and long span of Heavy Rail
Noise Level and Vibration	Monorail system with rubber wheel type has less noise level and vibration	Heavy Rail with steel wheel, thus causing more noise and vibration
Scenery	The structure of Monorail system is more clear and transparent, the scenery is beautiful.	The structure of Heavy Rail system is bigger than monorail, so the effects on the scenery will more than monorail system.

#### **4 Reasons for Monorail System**

No.	Consideration Topics	Monorail System and Heavy Rail System (Former Study)	Monorail System (The Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section)
1	Passenger Volume	In the future, passenger volume on the Srinagarindra Road, Phatthakan Road and Theparak Road is not higher than Lat Phrao Road during rush hours, so Monorail system can adequately accommodate.	Monorail system has been developed to serve in populated areas, so the monorail is suitable on Lat Phrao Road, Srinagarindra Road and Thepatak Road

No.	Consideration Topics	Monorail System and Heavy Rail System (Former Study)	Monorail System (The Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section)
2	The convenience of passengers	The system uses two systems on the same path. Passengers must to change another train. This makes the need to walk away and may be cost increases. It doesn't have convenient and may reduces the level of service of MRT.	Using the same line-up of passenger facilities. No need to switch off the car electric system. Thus increasing the service level of the train. This is an advantage of the Metro system.
3	Cost and Benefits	The Metro system has two systems on the same path, requiring Depot for maintenance of 2 signaling system, 2 civil systems, and 2 railway switching system, which will make the higher construction and operation cost.	The Metro system is the only system along the route Depot has one of the signaling system for the maintenance of one system Civil rail system Switching 1 system, which makes the whole construction. And the costs of implementing Save.
4	Environmental impacts - Scenery and Air Quality	The runway and terminal systems Heavy Rail structure are larger than the avoidance of waste, air emissions from cars on the street below.	The runway system and the Monorail station and some small open concrete trough over. Ventilation can be discharged from the cars on the road better.
	- Transportation	Civil construction phase is longer. The impact of higher transportation.	In the civil construction phase can be developed quickly and easily. It takes less than construction. Effects of transportation .

The comparison study of the MRT Yellow Line Project for total distances concludes that:

**The Lat Phrao-Phatthanakan section**

The study result of the original design of the monorail system involved in the MRT Yellow Line Project: Lat Phrao - Phatthanakan section is suitable. It is not necessary to review its result or do the comparison of the rail system alternatives. The following reasons are given as follows.

1) Maximum line loading from the recalculation and the original study are nearly equal. The consideration to choose the rail system is found that the monorail system has a proper mass transit capacity and also be suitable for the Lat Phrao Road which is physically narrow area.

2) The EIA report based on the OTP study result and primary design is already approved by the National Environment Board.

**The Phatthanakan-Samrong section**

The result of comparison of the alternative system in the Bangkok Mass Transit Yellow Line Project : Lat Phrao-Samrong section, supports the change of the MRT system involved

in the Phatthanakan-Samrong section from the heavy rail system to the monorail system for the total distance in this project.

1) The Compatibility with the MRT Network System

Now the MRT outer ring road line project is not involved in the master plan. The MRT system project: Phatthanakan - Samrong section should be compatible with the total distance of the MRT yellow line project without dividing into 2 sections. The change of using only one system, the Monorail System, for the total 30-km distance can be done. Such as the construction of the monorail system with the 60-km distance length in PRC.

2) The Number of Passengers

The forecasted number of passengers increase but nearly equal to the result of the original study. The maximum line loading for the total distance is 23,800 passengers - train/hr./direction (B.E. 2592) and the Monorail System can support. See the **Table 2.1.1 - 11** and **Figure 2.1.1 - 2**.

3) The Service Convenience

The single MRT system for the total distance helps passengers to travel more conveniently between the MRT dark Yellow Line system and the MRT yellow line system at the Phatthanakan station. The forecasted number of 77,800 passengers - train/day (B.E. 2592 in case of fares based on distance) will not change the MRT system on foot. See the **Table 2.1.1 - 12** and **Figure 2.1.1 - 3**.

4) The Total Limited of Project Investment

The change of the rail system to the Monorail System in the project, the Phatthanakan - Samrong section, saves the 11,239 mb of construction expenditure including the reduced construction cost of depots, 2 systems in one project, and the less work of managing the land ownership.

5) Economics and Financial Returns

The change of the rail system to the Monorail system will give higher economic and financial returns than Heavy Rail system due to the lower construction cost which gaining benefits are consistent.

6) Environmental Impact

- The Monorail system cause less environmental impact, the noise intensity and vibration, than the heavy rail system because the rubber tyres make less noise than the steel tyres do.

- The larger track structure of the Heavy Rail System. The structure of track and stations will block the ventilation of polluted car exhaust whereas the Monorail System, the smaller structure of track and stations including the parallel track structure with the gap between tracks, will have less impact on air quality and scenery.

- The Monorail system has less impact on the expropriation because of the small curve radius and its small structures when comparing to the Heavy Rail system.

Although the report of change on the EIA report of the project, Phatthanakan - Samrong section must be done and resubmitted, the approval should not take a long time due to the better improvement.

**Table 2.1.1 - 11 Passenger demand forecasting result in 2049 in case of 20 baht flat fare**

Passenger demand forecasting result in 2049

Case 2 :20 baht flat fare

Item	Station	Daily Trips (Passenger-Trip/Day)						Peak Hour (Passenger-Trip/Hr.)					
		Ratchada - Samrong			Samrong - Ratchada			Ratchada - Samrong			Samrong - Ratchada		
		Boarding	Alighting	Line Load	Boarding	Alighting	Line Load	Boarding	Alighting	Line Load	Boarding	Alighting	Line Load
1	Ratchada	91,571	0	91,571	0	99,279	0	9,729	0	9,729	0	17,425	0
2	Phawana	2,329	4,796	89,104	5,286	2,313	99,279	311	762	9,278	1,005	431	17,425
3	Chok Chai 4	13,223	28,849	73,478	30,832	12,914	96,306	3,265	2,486	10,057	6,939	2,106	16,851
4	Lat Phrao 71	1,505	1,204	73,779	1,650	1,436	78,388	357	286	10,128	375	174	12,019
5	Lat Phrao 83	4,167	7,460	70,486	9,693	3,969	78,173	547	766	9,909	1,131	631	11,818
6	Mahat Thai	8,087	10,933	67,640	8,858	7,721	72,450	1,485	1,403	9,991	1,604	1,555	11,318
7	Lat Phrao 101	7,990	8,631	66,999	8,209	7,787	71,313	1,401	1,070	10,322	1,343	1,394	11,269
8	Bang Kapi	16,350	10,680	72,669	11,766	14,113	70,891	2,092	988	11,427	1,501	1,884	11,320
9	Lam Sali	68,209	20,672	120,207	19,163	59,269	73,238	13,109	4,772	19,764	4,137	15,254	11,703
10	Si Kritha	5,039	5,905	119,340	5,609	4,990	113,345	1,006	622	20,148	1,289	563	22,821
11	Phatthanakan	41,245	40,740	119,844	36,613	42,911	112,726	5,842	8,336	17,654	6,660	8,366	22,094
12	Kalantan	2,315	6,635	115,525	5,901	2,760	119,024	503	1,885	16,273	1,204	541	23,800
13	Si Nut	1,590	3,073	114,042	3,886	1,222	115,883	470	513	16,230	1,178	416	23,137
14	Srinagarindra 38	3,583	6,879	110,746	8,883	2,571	113,219	769	0	16,999	1,644	146	22,374
15	Suan Luang Ro 9	6,995	15,964	101,778	15,751	6,873	106,906	1,324	1,803	16,521	2,283	873	20,876
16	Si Udom	401	2,086	100,093	1,865	423	98,028	202	290	16,433	428	126	19,466
17	Si lam	4,736	31,626	73,202	35,224	2,878	96,585	5,533	4,013	17,953	7,232	798	19,163
18	Si La Salle	1,069	1,988	72,283	2,585	1,052	64,240	356	272	18,037	597	156	12,729
19	Si Bearing	5,662	10,404	67,541	9,809	7,346	62,707	1,731	1,252	18,516	1,465	905	12,289
20	Si Dan	1,895	13,613	55,823	12,777	1,284	60,244	3,259	1,366	20,409	2,966	81	11,728
21	Si Thepha	14,075	11,017	58,880	11,478	13,320	48,750	4,623	1,131	23,901	2,142	732	8,844
22	Thippawan	213	236	58,858	577	0	50,593	22	0	23,924	231	161	7,434
23	Samrong	0	58,858	0	50,016	0	50,016	0	23,924	0	7,365	0	7,365
		<b>302,248</b>	<b>302,248</b>		<b>296,429</b>	<b>296,429</b>		<b>57,936</b>	<b>57,936</b>		<b>54,718</b>	<b>54,718</b>	

Total		Station		Transfer	
Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
91,571	99,279	8,975	8,889	82,596	90,390
7,615	7,109	7,615	7,109		
44,054	41,762	44,054	41,762		
3,155	2,640	3,155	2,640		
13,860	11,430	13,860	11,430		
16,945	18,655	16,945	18,655		
16,199	16,418	16,199	16,418		
28,115	24,793	28,115	24,793		
87,372	79,941	13,639	12,490	73,733	67,451
10,647	10,895	10,647	10,895		
77,858	83,652	72,685	77,805	5,173	5,847
8,216	9,394	8,216	9,394		
5,476	4,294	5,476	4,294		
12,466	9,449	12,466	9,449		
22,746	22,837	22,746	22,837		
2,266	2,508	2,266	2,508		
39,959	34,504	39,959	34,504		
3,654	3,041	3,654	3,041		
15,472	17,750	15,472	17,750		
14,672	14,897	14,672	14,897		
25,553	24,338	25,553	24,338		
790	236	790	236		
50,016	58,858	16,102	16,227	33,914	42,630
<b>598,677</b>	<b>598,677</b>	<b>403,261</b>		<b>195,415</b>	

Trip Length (Daily) = 8.58 KM      %Loading AM/Daily (R-S) = 19.90%      AM. Peak Max. Loading (R-S) = 23,924 Pax.      Case 1 : Distance Base Fare = 532,572  
 Trip Length (AM) = 8.41 KM      %Loading AM/Daily (S-R) = 20.00%      AM. Peak Max. Loading (S-R) = 23,800 Pax.      Case 2 : 20 Baht Flat Fare = 598,677  
 %Diff = 12.41%



Figure 2.1.1 – 2 Passenger demand forecasting result in 2049 in case of 20 baht flat fare

**Table2.1.1- 12 Passenger demand forecasting result in 2049 in case of distance base fare and free all MRTA transfer**

Passenger demand forecasting result in 2049

Case 1 : Distance base fare and free all MRTA transfer

Item	Station	Daily Trips (Passenger-Trip/Day)						Peak Hour (Passenger-Trip/Hr.)					
		Ratchada - Samrong			Samrong - Ratchada			Ratchada - Samrong			Samrong - Ratchada		
		Boarding	Alighting	Line Load	Boarding	Alighting	Line Load	Boarding	Alighting	Line Load	Boarding	Alighting	Line Load
1	Ratchada	80,882	0	80,882	0	89,825	0	9,331	0	9,331	0	15,693	0
2	Phawana	2,143	4,425	78,600	5,008	2,095	89,825	271	737	8,864	955	388	15,693
3	Chok Chai 4	9,162	29,794	57,968	31,882	8,765	86,911	2,383	2,584	8,663	6,993	1,620	15,126
4	Lat Phrao 71	1,197	957	58,207	1,597	1,055	63,795	291	232	8,721	323	149	9,753
5	Lat Phrao 83	3,827	8,268	53,766	9,661	3,102	63,253	494	1,046	8,169	1,110	508	9,579
6	Mahat Thai	7,155	7,512	53,409	8,003	6,426	56,694	1,194	1,020	8,343	1,415	1,419	8,977
7	Lat Phrao 101	6,813	7,901	52,321	7,816	6,566	55,117	1,192	1,019	8,516	1,307	1,202	8,981
8	Bang Kapi	14,246	10,475	56,092	10,847	11,817	53,867	2,082	1,028	9,570	1,195	1,560	8,876
9	Lam Sali	63,705	17,443	102,354	17,369	54,370	54,836	12,564	4,531	17,603	4,026	14,897	9,241
10	Si Kritha	4,528	5,285	101,597	4,927	4,403	91,838	921	573	17,951	1,149	514	20,112
11	Phatthanakan	35,654	34,518	102,733	29,559	38,729	91,313	5,380	7,460	15,870	5,910	7,838	19,477
12	Kalantan	1,667	6,402	97,997	4,950	2,163	100,483	408	1,808	14,471	1,070	444	21,405
13	Si Nut	1,502	2,997	96,502	2,895	1,126	97,697	417	514	14,375	1,060	351	20,779
14	Srinagarindra 38	3,013	5,303	94,212	7,933	2,268	95,928	669		15,044	1,435	92	20,070
15	Suan Luang Ro 9	6,180	14,459	85,934	14,168	5,928	90,263	1,179	1,686	14,537	2,035	866	18,726
16	Si Udom	335	2,381	83,888	1,670	359	82,022	166	253	14,449	379	108	17,557
17	Si lam	4,258	28,240	59,905	31,341	2,883	80,711	4,433	3,725	15,157	7,203	796	17,287
18	Si La Salle	806	3,136	57,575	2,527	764	52,254	301	235	15,223	617	155	10,880
19	Si Bearing	4,673	10,009	52,240	7,460	7,085	50,490	1,694	1,097	15,821	1,141	927	10,418
20	Si Dan	3,287	8,769	46,758	10,500	1,359	50,115	3,230	1,230	17,822	2,270	118	10,205
21	Si Thepha	13,454	9,272	50,940	9,396	12,796	40,975	4,751	983	21,589	1,671	816	8,053
22	Thippawan	202	396	50,745	543	0	44,375	28	0	21,617	217	152	7,198
23	Samrong	0	50,745	0	43,832	0	43,832	0	21,617	0	7,133	0	7,133
		268,688	268,688		263,884	263,884		53,379	53,379		50,614	50,614	

Case 1 : Distance base fare (Samrong - Ratchada)

Total		Station		Transfer	
Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
80,882	89,825	8,463	8,604	72,419	81,221
7,151	6,520	7,151	6,520		
41,044	38,559	41,044	38,559		
2,794	2,013	2,794	2,013		
13,488	11,370	13,488	11,370		
15,158	13,938	15,158	13,938		
14,630	14,467	14,630	14,467		
25,094	22,292	25,094	22,292		
81,073	71,813	13,560	13,604	67,514	58,209
9,455	9,687	9,455	9,687		
65,213	73,248	61,803	68,914	3,410	4,334
6,617	8,566	6,617	8,566		
4,397	4,122	4,397	4,122		
10,946	7,571	10,946	7,571		
20,348	20,387	20,348	20,387		
2,005	2,740	2,005	2,740		
35,599	31,124	35,599	31,124		
3,333	3,900	3,333	3,900		
12,133	17,094	12,133	17,094		
13,787	10,128	13,787	10,128		
22,850	22,068	22,850	22,068		
745	396	745	396		
43,832	50,745	14,081	14,263	29,751	36,482
532,572	532,572	359,478		173,094	

Trip Length (Daily) = 8.05 KM      %Loading AM/Daily (R-S) = 21.04%      AM. Peak Max. Loading (R-S) = 21,617 Pax.  
 Trip Length (AM) = 8.03 KM      %Loading AM/Daily (S-R) = 21.30%      AM. Peak Max. Loading (S-R) = 21,405 Pax.



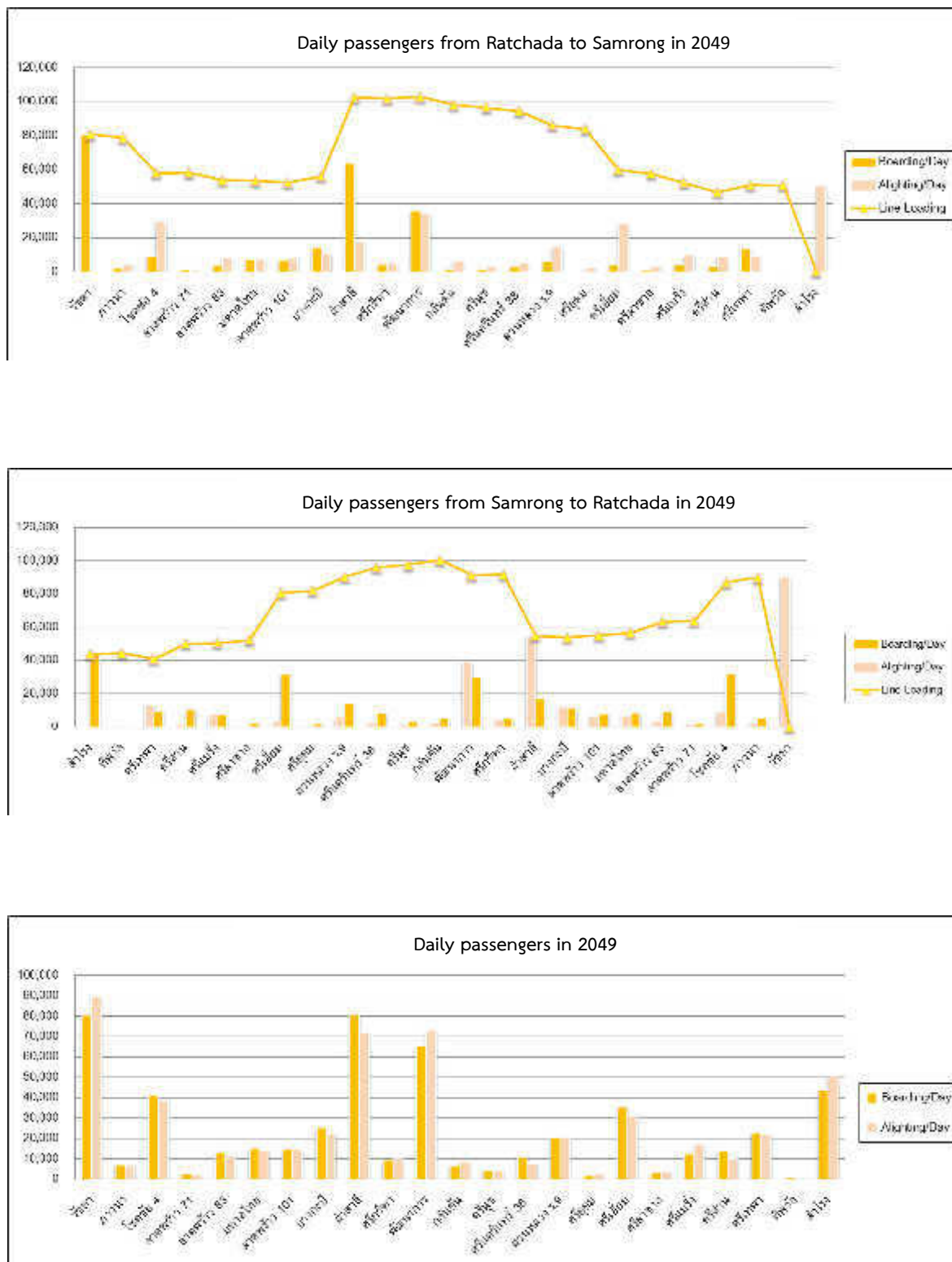


Figure 2.1.1 – 3 Passenger demand forecasting result in 2049 in case of distance base fare and free all MRTA transfer

## 2.1.2 The Changes of Number of Stations and Their Locations

There are 4 criteria for positioning the location of the stations.

- 1) The Distance Between Stations
- 2) The Transit to Other Transporting Systems
- 3) Transportation Centers
- 4) Radius of Picking Up Passengers

### 1) The Distance Between Stations

The determination of proper distance between the stations. The distance for walking should be within the radius of 500 meters from the end of the station, then each station will be 1,000 - 1,500 m. far from the others. The 2 stations with the less than 1,000 m. distance, this area is classified as the sensitive area of the environmental impact and a place of overlapping passengers. The 2 stations with the more than 1,500 m. distance, this area is classified as being the area where the rail system has not enough capacity of service and not support the city growth.

### 2) The Transit to Other Transporting Systems

The transit to other transporting systems. For the convenience of travel transit to other kinds of the MRT systems, the location of the stations or the entrance-exit ways are determined near the other stations or the entrance-exit ways of the other MRT system.

### 3) Transportation Centers

The determined location of the stations are near other transportation centers such as road, traffic circle, intersection, junction etc.

### 4) Radius of Picking up Passengers

Considering the radius of picking up passengers in area or communities such as market, shopping center, school, village, condominium etc., the location of the stations are determined to cover these areas.

The Bangkok Mass Transit Yellow Line Project : Lat Phrao-Samrong section has a total 30 km distance from Bangkok to Samut Prakan. (23 stations) The changed location and the original location of stations (OTP's study), in the MRT yellow line project are compared in the **Table 2.1.2 - 1**. The location of the stations are detailed as following.

**Table 2.1.2 - 1 The stations of MRTA Yellow Line Project (Lat Phrao – Samrong section)  
compare with the former stations in OTP’s study report.**

No.	No. (in OTP’s study report)	Station	Km.		Distance (m.)	
			The MRTA Yellow Line Project (Lat Phrao - Samrong)	OTP	The MRTA Yellow Line Project (Lat Phrao - Samrong)	OTP
YL - 01	Y-01	Ratchada	0 + 000	0 + 000		
YL - 02	Y-02	Phawana	1 + 314	1 + 425	1,314	1,175
YL - 03	Y-03	Chok Chai 4	2 + 606	2 + 800	1,292	1,375
YL - 04	FS-01	Lat Phrao 71	4 + 211	3 + 750	1,605	
YL - 05	Y-04	Lat Phrao 83	5 + 006	4 + 850	795	2,050
YL - 06	Y-05	Mahat Thai	6 + 118	5 + 750	1,112	2,000
YL - 07	Y-06	Lat Phrao 101	7 + 022	7 + 75	904	2,225
YL - 08	Y-07	Bang Kapi	8 + 262	8 + 525	1,240	2,775
YL - 09	Y-08	Lam Sali	9 + 411	9 + 600	1,149	2,525
YL - 10	Y-09	Si Kritha	10 + 710	10 + 850	1,299	2,325
YL - 11	Y-10	Phatthanakan	12 + 257	12 + 400	1,547	2,800
YL - 12	FS-02	Kalantan	13 + 527	-	1,270	-
YL - 13	Y-11	Si Nut	15 + 124	15 + 225	1,597	2,825
YL - 14	FS-03	Srinagarindra 38	16 + 261	-	1,137	-
YL - 15	Y-12	SuanLuang Ro 9	17 + 411	17 + 600	1,150	2,375
YL - 16	Y-13	Si Udom	18 + 982	19 + 150	1,571	1,550
YL - 17	Y-14	Si lam	19 + 985	20 + 200	1,003	1,050
YL - 18	Y-15	Si La Salle	21 + 421	21 + 550	1,436	1,350
YL - 19	Y-16	Si Bearing	22 + 861	22 + 950	1,440	1,400
YL - 20	Y-17	Si Dan	24 + 220	24 + 250	1,359	1,300
YL - 21	Y-18	Si Thepha	25 + 331	25 + 675	1,111	1,425
YL - 22	Y-19	Thippawan	26 + 951	27 + 175	1,620	1,500
YL - 23	Y-20	Samrong	28 + 691	28 + 800	1,740	1,625

Remark : Station YL - 04, YL – 12 and YL - 14 are new stations.

Source : Feasibility report of MRTA Yellow Line Project (Lat Phrao – Samrong section), MRTA; June, 2013.

### 1) YL - 01 Ratchada Station

Location It is located near Lat Phrao park and ride building, on the side of the building, which was large empty space. The important landmark is Lat Phrao park and ride building, medium density of community resident. It can connect to the MRT Chaloem Ratchamongkhon Line Project, as shown in **Figure 2.1.2 - 1**.

The travel to stations can use the four spots of Entrance and Exits, by the first spot is to accommodate the amount of traffic from road. The second spot is up - and down into the large green area. And one spot of elevator and ramp are accommodating the disabled. Including one spot of escalator is accommodated and facilitates the main passer from the offices.



Figure 2.1.2 - 1 Location of Ratchada station (YL - 01)

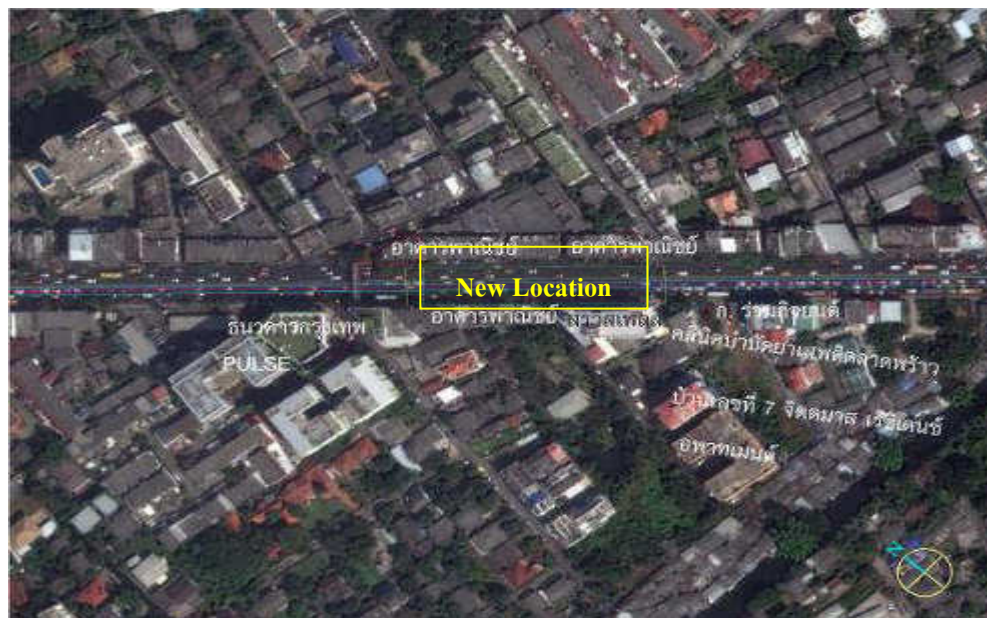
### 2) YL - 02 Phawana Station

Location: It is located near Soi Lat Phrao 41 or Soi Phawana, Bangkok Bank, the Pulse Condo, Shell Gas Station, Pibool Upphatham School. The station is located on the middle of Lat Phrao Road with the medium density of community resident.

Location: It is moved to put across the Soi Phawana Intersection shifted from its original position about 80 meters to accommodate users from across the intersection. The volume of commuters and students from Soi Phawana From Pibool Upphatham School is shown in **Figure 2.1.2 - 2**.



a) Location of Phawana station in previous study report



b) Location of Phawana station in this study report

Figure 2.1.2 – 2 Location of Phawana station (YL – 02)

### 3) YL - 03 Chok Chai 4 Station

Location: It is located near Soi Chok Chai 4. The station is located on the middle of Lat Phrao Road, Sap Chan Phan Market, Chok Chai 4 Police Station with the medium density of community resident, as shown in Figure 2.1.2 – 3. In order to support the volume of traffic from Soi Chok Chai 4, Soi Chok Chai 4 Fresh Market and Chok Chai 4 Police Station.





Figure 2.1.2 – 3 Location of Chok Chai 4 station (YL – 03)

#### 4) YL - 04 Lat Phrao 71 Station

Location: It is an additional station from the original. It is located on the entrance of Soi Lat Phrao 71, the middle of Lat Phrao Road with the medium density of community resident in order to support the volume of traffic from Soi Lat Phrao 71,82, 80, Pradist Manutham Road and Chalong Rat Expressway. It is also a station connecting to the Bangkok MRT Grey line in the future, as shown in Figure 2.1.2 - 4.

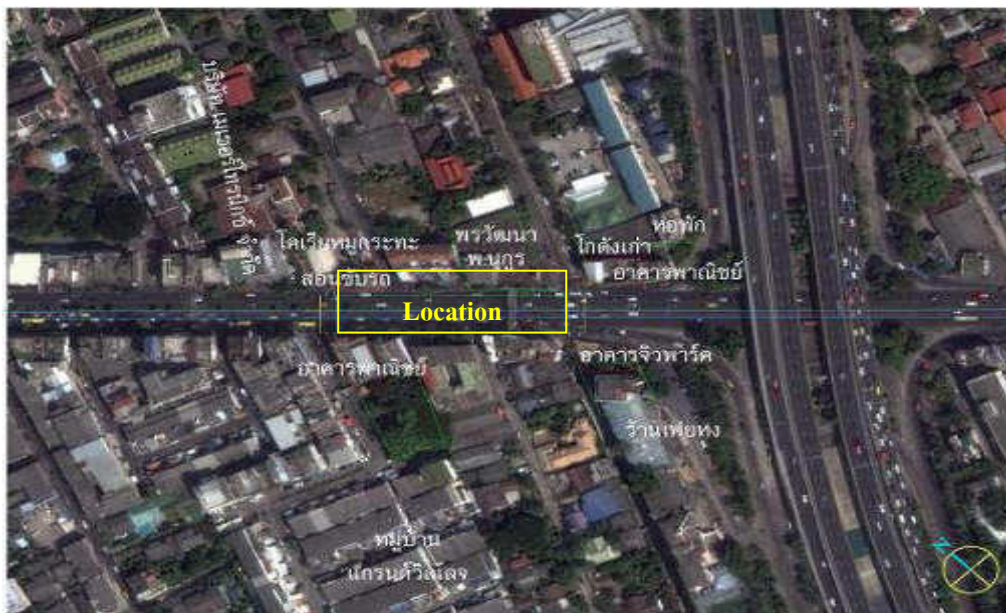


Figure 2.1.2 – 4 Location of Lat Phrao 71 (YL – 04)

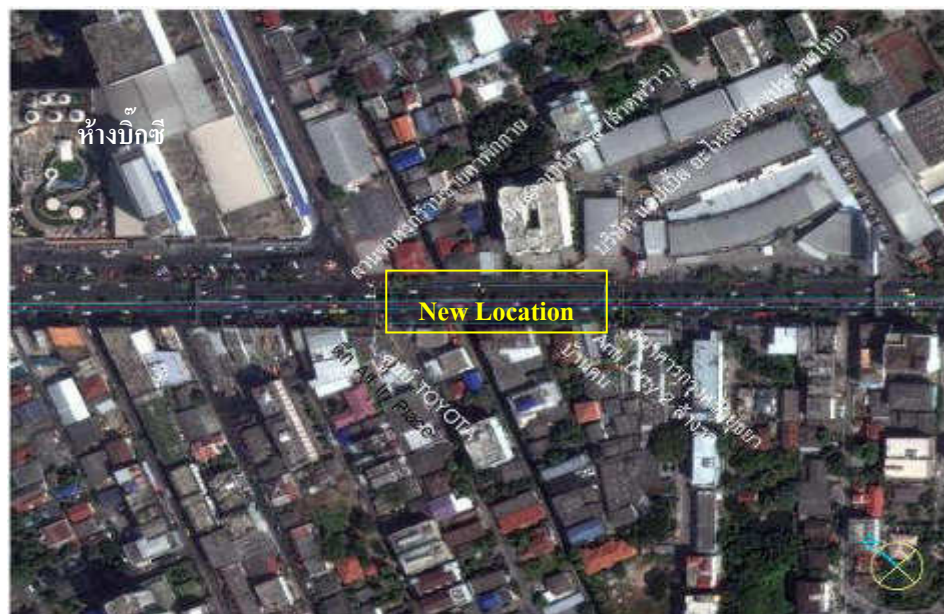
### 5) YL - 05 Lat Phrao 83 Station

Original Location: It is located near Chalong Rat Expressway, between Soi Lat Phrao 79 and Soi Lat Phrao 81, in the middle of Lat Phrao Road with the medium density of community resident.

New Location: The station must be shifted to a suitable distance from Lat Phrao 71 Station. Therefore, it is considered to be located between Soi Lat Phrao 83 and Soi Lat Phrao 85 which is opposite to Soi Lat Phrao 94. It is in the middle of Lat Phrao Road with the medium density of community resident and to support the traffic volumes from the Imperial World Lat Phrao Department Store, passengers from Pradist Manutham Road, and people living in the alley, as shown in **Figure 2.1.2 - 5**.



a) Location of Lat Phrao 83 station in previous study report



b) Location of Lat Phrao 83 station in this study report

Figure 2.1.2 – 5 : Location of Lat Phrao 83 station (YL – 05)



### 6) YL - 06 Mahat Thai Station

Original Location: It is located between Soi Lat Phrao 87 and 91, in the middle of Lat Phrao Road with the medium density of community resident.

New Location: The station must be shifted to a suitable distance from Lat Phrao 83 Station. Therefore, it is considered to be located near Lat Phrao Hospital, Food Land Supermarket Co. Ltd., and Volvo Service Center. It is in the middle of Lat Phrao Road with the medium density of community resident and to support the traffic volumes from near Lat Phrao Hospital, Food Land Supermarket Co. Ltd., and neighboring communities, as shown in **Figure 2.1.2 - 6**.



a) Location of Mahat Thai station in previous study report



b) Location of Mahat Thai station in this study report

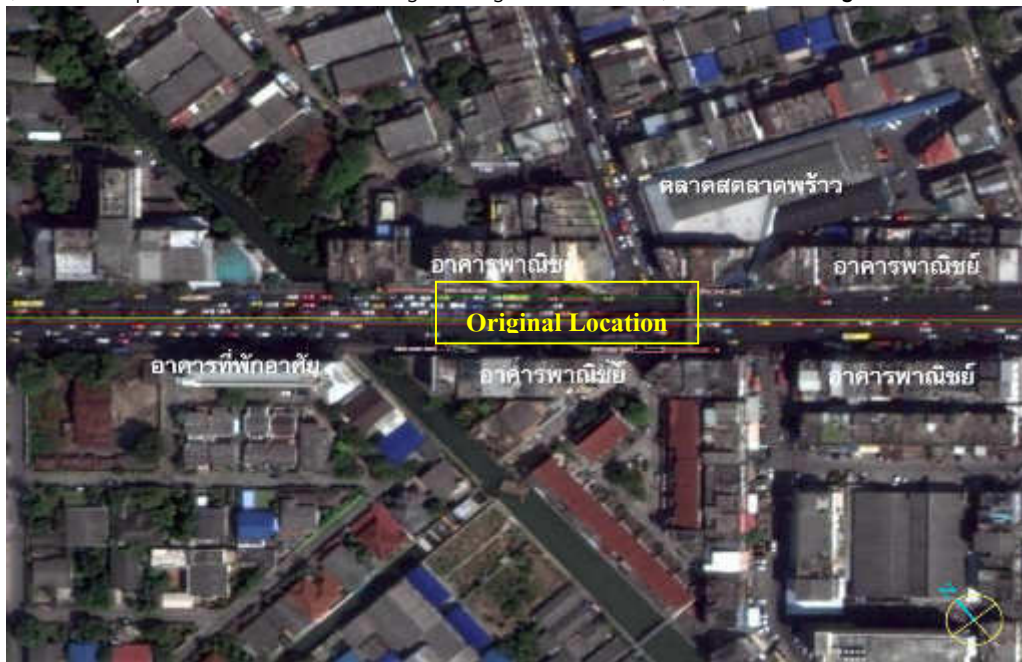
**Figure 2.1.2 - 6** Location of Mahat Thai station (YL – 06)



### 7) YL - 07 Lat Phrao 101 Station

Original Location: It is located near Lat Phrao Fresh Market, entrance of Soi Lat Phrao 101, which is in the middle of Lat Phrao Road, at the foot of elevated bridge, with the medium density of community resident.

New Location: The designed station is shifted from the original position, about 98 meters. So it is a suitable distance from Mahat Thai Station to support the traffic volumes from the hospital, Makro Department Store and neighboring communities, as shown in **Figure 2.1.2 - 7**.



a) Location of Lat Phrao 101 station in previous study report



b) Location of Lat Phrao 101 station in this study report

**Figure 2.1.2 – 7 Location of Lat Phrao 101 station (YL – 07)**

### 8) YL - 08 Bang Kapi Station

Original Location: It is located near the Mall Department Store at Bang Kapi, Makro Department Store and Tawanna Square, which is in the middle of Lat Phrao Road, at the foot of elevated bridge, with the medium density of community resident.

New Location: The designed station is shifted from the original position, about 200 meters. So it is a suitable distance from Lat Phrao 101 Station to accommodate the traffic volumes from the Mall and Lotus Department Store, and neighboring communities, as shown in **Figure 2.1.2 - 8**.



a) Location of Bang Kapi station in previous study report



b) Location of Bang Kapi a station in this study report

Figure 2.1.2 – 8 Location of Bang Kapi station (YL – 08)



### 9) YL - 09 Lam Sali Station

Location: It is located on Lam Sali Intersection. It is an Interchange Station of MRT Orange Line (underground). The station is location in the middle of Srinagarindra Road intersecting with the Ramkhamhaeng Road, with the medium density of community resident in order to support the traffic volumes from Lam Sali Intersection, the passengers going to Ramkhamhaeng Road, and neighboring communities, as shown in **Figure 2.1.2 – 9**.



Figure 2.1.2 - 9 : Location of Lam Sali Station (YL – 09)

### 10) YL - 10 Si Kritha Station

Location: It is located on Srinagarindra Road intersecting with Hua Mak and Kritha Road which traffic can be expanded in several directions. The side of the station is the large green area. Neighboring landmarks include Samitivej Srinagarindra Hospital, Nakarin movie theater with the low density of community resident. Throughout the route, there are private companies, office, high residential buildings. The surrounding area is mostly green space that has not been developed. The Srinagarindra Road traffic inbound to the down town area is quite dense in order to support the traffic volumes from Samitivej Srinagarindra Hospital, incoming passenger to the down town area, and neighboring communities, as shown in **Figure 2.1.2 - 10**.



Figure 2.1.2 – 10 Location of Si Kritha Station (YL – 10)

#### 11) YL - 11 Phatthanakan Station

Original Location: It is an Interchange Station located on Srinagarindra Road intersecting with Motorway Road. It connects with Hua Mak Airport rail link. It makes a trip into down town or to the airport with ease, and connect with the Phatthanakan Station. The side of the station is the large green area. Neighboring landmarks include Hua Mak Station, Hua Mak School with some community residents. The surrounding area is mostly green space that has not been developed. The Srinagarindra Road traffic inbound to the down town is quite dense.

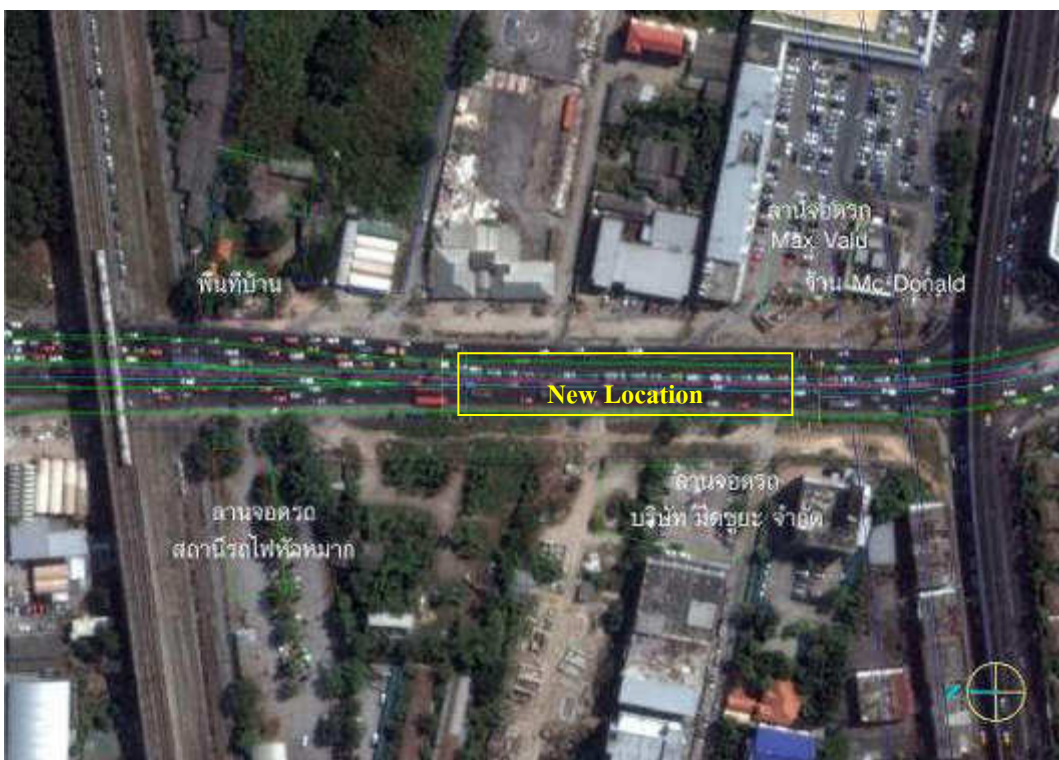
New Location: It is located on Srinagarindra Road near the Max Value Department Store. It connects with Hua Mak Airport rail link which makes a trip into down town or to the Suvarnabhumi airport with ease.

It support the volume of incoming passengers to down town area and connects with Hua Mak Airport rail link to enter the Suvarnabhumi airport, or into down town area by another way, as shown in **Figure 2.1.2 - 11**.





a) Location of Phatthanakan station in previous study report



b) Location of Phatthanakan station in this study report

Figure 2.1.2 – 11 Location of Phatthanakan Station (YL – 11)

## 12) YL - 12 Kalantan Station

Location: It is the new proposed station to support the expansion of the community in the future. It is located on Srinagarindra Road. The side of the station is the large green area. Neighboring landmarks include Thanya Shopping Park Department Store, Trium Udom Suksa Phatthanakan School, with the high density of community resident The Srinagarindra Road traffic inbound to the down town is quite dense, as shown in **Figure 2.1.2 – 12**.



Figure 2.1.2 – 12 Location of Kalantan Station (YL – 12)

## 13) YL - 13 Si Nut Station

Location: It is located on Srinagarindra Road intersecting of On Nut Road on the South of Si Nut Intersection. There are private company buildings and show rooms, with the low density of community resident on Srinagarindra Road. It is to accommodate the volume of incoming passengers to down town area and connects with Srinagarindra Road or On Nut Road in order to into down town area by another way, as shown in **Figure 2.1.2 – 13**.





Figure 2.1.2 – 13 Location of Si Nut Station (YL – 13)

#### 14) YL - 14 Srinagarindra 38 Station

Position: It is the new proposed station. There are private company buildings in surrounding area of Srinagarindra Road, with the high density of community resident. The Srinagarindra Road traffic inbound to the down town is quite dense, as shown in **Figure 2.1.2 – 14**



Figure 2.1.2 – 14 Location of Srinagarindra 38 Station (YL – 14)





### 17) YL - 17 Si lam Station

Original Location: It is located on Srinagarindra Road intersecting with Bang Na - Trat Road. Neighboring landmarks include Sri lam Temple, Show Rooms and private company office buildings, and Thainakarin Hospital. The surrounding area is mostly green space that has not been developed with hardly a community resident, as shown in **Figure 2.1.2 - 17**.

New Location: It is moved to be prior to reaching the Bang Na - Trat Road opposite to Wat Sri lam Anusorn School and Sri lam Temple. It is to accommodate the traffic volumes from Thainakarin Hospital, neighbouring office buildings and passengers from Srinagarindra Road.



a) Location of Si lam station in previous study report



b) Location of Si lam station in this study report

**Figure 2.1.2 – 17 Location of Si lam Station (YL – 17)**

### 18) YL - 18 Si La Salle Station

Location: It is located on Srinagarindra Road intersecting with La Salle Road (Soi Sukhumvit 105). Neighboring landmarks include Sikirin Hospital, Premier Place Department Store, La Salle Driving Range, and Bay Hotel Suvarnabhumi. It is to accommodate traffic volumes from Bay Hotel Suvarnabhumi, Sikirin Hospital, neighboring office buildings, and passengers from Srinagarindra Road, as shown in **Figure 2.1.2 - 18**.



Figure 2.1.2 – 18 Location of Si La Salle Station (YL – 18)

### 19) YL - 19 Si Bearing Station

Location: It is located on Srinagarindra Road intersecting with Bearing Road (Soi Sukhumvit 107). Neighboring landmarks include residential housing, hotels, entertainment spot, private business buildings, and car showrooms. It accommodate traffic volumes from hotel, neighboring office buildings and passengers from Srinagarindra Road, as shown in **Figure 2.1.2 – 19**.



Figure 2.1.2 – 19 Location of Si Bearing Station (YL – 19)



## 20) YL - 20 Si Dan Station

Original Location: It is located on Srinagarindra Road in the area of Nayarin Golf Driving Court connecting with Wat Dan Samrong Road and Wat Nam Daeng Road. Neighboring landmarks include Klong Samrong, Golf Driving Court, Department Stores, Supermarkets, Office Buildings with the low density of community resident. The surrounding area is mostly green space that has not been developed, as shown in **Figure 2.1.2 – 20**.

New Location: It is moved closer to the foot of slope of the Si Thepha Intersection Bridge. It is accommodate the volume of traffic from the Foodland Supermarket, neighboring office buildings, Aek Pailin Shopping Mall, and passengers from Srinagarindra Road.



a) Location of Si Dan station in previous study report



b) Location of Si Dan station in this study report

**Figure 2.1.2 – 20 Location of Si Dan Station (YL – 20)**

## 21) YL - 21 Si Thepha Station

Original Location: It is located on Thepharak Road in front of Rinrada Health Club, near Thepharak Intersection intersecting with Srinagarindra Road. Two sides along the road are private commercial buildings with the low density of community resident. Neighboring areas are condominiums and office buildings, as shown in **Figure 2.1.2 - 21**.

New Location: It is moved closer to Si Thepha Intersection (west side) in order to support traffic volumes from the neighbouring office buildings and passengers from Srinagarindra and Thepharak Road.



a) Location of Si Thepha station in previous study report



b) Location of Si Thepha station in this study report

Figure 2.1.2 – 21 : Location of Si Thepha Station (YL – 21)



## 22) YL - 22 Thippawan Station

Original Location: It is located on Thepharak Road in the area of Soi Thippawan. Two sides along the road are private commercial buildings with the low density of community resident. Neighboring areas are condominiums, office buildings, and paper industrial plant. Neighboring landmarks include Chularat Hospital and Taekwondo Association of Thailand as shown in **Figure 2.1.2 - 22**

New Location: It is moved to the entrance of Thippawan Village. In order to accommodate volume of traffic from main alley, neighbouring office buildings and passengers from Thepharak Road.



a) Location of Thippawan station in previous study report



b) Location of Thippawan station in this study report

**Figure 2.1.2 – 22 Location of Thippawan Station (YL – 22)**

### 23) YL - 23 Samrong Station

Location: It is located on Thepharak Road around the road corner intersecting with Sukhumvit Road. Two sides along the road are private commercial buildings with the low density of community resident. Neighboring areas are condominiums, office buildings, and department stores. Neighboring landmarks include Chulavej Hospital and Matthayom Dansamrong School which connects with Light Green MRT Line, as shown in **Figure 2.1.2 - 23**.

The travel to the station accommodate traffic volumes from Neighboring office buildings, and passengers from Thepharak and Samrong Road.



**Figure 2.1.2 - 23 Location of Samrong station (YL – 23)**

The original 21 stations are increased to 23 stations. The details of two new additional station are as follows:

1. Lat Phrao 71 Station: It is an additional station from the original study. Because it is the transition point to another system, therefore the Lat Phrao 71 Station is designed to connect to Bangkok MRT Grey Line Project. On Praditmanutham Road is intended to have Grey Line station to accommodate the connection with the Yellow Line during the Lat Phrao - Samrong Station by the Lat Phrao 71 Station. The important reason to determine the location of the station is the establishment for trip connecting, and convenient trip redirecting to other routes, as shown in **Figure 2.1.2 - 24**.

2. Srinagarindra 38 Station: It is an additional station from the original study. Because of the station location should be a proper distance and better access to the station. The distance from each station should be between 0.8 - 1.5 km. The walking distance from the area covered by the end of station, with a radius of 500 meters of walking between stations. The scope of accommodating passengers from the original plan between Si Nut Station and Suan Luang Ro 9

Station is increased by inserting the Srinagarindra 38 Station into between Si Nut Station and Suan Luang Ro 9 Station. Therefore, the distance between Si Nut Station and Suan Luang Ro 9 Station is decreased from 3 kilometers to 1.5 kilometers, which can accommodate more passengers, as shown in Figure 2.1.2 - 2.1.2 and Figure 25 - 26.

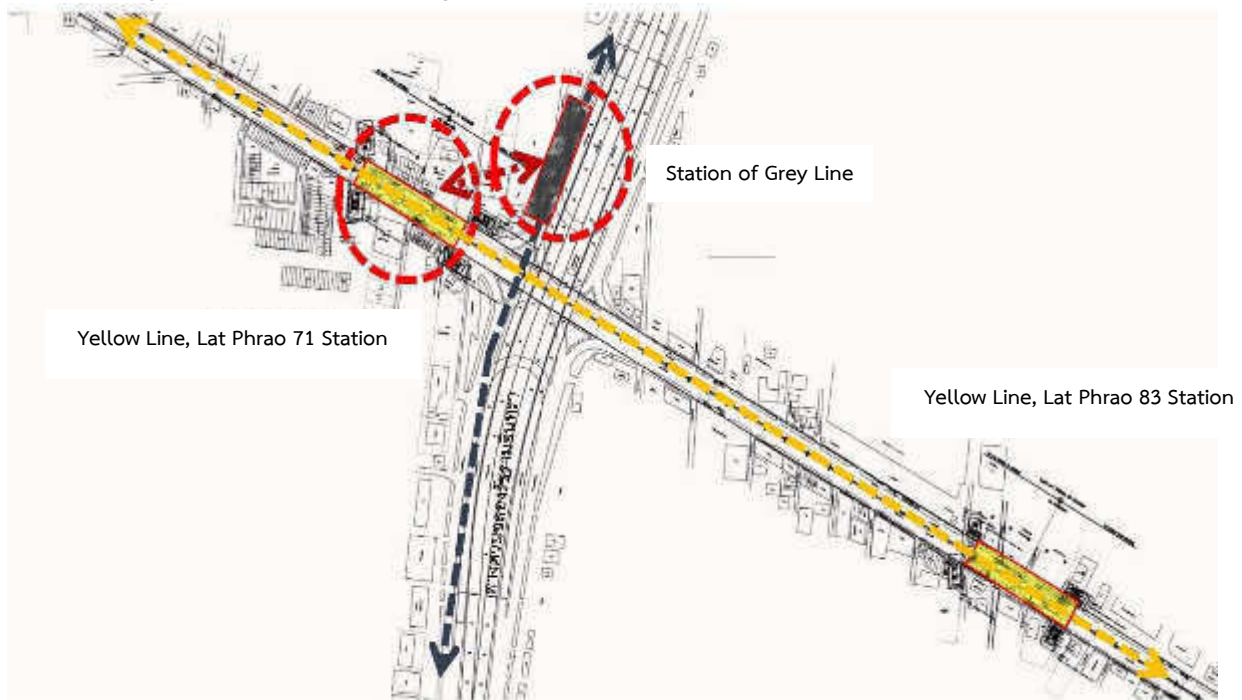


Figure 2.1.2 - 24 MRT Gray Line Project (Watcharapol – Rama 9 Bridge) connect with MRT Yellow Line Project (Lat Phrao – Samrong section) at Lat Phrao 71 station

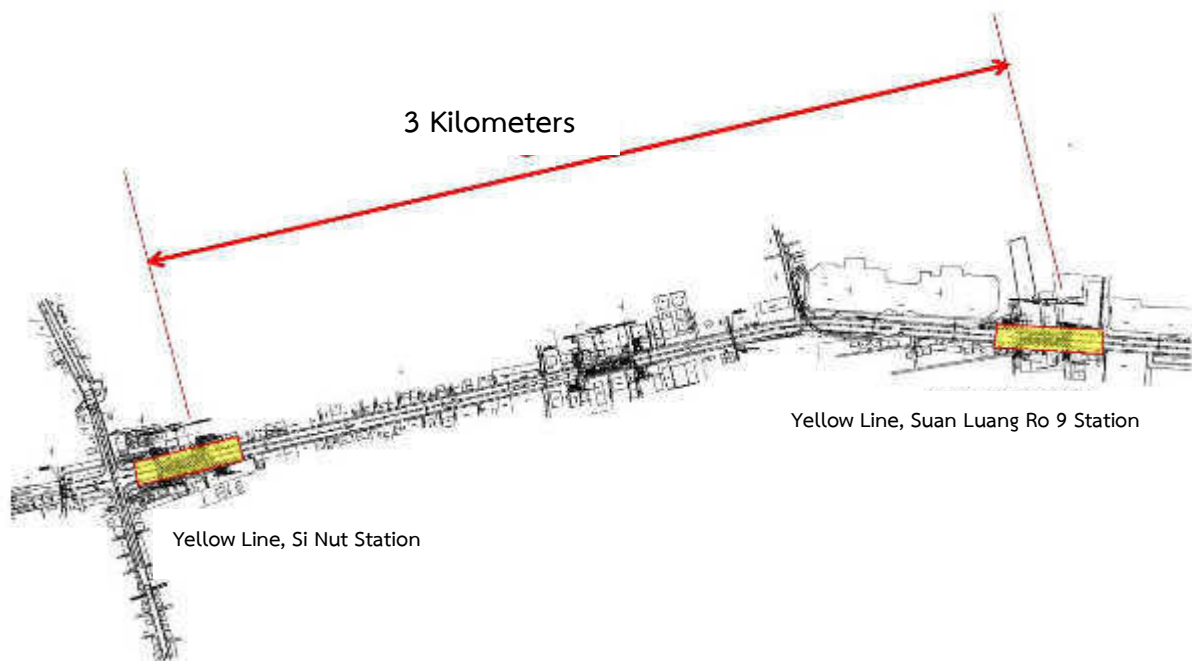


Figure 2.1.2 - 25 Distance between Si Nut Station and Suan Lung Ro 9 Station in the previous study report



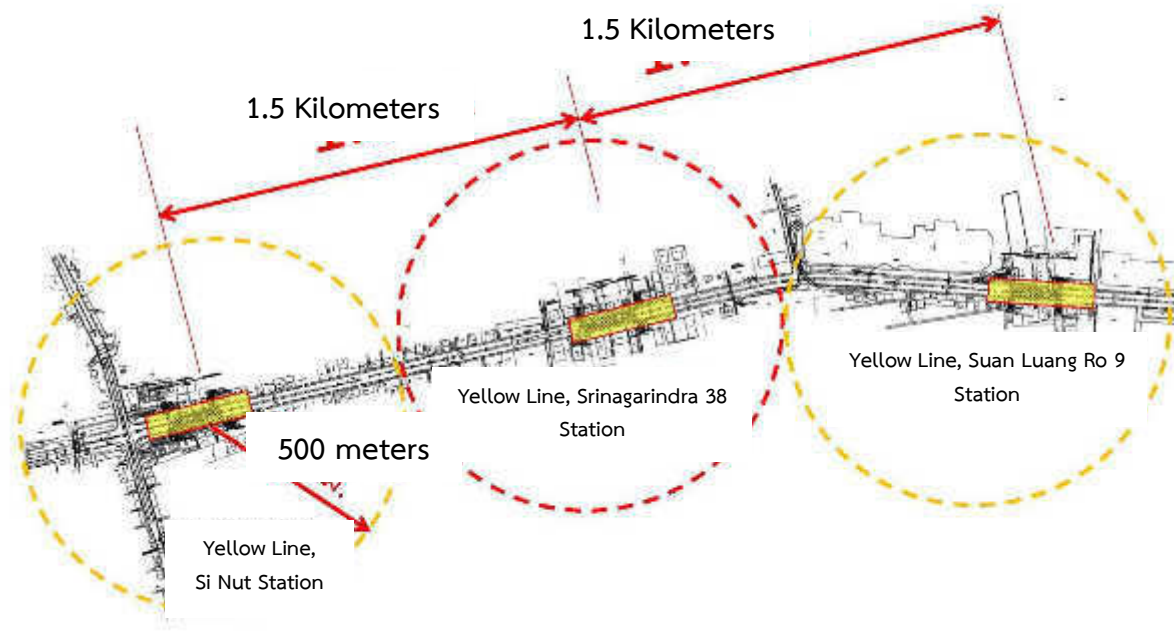


Figure 2.1.2 - 26 Distance between Si Nut station and Suan Lung Ro 9 station after add Srinagarindra 38 station

The addition of train station to be 23 stations do not affect the increase of the distance or duration of the project construction, but making an increasing of project construction cost, of about 840 million baht. However, increasing the number of stations will facilitate travel of the people who use the service. Since the original study by the Office of Transport and Traffic Policy and Planning (OTP) has determined quite a lot of distances between the train station on Srinagarindra Road, by the distance between some stations is 2-3 kilometers. While recommendations about the distance of the train station reveal that it should be enough space for passengers to walk easily to the station in a reasonable period. Therefore, in the urban areas routes with dense communities, the distance between station is required between 0.800 to 1.500 kilometers for the pedestrians who use the services to have the proper walking distance. But in the suburban areas with uncrowded communities, it may consider the distance between station to be more than this. However, it should not keep away from the communities beyond a reasonable walking distance. In the case of the Bangkok Mass Transit Yellow Line Project : Lat Phrao-Samrong is considering the distance from the community with the density of population should not exceed one kilometer.

It, therefore, proposes to increase another two more stations. Moreover, when considering with the Comprehensive City Planning Plan of Srinagarindra Road area, it revealed that the Bangkok Metropolitan Administration has improved the land use on various sections of Srinagarindra Road areas to be the densely utilized area. Therefore, the design model of travel is sufficient to expected population to migrate in the area in the future.



### 2.1.2.1 Change of Depot Location

Since the original study of MRTA Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan section) and MRTA Dark Yellow Line Project (Phatthanakan-Samrong section) by the OTP revealed that it will use the different electric railway system. MRTA Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan section) will use Monorail system, and MRTA Dark Yellow Line Project (Phatthanakan-Samrong section) will use Heavy Rail system. Therefore, the Depot for each system must be separated. MRTA Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan section) will have one Depot located near the terminal at Rama IV Interchange on approximately 35 rai of open space between the Eastern Railroad and the Intercity Motorway No. 7 (Bangkok - Chonburi). MRTA Dark Yellow Line Project (Phatthanakan-Samrong section) will have another Depot located on approximately 112 rai of large open space on the East of Si lam Interchange.

As a result of the review of project feasibilities, the electric railway system is modified to be the same system throughout the entire line. Therefore, there is only one Depot located near the intersecting Srinagarindra Road and Bang Na-Trat Road. The slanting to the rear area of the new Depot is the old Depot Building of MRTA Dark Yellow Line Project (Phatthanakan-Samrong section) from the original study of OTP, approximately 122 rai, as shown in **Figure 2.1.2 – 1. Location of the Depot of MRTA Yellow Line Project : Lat Phrao – Samrong section.**

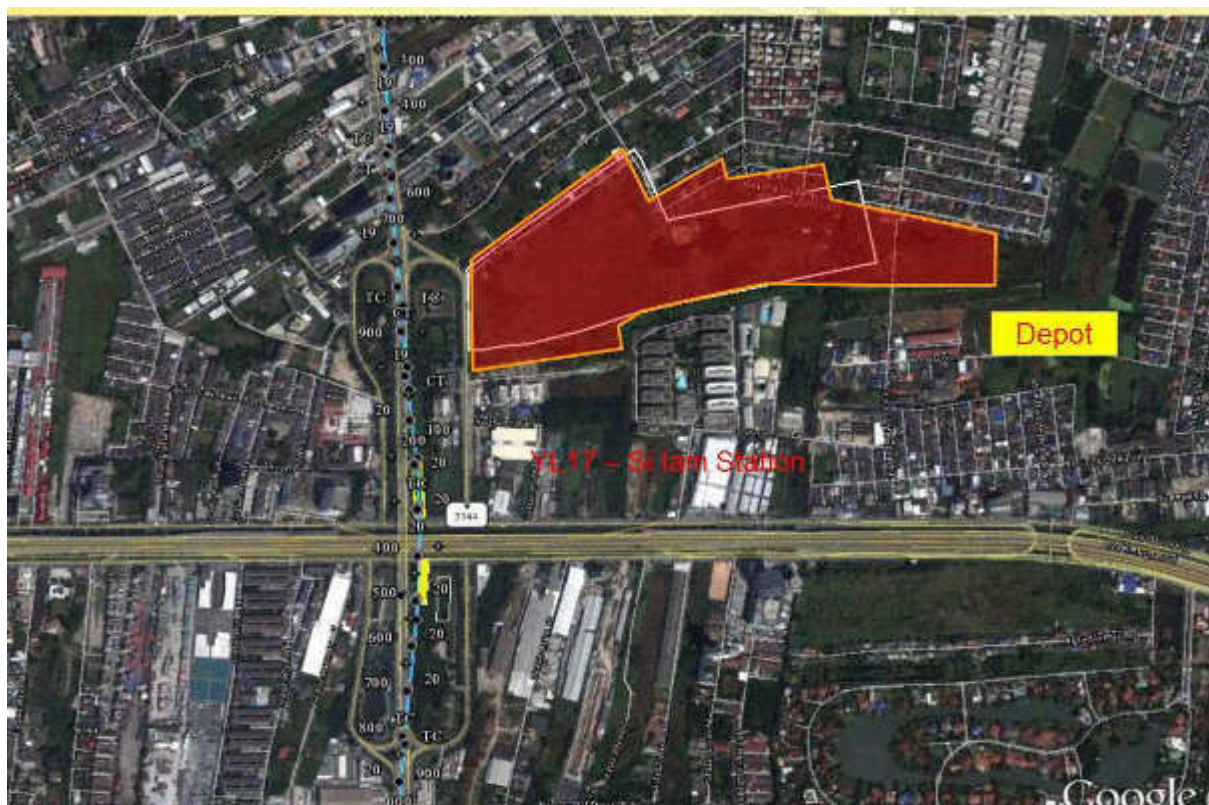


Photo 2.1.2 – 1 Depot location of MRT Yellow Line Project (Lat Phrao – Samrong section)

### 2.1.2.2 Changing of Park & Ride Buildings Location

Since the original study of MRTA Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan section) and MRTA Dark Yellow Line Project (Phatthanakan-Samrong section) by the OTP specified that there was one location of Park & Ride, for the convenience of passengers using the private car. It was located at Phatthanakan Station area, Rama IV Interchange. It will request approximately 55,860 sq.m. of open space from Expressway Authority of Thailand and Department of highways to develop a parking lot, approximately 2,800 parking spaces with designated points of in- out of a parking lot in the proper position such as U Turn under the interchange or a flat surface road for vehicles turning left before the interchange. Therefore, the vehicles in interchange will be secured as the same and do not increase problem of intersecting.

As a result of the review of project feasibilities, the new proper location of Park & Ride Buildings has been reconsidered. Since this Park & Ride Buildings is for those who use the service in the system which requires a sufficient amount of parking space for both current and projected for the future. The appropriate issues must be considered, as follows:

- 1) Area
- 2) Distance to station
- 3) Distance to the Depot
- 4) Supporting route alignment
- 5) Access
- 6) Landmarks within one kilometer of the surrounding.

The results of the comparative study of location of Park & Ride Buildings of Bangkok Mass Transit Yellow Line Project : Lat Phrao-Samrong section are shown in **Table 2.1.2 - 2**.

The results of the comparative study of location of Park & Ride Building revealed that space of Park and Ride Buildings in the area of alternative No.1 and No.3 are appropriate in the first and the second, respectively. Because there is lot of space to accommodate and is very close to the station, respectively. It is also more support routes and space. The important point is more communities and adjacent to the Bang Na - Trat Road to accommodate all traffic in the in the east of the country.

The conclusion results of the project feasibilities regarding to the proper location of Park & Ride Buildings is the change of the location from the OTP's original study of The new location of Park & Ride Building is located on Srinagarindra Road intersecting with Bang Na-Trat Road. The location of Park & Ride Buildings of Bangkok Mass Transit Yellow Line Project : Lat Phrao-Samrong section is shown in **Photo 2.1.2 - 2**.

**Table 2.1.2 - 2 Results of Park & Ride Location Comparisons**

Area/ importance sequence	OTP1/ Priority 6	OTP2/ Priority 5	1 <sup>st</sup> Alternative/ Priority 1	2 <sup>nd</sup> Alternative/ Priority 4	3 <sup>rd</sup> Alternative/ Priority 2	4 <sup>rd</sup> Alternative/ Priority 3
1. Land size	5 rai	46 rai	40 rai	11.5 rai	28 rai	17.5 rai
	7,485 m <sup>2</sup>	74,000 m <sup>2</sup>	63,570 m <sup>2</sup>	18,400 m <sup>2</sup>	45,450 m <sup>2</sup>	28,150 m <sup>2</sup>
2. Distance to station (m)	150.00	750.00	65.00	220.00	510.00	560.00
3. Distance to Depot (m)	2,310.00	0.00	6.00	158.00	460.00	540.00
4. No. of road connectivity (width of road, m)	1 (6)	1 (6)	3 (6) (10) (6)			
5. Compatible network	Residence and commercial area along Srinagarindra Road and Soi La Salle	Residence and commercial area along Srinagarindra road, Phatthanakan Road and Motorway (Bangkok – Chonburi)	Residence and commercial area along Srinagarindra road, Soi Udomsuk (Sukhumvit 103), Bang Na – Trat road and Burabhavithi Expressway			
6. Access	Main road	Secondary road (Soi)	Main road			
7. Important place in radius of 1 km.	Big C superstore, Makro superstore, Bay hotel, Evergreen International School, Plaiploy Temple, Baan Klang Mueang condominium	Max Value superstore, Lotus superstore, Hua Mak railway station, Airportlink station, Ueasuk village, Mueang Thong village, Triamudomsakkapata nakran School, Bangkok bank, Vibharam Hospital	Sri lam Temple, Novotel hotel, Maple hotel, Empire tower, Pairojkijja building, Thainakaran Hospital, Central Bang Na department store, Big C, Bang Na complex, Supalai Condominium, Prachakhom International School, Technopremruethai School, The Nation building, Samut Prakan Revenue Office, Premruethai village			

### 2.1.3 Change of Route Alignment

The route alignment of MRTA Yellow Line Project is modified to be suitable to reduce the impact of expropriated buildings in crowded areas, the physical limitations of the original bridge, and the continuation of the route geometry. The performing of modifications in the six routes are as follows:

- Bang Kapi Intersection Area
- Bridge across Canel Prawet Burirom area
- Si Udom Intersection continuous to Si lam Interchange area
- Modification of route alignment in the Phatthanakan Intersection area
- Route alignment in relating area of structure or BMA project in the future
- Route alignment for the project extension in the future



Photo 2.1.2 – 2 Park & Ride building location of MRT Yellow Line Project (Lat Phrao - Samrong section)

### 1) Bang Kapi Intersection Area

There is an overpass with four traffic lanes and no gap in the middle in the route alignment of Bang Kapi Intersection area. According to the results of the OTP's original study by the designated route turns slightly to the right prior to turning into Srinagarindra Road. Therefore, it needs for land expropriation and demolition of buildings, including Mall Suites Express Hotel, Bann Suan Saghob and commercial buildings. The consultant has proposed four alternative models, as follows:

(1) 1<sup>st</sup> Alternative: by pass to the right of route according to the results of OTP study, which there are buildings that will be moderately affected by the expropriation.

(2) 2<sup>nd</sup> Alternative: by pass to the left of route which there are N-Mark Plaza, Bang Kapi Market, and commercial buildings that will be much affected by the expropriation.

(3) 3<sup>rd</sup> Alternative: Two separate banks. The runway is separated both sides, and a runway in the middle and using portal frame to support the runway. It will make the size of the pillars to be smaller. But it was still affected by the expropriation. Because the sidewalks are very narrow.

(4) 4<sup>th</sup> Alternative: In the middle of overpass. This approach must dismantle the original overpass floor by construction pillars to support the monorail runway in the middle of the overpass. And then the new overpass will be constructed by improving the model to be separated in order to make space for pillars of the Monorail. This approach does not require expropriation or



less expropriation. But it will impact on high traffic during construction please and construction costs are high.

The alternative models of route alignment of Bang Kapi Intersection area are shown in **Photo 2.1.3 - 1**, the cross section of Bang Kapi Intersection area, as shown in **Photo 2.1.3 - 1** to **Figure 2.1.3 - 4**. The comparative of alternative models in Bang Kapi Intersection area is shown in **Table 2.1.3 - 1**

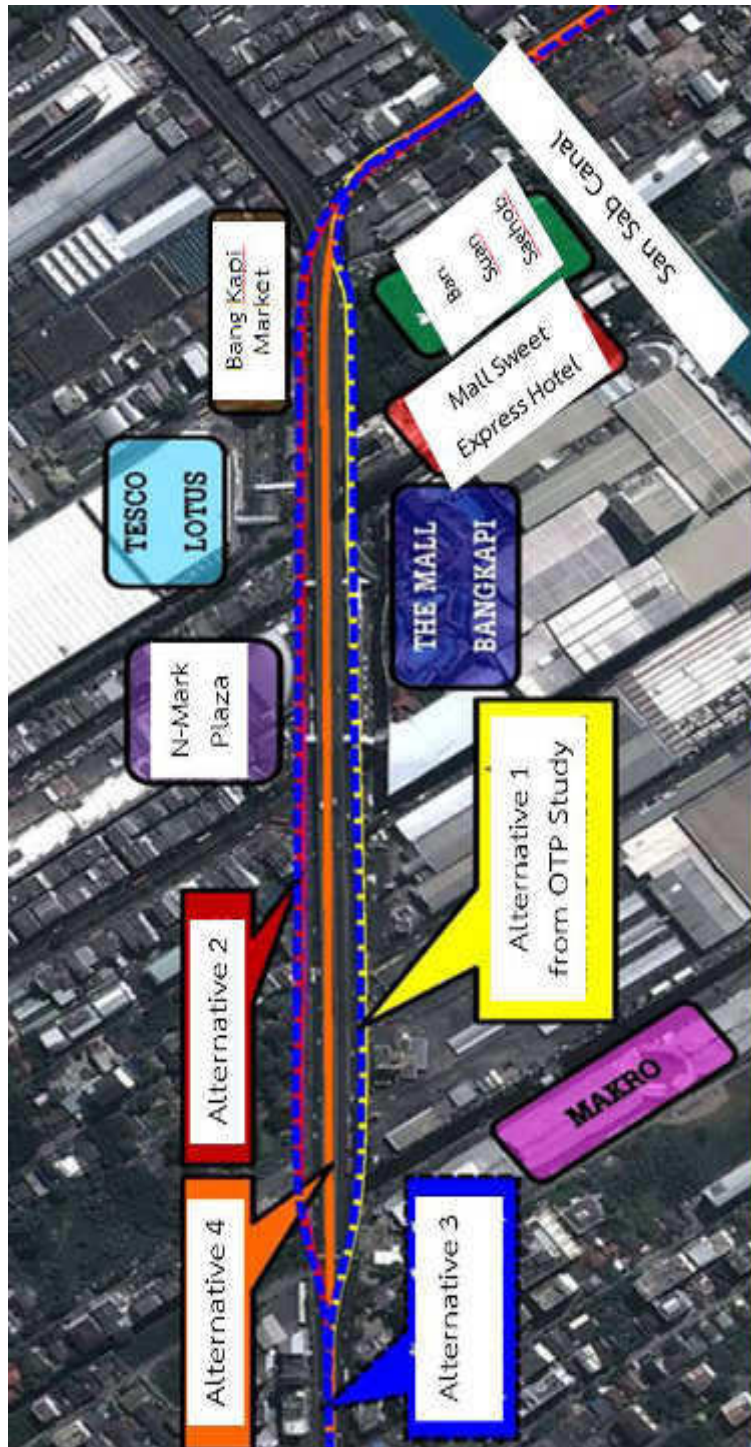


Photo 2.1.3 - 1 Alternatives project of route at Bang Kapi Junction

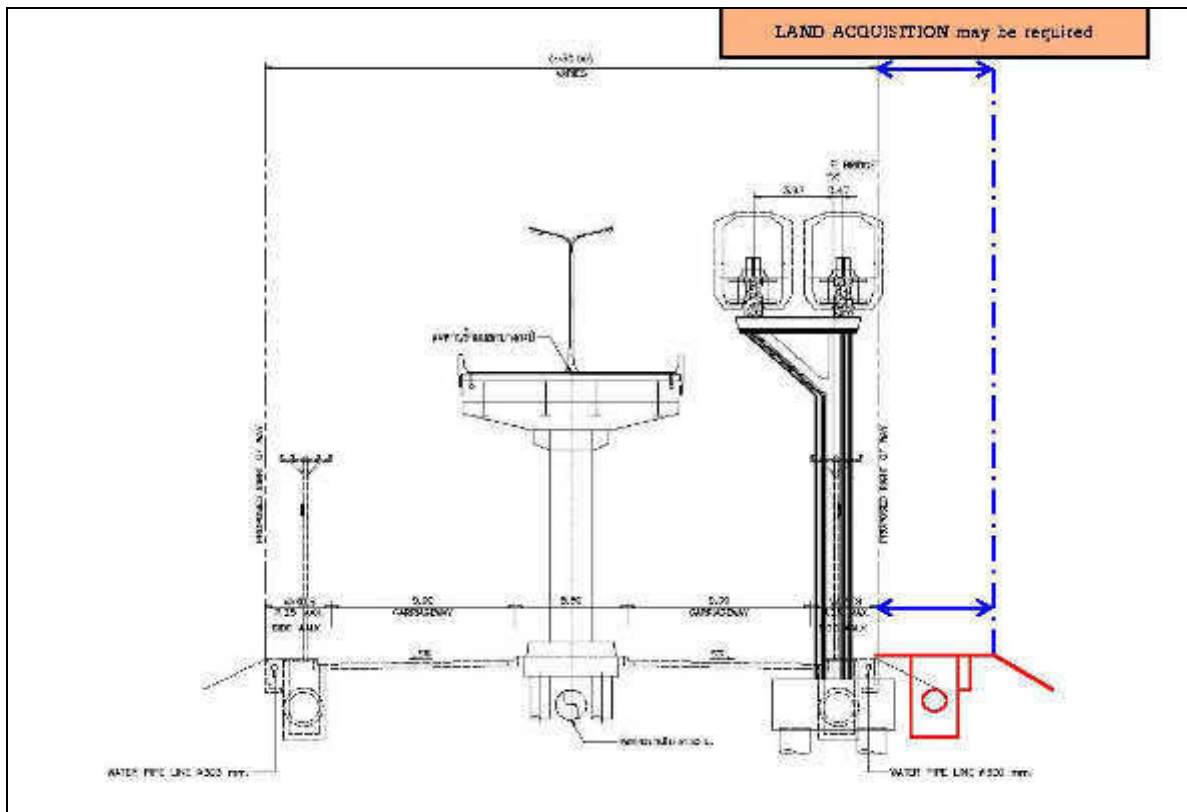


Figure 2.1.3 - 1 Cross section of project at Bang Kapi Junction, 1<sup>st</sup> Alternative

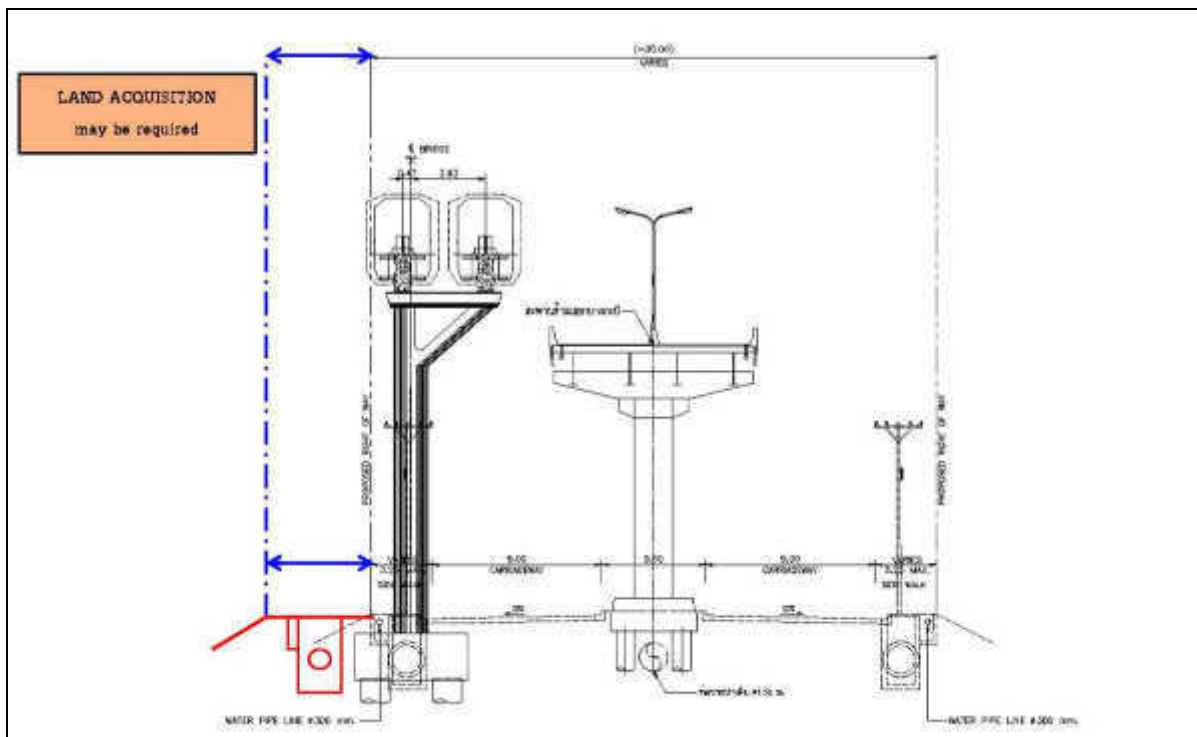


Figure 2.1.3 - 2 Cross section of project at Bang Kapi Junction, 2<sup>nd</sup> Alternative

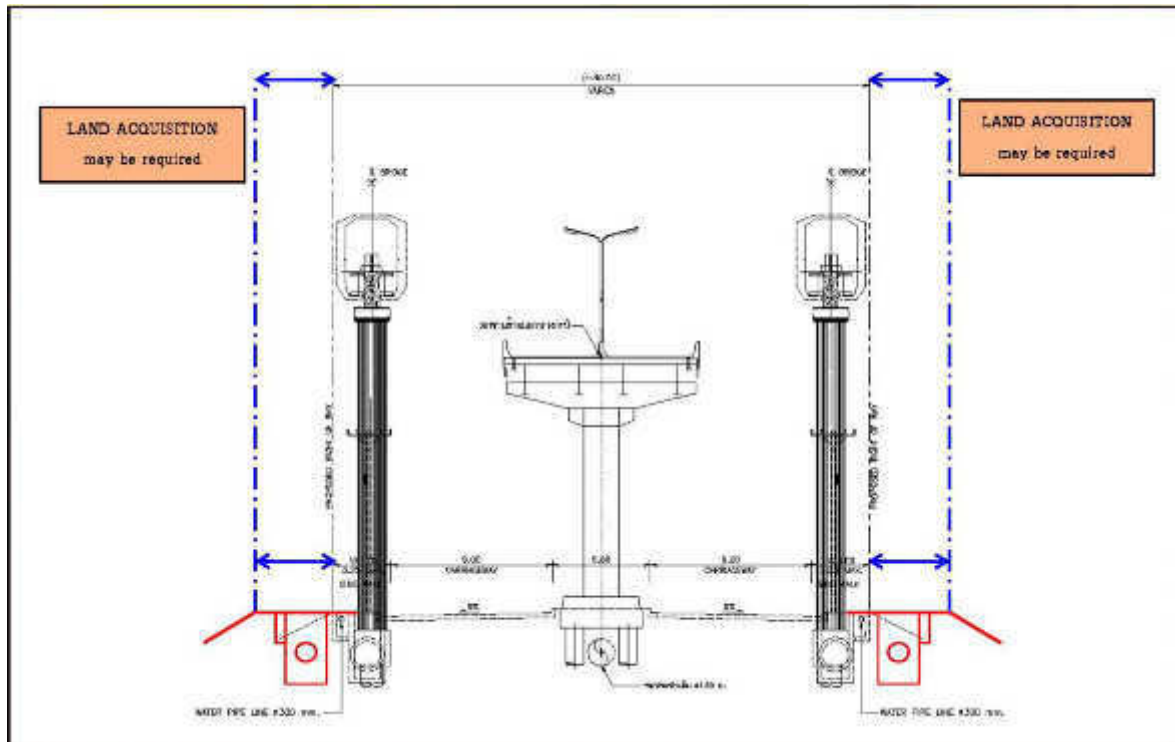


Figure 2.1.3 - 3 Cross section of project at Bang Kapi Junction, 3<sup>rd</sup> Alternative

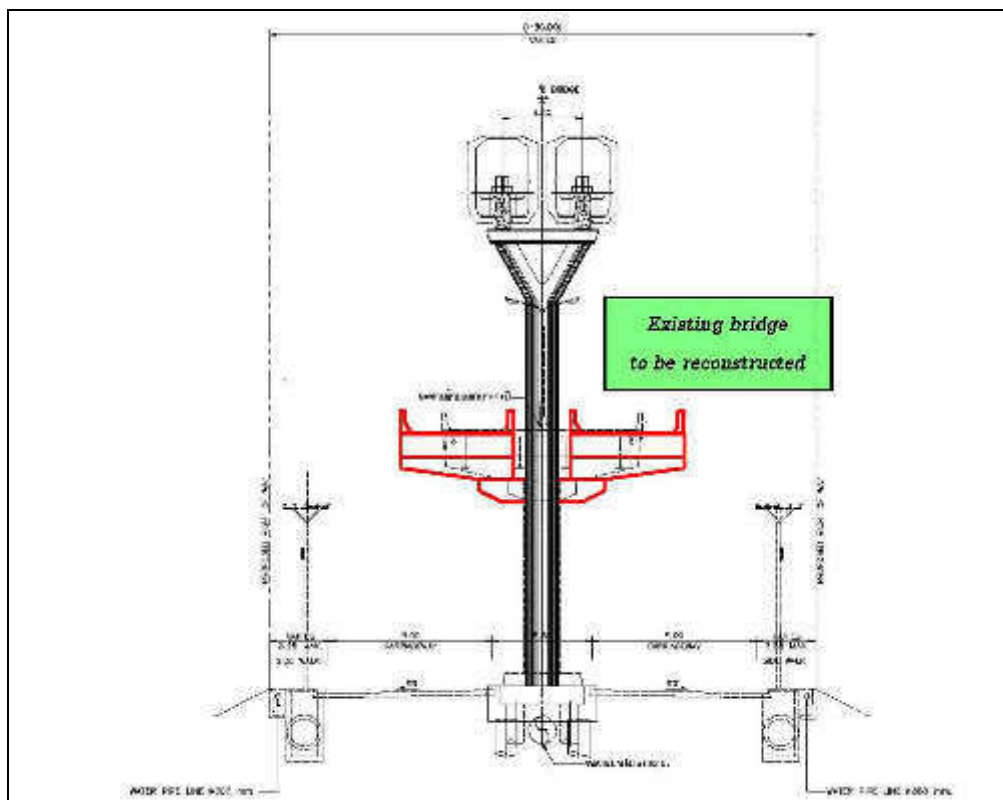


Figure 2.1.3 - 4 Cross section of project at Bang Kapi Junction, 4<sup>th</sup> Alternative



**Table 2.1.3 - 1 The comparative of alternative models in Bang Kapi Intersection area**

Alternative	Engineering Aspects	Cos Estimation Aspects	Environmental Impact Aspects
Alternative No. 1 : by pass to the right of route according to the study of OTP	1. Radius of curve is required to reduce, speed will be drop.	Moderate	Almost high impact on land expropriation * EIA report has been approved by NEB
Alternative No. 2 : by pass to the left of route	1. the span of bridge's structure is very long 2. Radius of curve doesn't require to reduce	Almost High	High impact on land expropriation
Alternative No. 3 : two separate banks	the span of bridge's structure is very long	High	Most impact on land expropriation
Alternative No. 4: in the middle of overpass	geometry alignment is best	Highest	1. Less impact on land expropriation. 2. High impact on traffic during construction phase 3. Best scenery

**The conclusion of comparative results in Bang Kapi Intersection area**

The Alternative No. 4 is an appropriate model by dismantling the original overpass floor to construct runway pillars, and then building the new overpass. Because this model has better scenery and reduce the impact of land and buildings expropriation. By the reduced expropriation costs can be used to improve the overpass. There is an impact on traffic only during the construction phase, however in this alternative, it concisely requires planning, construction and traffic management during construction. And initial coordination with resolution of BMA is the agreeable in principle that BMA will allow the designated closure of traffic on the overpass for a period of not exceeding six months for the construction of the rail runway and overpass improvements.

**2) Bridge across Canal Prawet Burirom Area**

As a result of OTP study, the route alignment along bridge across Prawet Burirom Canal Area will use the street isle of Srinagarindra Road. But BMA is currently working to expand the road and bridge improvements, by the construction of the bridge inward on leaving no space for the construction of runway pillars. After discussions with the BMA, it initially found that it is less possible to get permission to dismantle the bridge. Therefore, it needs to consider four alternatives, as follows:

- (1) Alternative No. 1 : along the street isle of Srinagarindra Road (according to the OTP study). The structural design is using the portal frame located between the bridge and U Turn to support the runway.
- (2) Alternative No. 2 : by pass to the left of the route
- (3) Alternative No. 3 : by pass to the right of the route
- (4) Alternative No. 4 : Two separate banks.

Bypassing the rail route alignment to the left or to the right, it will bypass to the gap between the car bridge and U Turn way under the bridge in order to shorten the bypassed distance, and making the runway pillars not go near the land of the people at the roadside. It may need to improve new U Turn way in the area with little space so that the runway pillars can be constructed.

The alternative models of route alignment of the bridge across Canal Prawet Buri Rom area are shown in **Photo 2.1.3 - 2**, the cross section of the bridge across Canal Prawet Buri Rom area, as shown in **Figure 2.1.3 - 5** to **Figure 2.1.3 - 8**. The comparative of alternative models of the bridge across Prawet Burirom Canal area is shown in **Table 2.1.3 - 2**

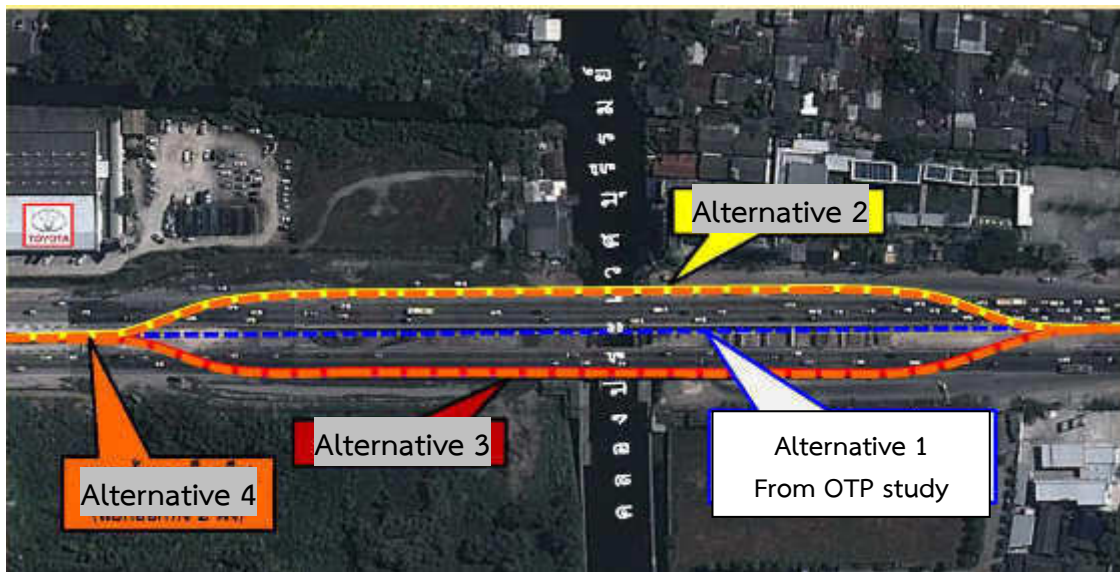


Photo 2.1.3 - 2 Alternatives of project route at Prawet Burirom Canal

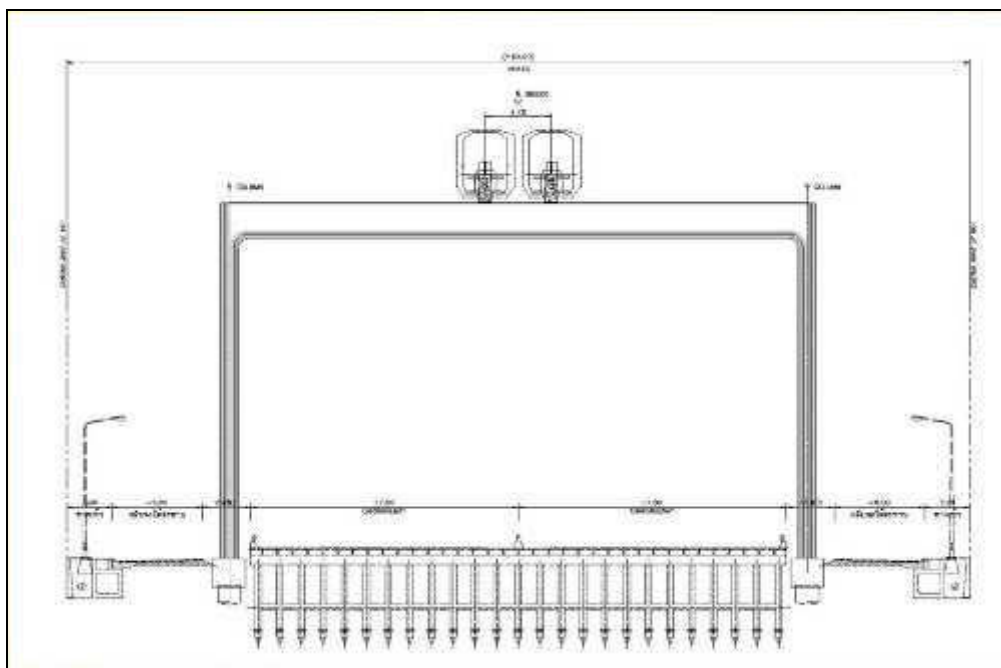


Figure 2.1.3 - 5 Cross section of road at Prawet Burirom Canal, 1<sup>st</sup> Alternative

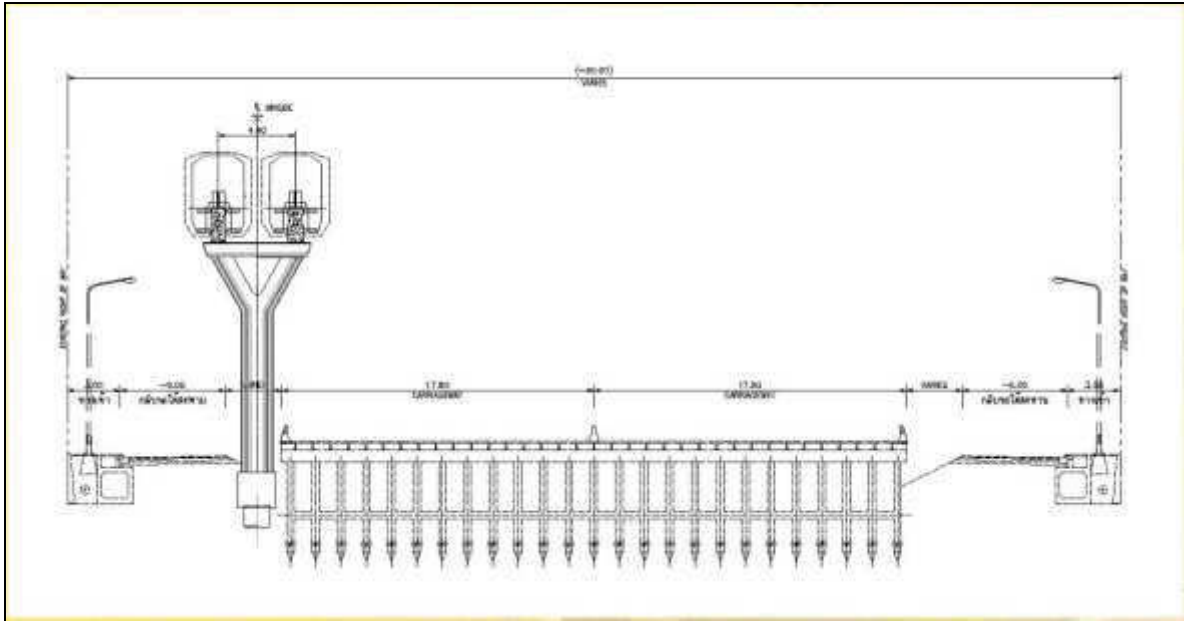


Figure 2.1.3 - 6 Cross section of road at Prawet Burirom Canal, 2<sup>nd</sup> Alternative

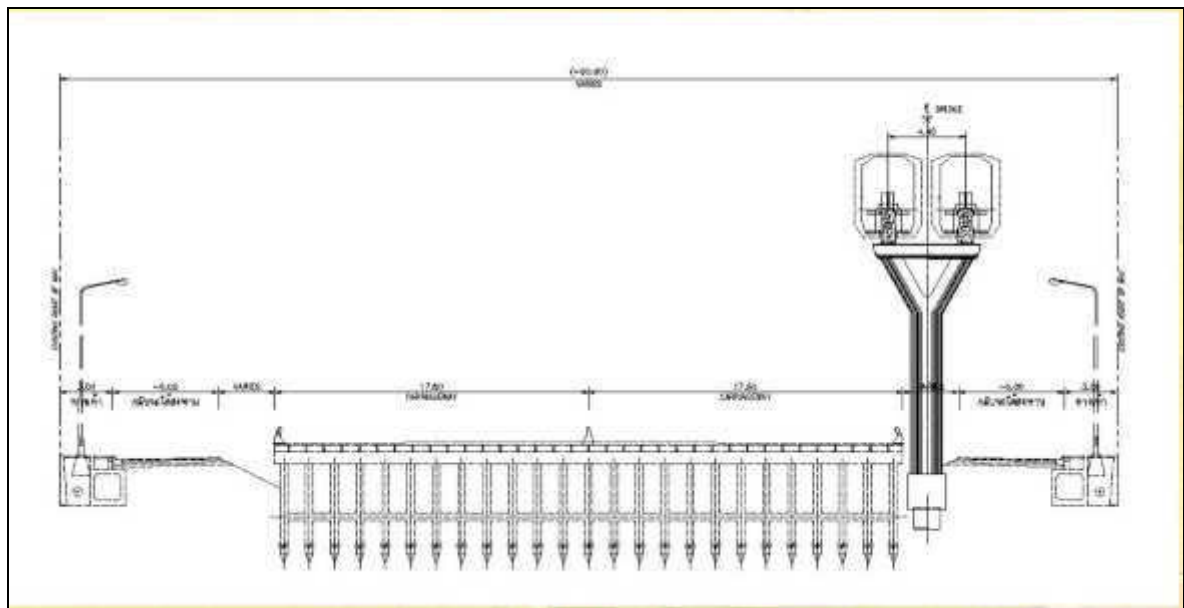


Figure 2.1.3 - 7 Cross section of road at Prawet Burirom Canal, 3<sup>rd</sup> Alternative

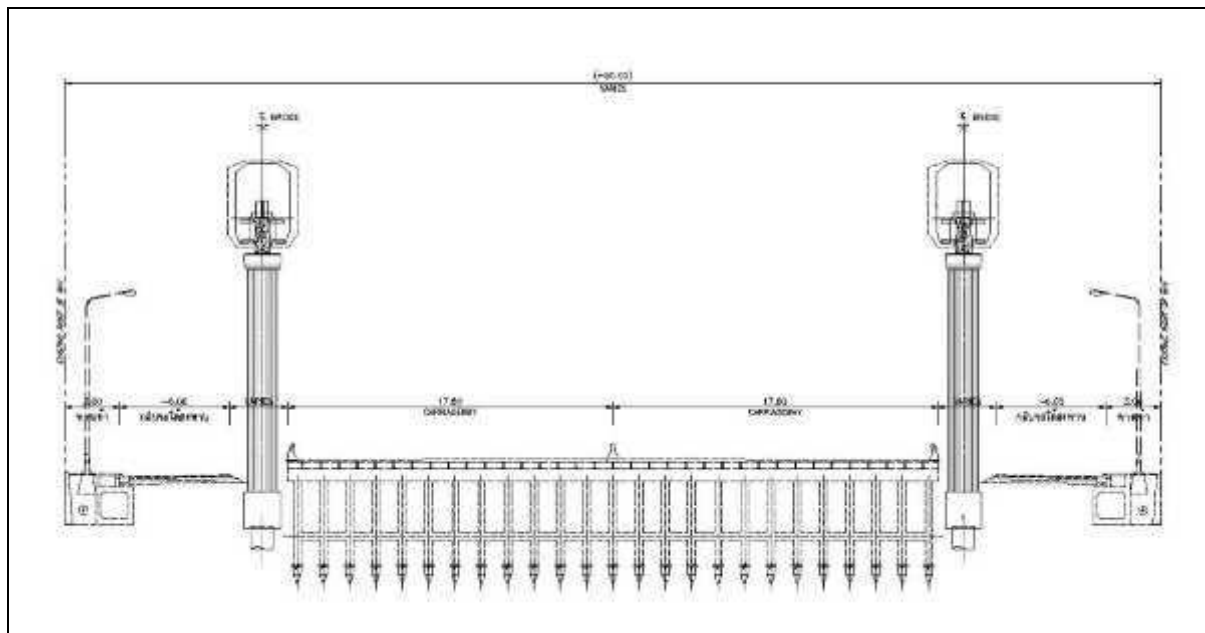


Figure 2.1.3 - 8 Cross section of road at Prawet Burirom Canal, 4<sup>th</sup> Alternative

Table 2.1.3 - 2 The comparative of alternative models of the bridge across Prawet Burrom Canal area

Alternative	Engineering Aspects	Cos Estimation Aspect	Environmental Impact Aspects
1 <sup>st</sup> Alternative : along the street isle of Srinagarindra Road (according to the OTP study).	geometry alignment is best	Highest	Almost high impact on land expropriation
2 <sup>nd</sup> Alternative : by pass to the left of the route	geometry alignment is fair	Moderate	Almost high impact on land expropriation
3 <sup>rd</sup> Alternative : by pass to the right of the route	geometry alignment is fair	Moderate	Less impact on land expropriation
4 <sup>th</sup> Alternative : Two separate banks.	geometry alignment is fair	High	High impact on land expropriation

**The conclusion of comparative results of the bridge across Prawet Burirom Canal area**

The alternative No. 3 is an appropriate model by bypassing to the right of the route. Because this model has better scenery, the construction cost is not high, and the least environmental impact.



### 3) Si Udom Intersection continuous to Si lam Interchange area

As a result of OTP study, when the route alignment passes Si Udom Intersection, the rail tunnel will be along the Srinagarindra Road, then the route will be bypassed to the left to avoid tunnel line, then bypass back into the street isle at a short distance of about 300 meters and bypass back again to the left in order to pass under Burapha Withi Expressway. In this study, it shall propose a new approach to improve the better rail route alignment by two alternatives, as follows:

(1) 1<sup>st</sup> Alternative : (bypass to the road street isle) according to the results of the original OTP study.

(2) 2<sup>nd</sup> Alternative : (continuous on the left side of the route)

The alternative models of route alignment of Si Udom Intersection continuous to Si lam Interchange area is shown in **Photo 2.1.3 - 3**, the cross section of Si Udom Intersection continuous to Si lam Interchange area; 1<sup>st</sup> alternative and 2<sup>nd</sup> alternative, as shown in **Figure 2.1.3 - 9** to **Figure 2.1.3 - 10**. The detailed comparative of alternative of Si Udom Intersection continuous to Si lam Interchange area is shown in **Table 2.1.3 - 3**.



Photo 2.1.3 - 3 Alternative of project route from Si Udom Intersection to Si lam Interchange

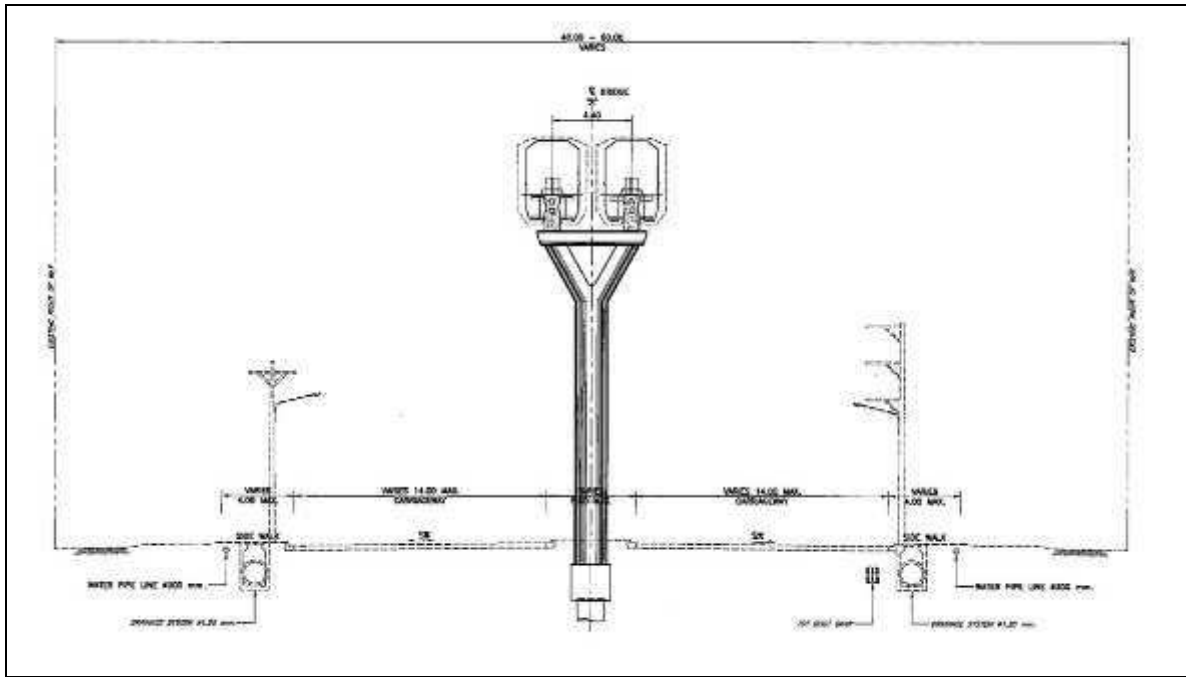


Figure 2.1.3 - 9 Cross section of road from Si Udom Intersection to Si lam Interchange,  
1<sup>st</sup> Alternative

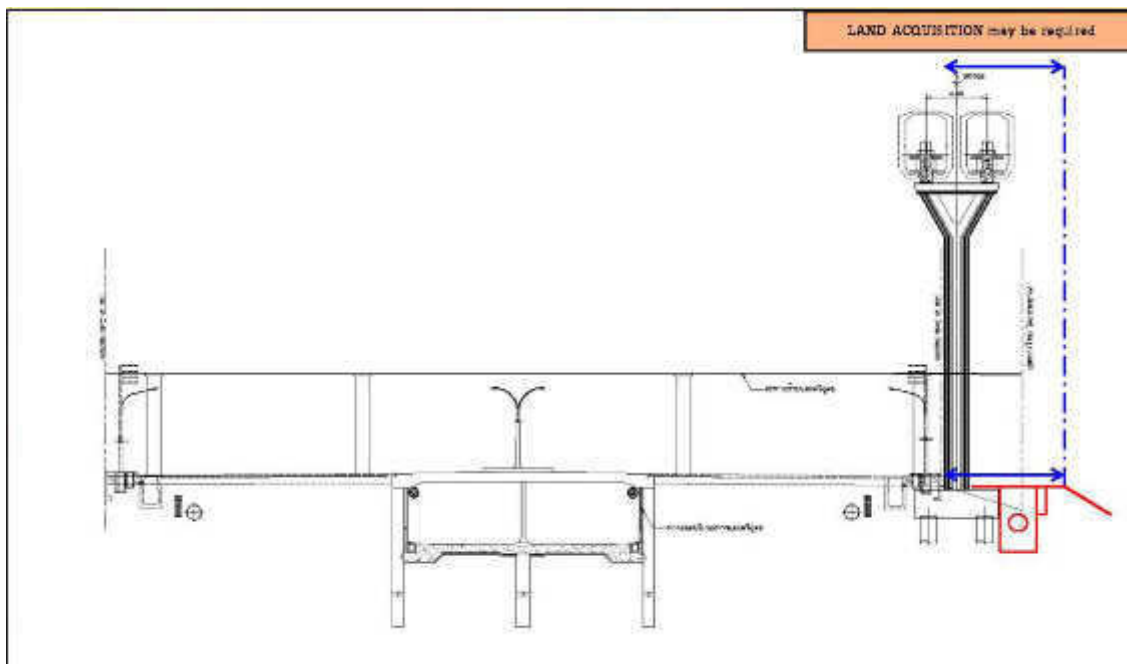


Figure 2.1.3 - 10 Cross section of road from Si Udom Intersection to Si lam Interchange,  
2<sup>nd</sup> Alternative

**Table 2.1.3 - 3 The Comparative of Alternative of Si Udom Intersection continuous to Si lam Interchange area**

Alternative	Engineering Aspects	Cos Estimation Aspects	Environmental Impact Aspects
Alternative 1 : bypass to the road isle according to the study of OTP.	1. geometry alignment isn't good 2. connected to depot by the long distance	Moderate - High	Less impact on land expropriation
Alternative 2 : continuous on the left side of the route	1. geometry alignment is good 2. access easily to depot	Moderate	Moderate impact on land expropriation

**The conclusion of comparative results of Si Udom Intersection continuous to Si lam Interchange area**

The alternative 2 is an appropriate model by continuous bypassing to the left side of the route. Because the geometry of the routes is better, including connecting to the depot is more convenient. The impact of expropriation is moderate due to the expropriation of mostly empty space, and temporary buildings.

**4) Modification of Route Alignment in the Phatthanakan Intersection Area**

The results of the original study defined that there is two system of electric railway: monorail for Lat Phrao-Phatthanakan and heavy rail (MRT) for Phatthanakan-Samrong section. Therefore, the route alignment of both system is separated at access point. The consultants have modified the route alignment to be continuous. According to the results of MRTA study, the entire rail route alignment system will be monorail. The rail route alignment and position of Phatthanakan Station from the OTP original study is shown in **Photo 2.1.3 - 4**, and the new modified rail route alignment and position of Phatthanakan Station, as shown in **Photo 2.1.3 - 5**, respectively.



**Photo 2.1.3 - 4 Project route and Location of Phatthanakan Station in Previous Study Report (OTP study)**





Photo 2.1.3 - 5 Modify project route and location of Phatthanakan station in this study.

#### 5) Route Alignment in relating area of Structure or BMA Project in the Future

According to the coordination with Construction Design Office, Department of Public Work, BMA regarding to the rail route alignment passing to the structure of original overpass or the future overpass, including the future tunnel projects of BMA, it can be concluded, as follows:

##### (1) Bang Kapi Overpass (Improvement of original overpass)

The original Bang Kapi overpass is currently a steel bridge structure with four traffic lanes, two-way (two lanes each direction). A starting point is in front of Makro Department Store Lat Phrao, and overpass the intersecting of Srinagarindra Road and Bang Kapi Intersection in front of the National Institute of Development Administration (NIDA). The total length of approximately 1.6 kilometers. The structure of top bridge is close together, without spaces in the middle for the construction of the rail runway stanchion. The rail runway alignment should be in between middle of the bridge to minimize the impact on the public in terms of expropriation, and to have the scenery of the runway along the route alignment better than the original route alignment from the OTP study. For this reason, it is necessary to dismantle the floor and beam of the old bridge in order to improve structure to have gap in the middle of bridge. The number of traffic lanes on the bridge remains unchanged. The construction and improvement will be carried out from the Makro Department Store Lat Phrao to intersection with Srinagarindra Road, about 800 meters, by separated structures of bridges and electric railway, as shown in **Figure 2.1.3 - 11**.



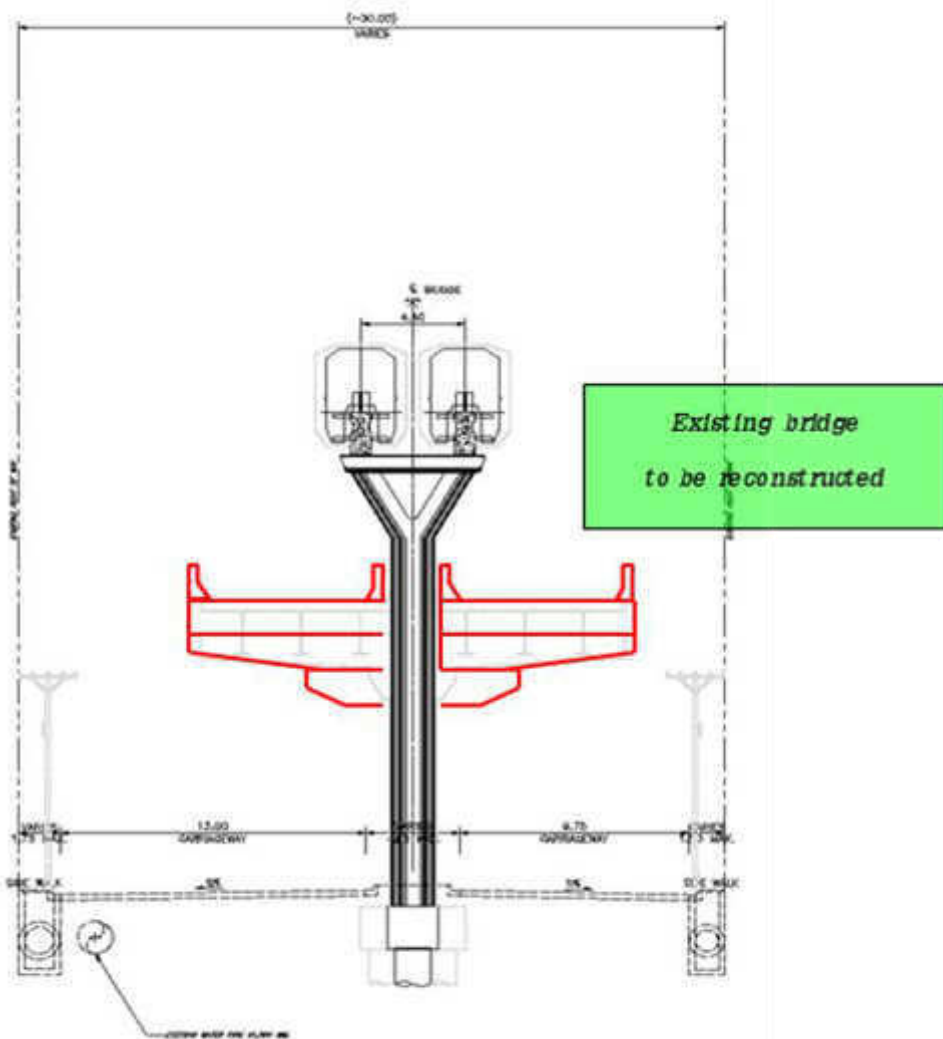
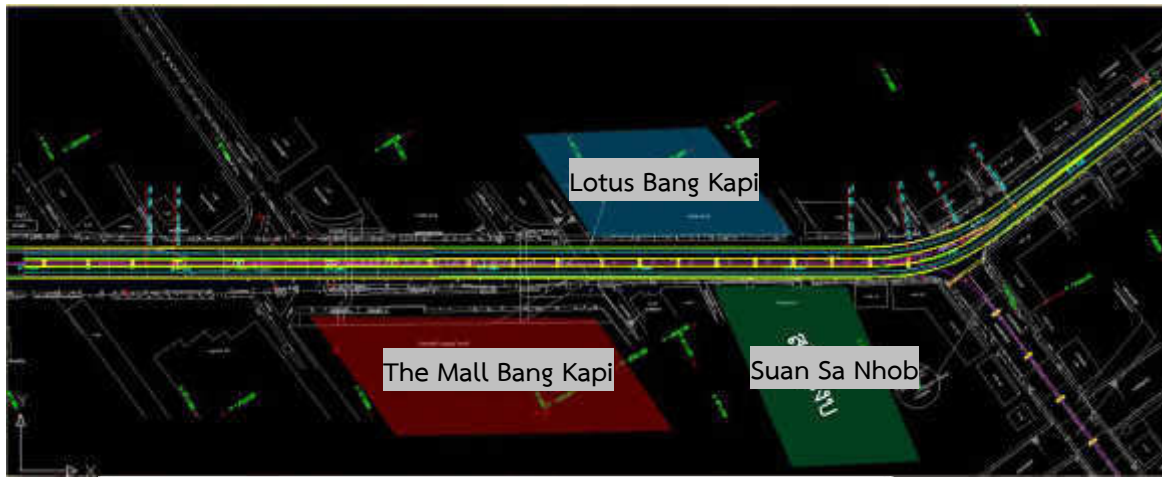


Figure 2.1.3 - 11 Plan and Cross Section of Guide Way at Bang Kapi Flyover Bridge

(2) Tunnel in the Phatthanakan Intersection area (Future Project)

BMA has a project to construct a tunnel through the rail and road at Phatthanakan Intersection area of about 900 meters. The rail route alignment will be in the middle of the road, by design the structure of runway pillar on the diaphragm wall of the tunnel. The construction will be carried out both the tunnel and the rail runway alignment in the meantime by MRT, as shown in Figure 2.1.3 - 12.

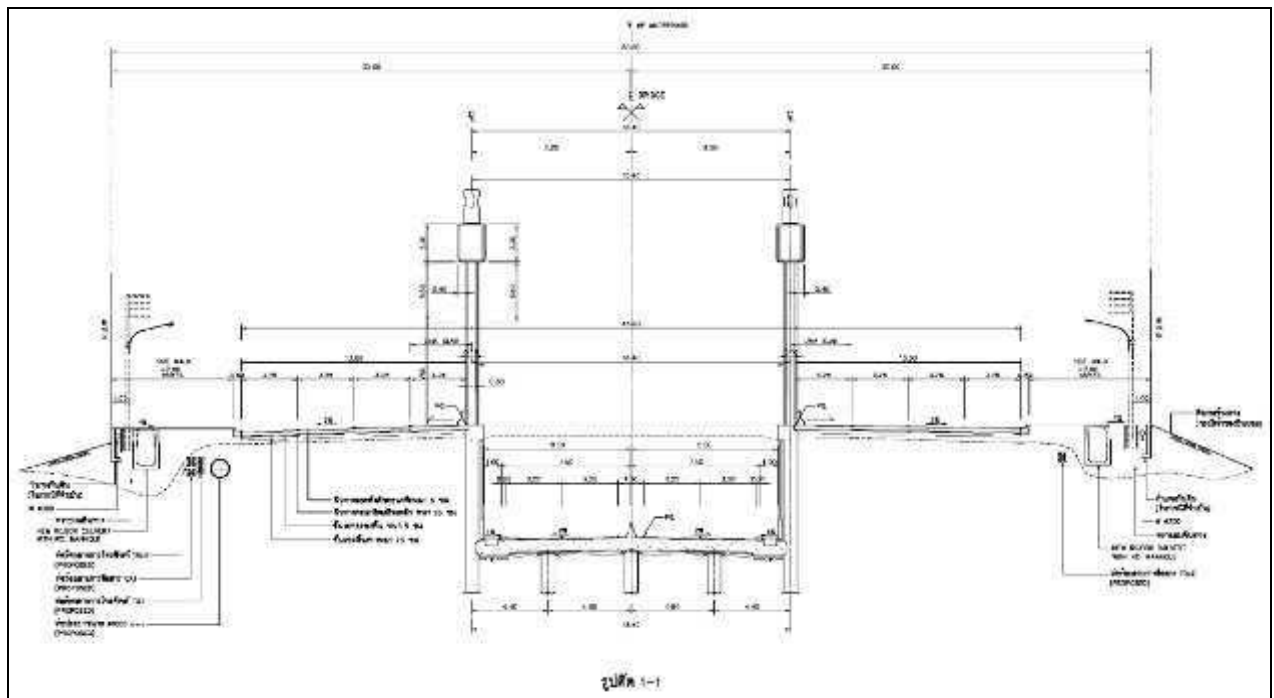
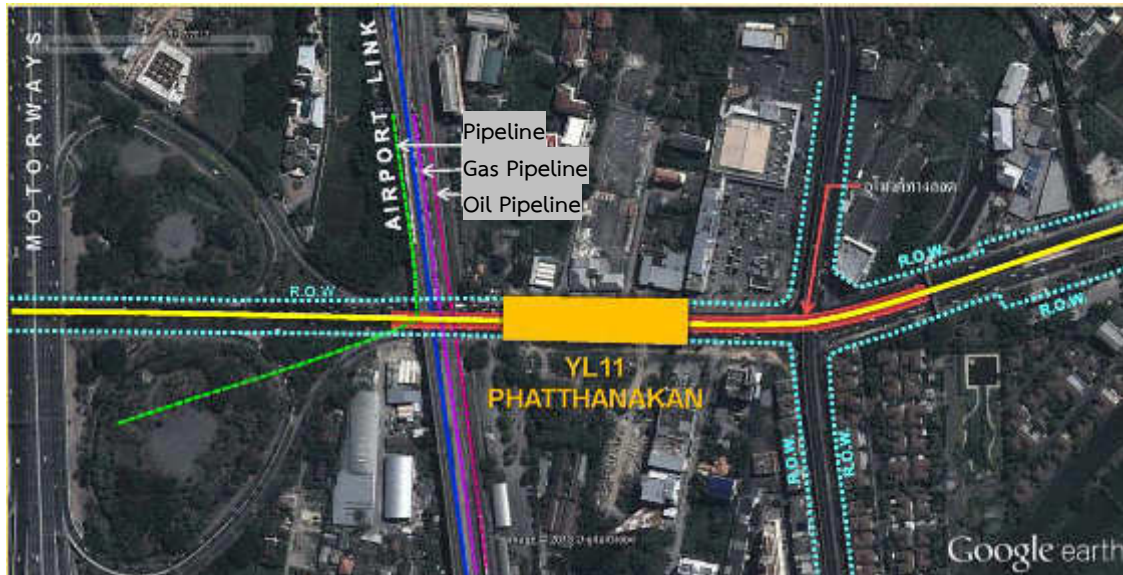


Figure 2.1.3 - 12 Plan and Cross Section of Guide Way on Phatthanakan Underpass Tunnel

(3) U Turn Bridge in Khokwat Canal area (Future Project)

BMA has a project to construct an elevated U Turn bridge in Khok Wat Canal area in the future. As a results, the rail runway alignment needs to reserve for higher than normal for constructing an elevated U Turn bridge by BMA in the future, as shown in **Figure 2.1.3 - 13**.

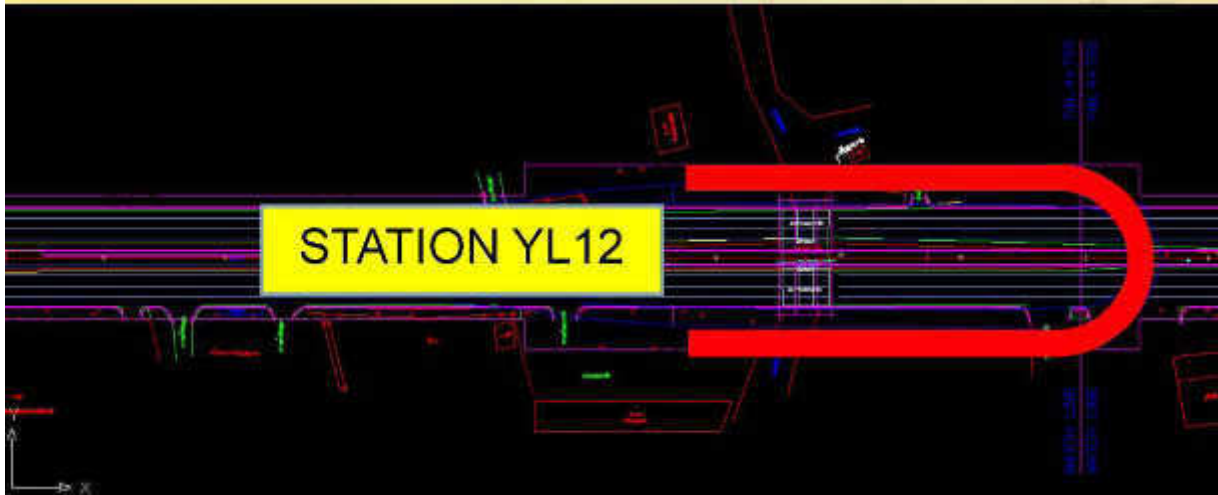


Figure 2.1.3 – 13 Plan and Cross Section of Guide Way at Khokwat Canal U-turn Bridge

(4) Premier Overpass (Future Project)

BMA has a project to construct Premier overpass in the future to cross Soi Srinagarindra 57 and 59, with 4 traffic lanes, two-way in the original zone of 40 meters. As a results, the rail runway alignment must be elevated higher than normal. The design will jointly use the pillar to support both of the overpass and the rail runway alignment, as shown in **Figure 2.1.3 -14**.

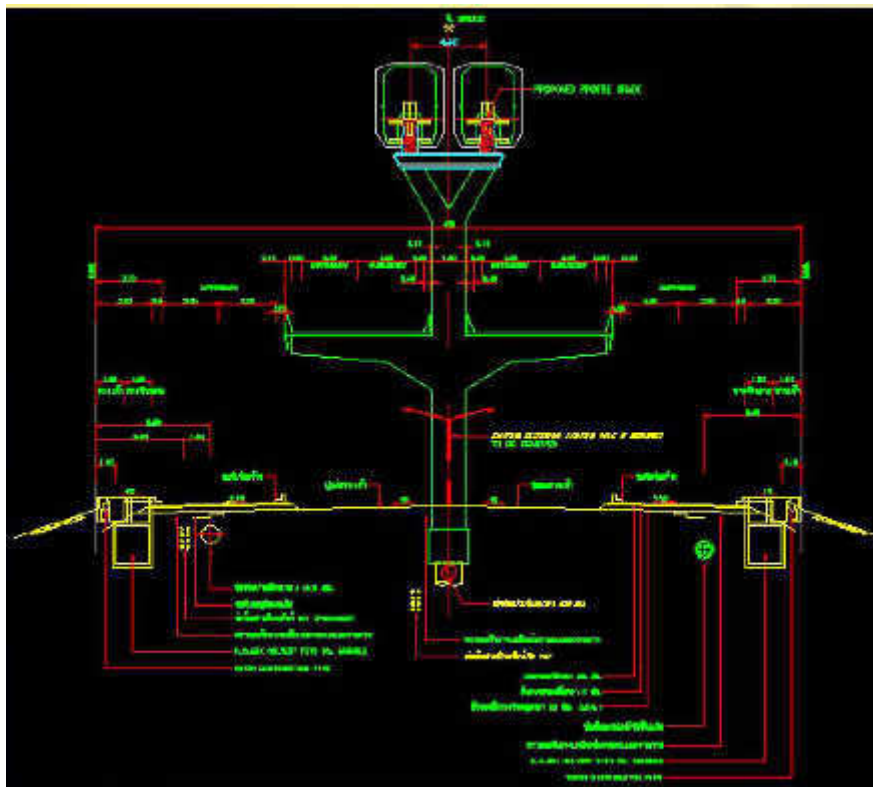


Figure 2.1.3 - 14 Plan and Cross Section of Guide Way on Premier Flyover Bridge

(5) Interchange in Krung Thep Kritha Intersection area (Future Project)

BMA has a project to construct an Interchange in Krung Thep Kritha Intersection area. The construction will be carried out on August 2014. As a results, the design level of the rail runway alignment and the Si Kritha Station need to reserve for higher than normal. The consultation with BMA has offered to entrust the piling work of MRT Yellow Line Project to the Interchange construction project, because such construction in the future will be difficult, if it is not operated in advance, as shown in Figure 2.1.3 - 15.



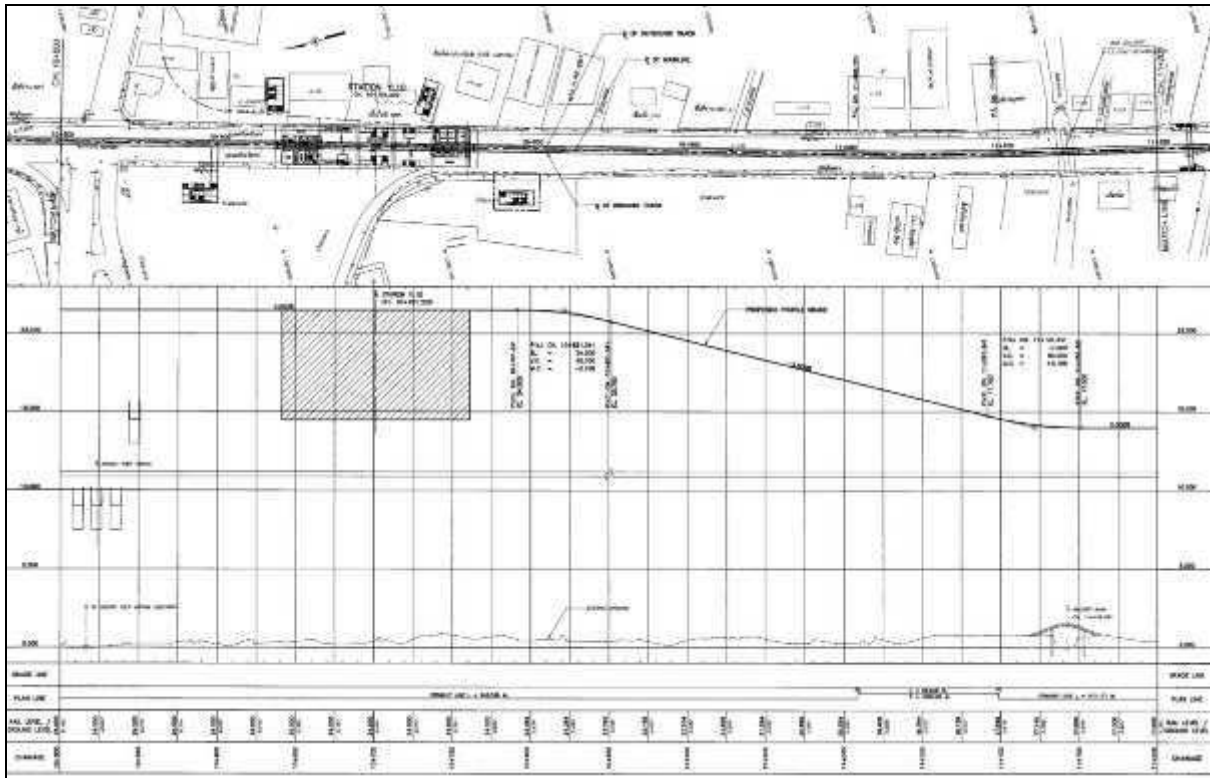


Figure 2.1.3 - 15 Plan and cross section of guide way at Krungthep Kritha Interchange

#### 6) Rail route alignment on the extension section

Around the beginning of the project at the Ratchada Station can continue to expand the route in the future along the Ratchada. Road to link up with The MRT Green Line extension Project (Mor Chit-Saphan Mai). Around the end of the project at the Pu Chao Saming Phrai Road can continue to expand the route in the future to connect to the MRT Purple Line at Suk Sawat Road. The considerations for determining the alternatives are as follows:

##### (1) The area consideration for determining the alternatives

In determining the alternatives for the MRT Yellow Line extension Project needs to study the information from the Urban Rail Transportation Master Plan in Bangkok and Surrounding Areas, and road networks. There are important issues to consider, as follows:

- Should be consistent with the Urban Rail Transportation Master Plan in Bangkok and Surrounding Areas.
- Should be able to use the street isle area or inside the area of the road along the current road network to reduce the impact of land expropriation.
- Can be connected to MRT Purple Line or MRT Green Line at terminal station to facilitate the passengers.
- There is the feasibility of building in terms of engineering and environment.

## 2.2 Detailed change conclusion

The Bangkok Mass Transit Yellow Line Project : Lat Phrao-Samrong has changed in various of project details, such as electric railway system, location of stations, rail route alignment, measures to prevent and reduce environmental impact, and measures to monitor environmental quality. Summary of the change of the project and approval report of the National Environment Board on January 16, 2012 (B.E. 2555) as shown in **Table 2.2 - 1**, and comparing the station to the original study with the details of change in **Table 2.2 - 2**.

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012

No.	Items	Details from Approved EIA report by NEB (2012)	The Details to be change	Reasons of Change
1.	1.1 Mass Rapid Transit System	- Monorail system for the MRT Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan section), with a total distance of 12.60 km	- Nothing to be changed	According to the study of Mass Rapid Transit System, passengers access easily to MRT's service and decrease the investment cost approximately one times.
		- Heavy rail system for the MRT Dark Yellow Line Project (Phatthanakan-Samrong section), for a total distance of 17.90 km	- Modify to use the monorail system along the route project and namely as the MRT Yellow Line Project (Lat Phrao-Samrong section) for a total distance of 30 km	
	1.2 Connection of Yellow Line Project and Dark Yellow Line Project	- For the MRT Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan section), the last terminal was Y-10 where was located between Rama IX interchange and Phattanakan intersection. It could be connected to the Yellow Line Project and Airport Rail Link	- There is only monorail system along the route project and the passengers will get more convenient by accessibility the service without having to change the car.	
		- For the MRT Dark Yellow Line Project (Phatthanakan-Samrong section), Y-10 Phatthanakan was the interchange station to the Yellow Line Project and located at Rama IX interchange. These station also connected to (Airport Rail Link)		
2.	2.2 Addition of Station and changing of Location 2.2.1 Depot and Stabling Yard	- Depot of the Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan section) will be located near the terminal at Rama IX Interchange on approximately 35 rai of open space between the Eastern Railroad and the Intercity Motorway No. 7 (Bangkok - Chonburi)	- To abort the Depot of the Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan), still having the depot of the Dark Yellow Line Project (Phatthanakan-Samrong section section)	- As a result of the review of project feasibilities, the MRT system is modified to be monorail system for the entire route alignment. Therefore, there is only one Depot

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Details from Approved EIA report by NEB (2012)	The Details to be change	Reasons of Change
		<ul style="list-style-type: none"> <li>- Depot of the Dark Yellow Line Project (Phatthanakan-Samrong section) will be located on approximately 112 rai of large open space on the East of Si lam Interchange.</li> </ul>	<ul style="list-style-type: none"> <li>- Nothing to be changed</li> </ul>	
	<b>2.2.2 Park &amp; Ride</b>	<ul style="list-style-type: none"> <li>- Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan), there was one location of Park &amp; Ride at Phatthanakan Station, for the convenience of passengers using the private car. It was located near Rama IX Interchange that request approximately 55,860 sq.m. from Expressway Authority of Thailand and Department of Highways to develop a parking lot, approximately 1,500 cars ((using with the Dark Yellow Line Project))</li> <li>- Dark Yellow Line Project (Phatthanakan-Samrong section) there was one location of Park &amp; Ride at Phatthanakan Station, for the convenience of passengers using the private car. It was located near Rama IX Interchange that request approximately 55,860 sq.m. from Expressway Authority of Thailand and Department of Highways to develop a parking lot, approximately 1,500 cars ((using with the Yellow Line Project))</li> </ul>	<ul style="list-style-type: none"> <li>- The new location of Park &amp; Ride Buildings is located on Srinagarindra Road intersecting with Bang Na-Trat Road</li> <li>- The new location of Park &amp; Ride Buildings is located on Srinagarindra Road intersecting with Bang Na-Trat Road.</li> </ul>	<ul style="list-style-type: none"> <li>- The 40 rai of Park &amp; Ride Buildings is located at the fitted area as to close to the station, including the connectivity and access ways.</li> </ul>
	<b>2.2.3 Number of stations</b>	<ul style="list-style-type: none"> <li>- the Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan section) with 10 stations</li> <li>- the Dark Yellow Line Project (Phatthanakan-Samrong section) with 11 stations</li> </ul>	<ul style="list-style-type: none"> <li>- The MRT system is modified to be monorail system for the entire route alignment. There has 23 stations and added the new 3 stations as follows, Lat Phrao 71 station, Kalantan station and Srinagarindra 38 station.</li> </ul>	<ul style="list-style-type: none"> <li>- To improve the details of station to comply with the existing condition and the future mass transit projects.</li> </ul>



Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Details from Approved EIA report by NEB (2012)	The Details to be change	Reasons of Change
	2.2.4 Modify the name of Stations	<ul style="list-style-type: none"> <li>- Y - 05 Wang Thong Lang</li> <li>- Y - 08 Lam Sali Intersection</li> </ul>	<ul style="list-style-type: none"> <li>- YL - 05 Mahat Thai</li> <li>- YL - 08 Lam Sali</li> </ul>	<ul style="list-style-type: none"> <li>- To modify the name of stations to comply with the location</li> </ul>
3.	Change of Route Alignment	<p>Yellow Line Project (Ratchada/Lat Phrao-Phatthanakan section):</p> <ul style="list-style-type: none"> <li>- Construction area at Bang Kapi Intersection will has very high impact on land expropriation (community building, hotel, commercial building)</li> <li>- Y-10 Phattanakan station where located at Phattanakan Intersection is the terminal station of Yellow Line Project and connect to depot of monorail system.</li> </ul>	<ul style="list-style-type: none"> <li>- To relocate the structure of Bang Kapi intersection</li> <li>- Modification with combine the route alignment</li> </ul>	<ul style="list-style-type: none"> <li>- Reroute alignment at Bang Kapi intersection for decrease the impact on land expropriation</li> </ul>
		<p>Dark Yellow Line Project (Phatthanakan-Samrong section):</p> <ul style="list-style-type: none"> <li>- At the bridge across Prawet Buri Rom Canal, the route alignment goes to the road isle.</li> <li>- At Si Udom intersection and Si lam interchange, the route alignment goes to the road isle about 300 meters and pass under to the left in order to pass under Burapha Withi Expressway</li> <li>- Phattanakan intersection is the beginning of the Dark Yellow Line Project (heavy rail) and Y-10 will be the first station</li> </ul>	<ul style="list-style-type: none"> <li>- Reroute alignment to decrease the impact on land expropriation</li> <li>- Reroute alignment to decrease the impact on land expropriation</li> <li>- Modification with combine the route alignment</li> </ul>	<ul style="list-style-type: none"> <li>- Reroute alignment at Prawet Buri Rom Canal because of being project of bridge construction</li> <li>- To modify the alignment for comfortable and safety.</li> <li>- There is monorail system for entire route alignment and separation of station doesn't have requirement.</li> </ul>

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Details from Approved EIA report by NEB (2012)	The Details to be change	Reasons of Change
4.	Environmental Mitigation Measures	The mitigation measures that proposed in the EIA report could be reduced the impacts.	<p><b>Cancellation of measures</b></p> <p><b>Construction Phase</b></p> <p>1) Noise Level, Installation of Noise barrier along route project at least 200 meters whereas before and after passing the sensitive areas</p>	<p>- Due to safety concerning of fire or accidents and the impact on scenery as well (as shown in figure below), the results of Noise Level sampling on the sensitive areas was lower the standard (70 dB (A)). Except for Vejthani Hospital and Chulavej Hospital, there was noise level slightly higher than the standard. To formulate measures for preventing and mitigating environmental impacts, installing of sound absorbent material under 4 stations are as follow; Phawana Station, Chok Chai 4 Station, Lat Phrao 101 Station and Samrong Station</p> <div style="display: flex; flex-direction: column; align-items: center;">   </div>

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
4.	Environmental Mitigation Measures (Cont'd)	<p><b>1) Geology and Earthquake</b>  <u>Construction Phase</u>            - The way to prevent soil erosion and stabilization of soil such as using polymer mixed with a solution of bentonite (Bentonite Slurry) ratio 1: 12.50. For soil stabilization, Bentonite Slurry mixture can reduce the permeability sand layer and support the adhesion of soil or sand particles for siltation.</p> <p><b>2) Surface Water Quality</b>  <u>Construction Phase</u>            - The construction area of depot has to prepare the temporary drainage system. The temporary drainage system consists of gutters w0.60x0.60 meters and sediment trap (sumps) w1.00x1.00xh1.00 meters. This system can gather the effluent from construction activities, sediment, and etc. and also prevent the wastewater flow into the nearest water surface and flood plain areas directly.</p> <p><u>Operation Phase</u>            - To treat the wastewater in the depot, three set of 50-cubic meter onsite treatment plants (Anaerobic Filter and Contact Aeration Process), totaling 150 cubic meters. The wastewater caused by activities in the office, control center and employee dormitory will be gathered in the onsite treatment plant. The wastewater caused by canteen, maintenance and train washing will flow through the oil separator, which separates the grease and oil, before running into the onsite treatment plant and finally into Canal Khlet.</p>	<p><u>Modified mitigation measures</u>  <b>1) Geology and Earthquake</b>  <u>Construction Phase</u>            - The methods are set up to prevent soil erosion and stabilize the hole, such as using polymer slurry to increase the side force friction between the bored pile and sand layer. Unlike polymer slurry, the bored pile under bentonite slurry affects the friction on pile surface.</p> <p><b>2) Surface Water Quality</b>  <u>Construction Phase</u>            - In the south of depot construction area, the temporary sedimentation tank, with over 5,100-cubic meter capacity, and the temporary gutter are made to prevent the sediments that come with the water or rain from flowing into the surface water, public drainage channel or lowlands.</p> <p><u>Operation Phase</u>            - To treat the wastewater in the depot, three set of 50-cubic meter onsite treatment plants (Septic - Anaerobic Filter and Contact Aeration Process), totaling 150 cubic meters, must be installed, along with the retention pond. The wastewater caused by activities in the office, control center and employee dormitory will be gathered in the onsite treatment plant. The wastewater caused by canteen, maintenance and train washing will</p>	

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
4.	Environmental Mitigation Measures (Cont'd)		<p><u>Modified mitigation measures</u> (Cont'd) flow through the oil separator, which separates the grease and oil, before running into the onsite treatment plant and finally into Canal Khlet.</p> <p><u>Additional mitigation measures</u></p> <p>1) Soil Resources</p> <p><u>Construction Phase</u></p> <ul style="list-style-type: none"> <li>- In the south of depot construction area, the temporary sedimentation tank, with over 5,100-cubic meter capacity, and the temporary gutter are made to prevent the sediments rain flowing into the surface water, public drainage channel or lowlands.</li> </ul> <p>2) Noise Level</p> <p><u>Construction Phase</u></p> <ul style="list-style-type: none"> <li>- Install 2 meters high concrete wall and metal sheet in the construction site.</li> <li>- Install 2 meters high solid steel fencing</li> </ul> <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> <li>- Design the guide way to ensure the even top and side surface.</li> <li>- Monorail train is designed to operate with rubber tires only. All rubber tires of the monorail trains must be strictly checked and replaced as scheduled.</li> <li>- The Monorail train must have the nave plates designed to cover the whole wheel to reduce the noise caused by the running train throughout the operation.</li> </ul>	



Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
4.	Environmental Mitigation Measures (Cont'd)		<p><u>Additional Mitigation Measures (Cont'd)</u></p> <p>3) Terrestrial ecology</p> <p><u>Forests</u></p> <p><u>Construction Phase</u></p> <ul style="list-style-type: none"> <li>- Coordinate with the agencies concerned in Bangkok, such as District Office of Lat Phrao, Wang Thonglang, Bang Kapi, Suang Luang, Prawet and Bang Na, and in Samut Prakan province, namely Samrong Nuea Municipality and Thepharak Administrative Organization, to discuss about the construction guideline and setting the construction area to limit the expected effect on trees.</li> <li>- Survey and estimate the number of trees to be cut down during the project operation and to be removed (dig around) from the project area and planted in the prepared areas.</li> <li>- Use labors or machines to remove (dig around) the large and important trees (with the chest-wide diameters; DBH &gt; 10 cm.) from the project area before the construction phase.</li> <li>- The workers are allowed to cut down the degenerating trees but they need to clear the scraps out of the area.</li> <li>- After the area opening to construct the project, the land must be cleared and graded to facilitate the tree planting process.</li> <li>- Fill the land with the soil from or outside the project area before planting trees so that the roots can attach the soil in the first phase.</li> <li>- Grow the plant succession to save the eco-system. The Project may ask for the advice or</li> </ul>	

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
4.	Environmental Mitigation Measures (Cont'd)		<p><u>Additional mitigation measures (Cont'd)</u>  sapling from BMA, Samut Prakan province, Royal Forest Department and National Park, Wildlife and Plant Conservation and Department. The selected types of plants should be suitable for the urban ecology, can grow in the project environment, and does not obstruct the view when the train runs.</p> <ul style="list-style-type: none"> <li>- Take care of the trees, such as loosen the soil, add fertilizer, get rid of weeds and pests, and plant replacement trees.</li> <li>- Check the trees planted and environment of remaining forest around the project.</li> <li>- After the construction is completed, the workers' camps must be immediately taken apart and taken out of the site. Then, the land must be cleared to resume its previous condition. If the eco-system of any area needs to be revived by tree planting, the action should be taken at once.</li> </ul> <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> <li>- Control and prevent the woodcutting in the project area by coordinating with the agencies concerned in Bangkok Metropolitan, such as District Office of Lat Phrao, Wang Thonglang, Bang Kapi, Suan Luang, Prawet and Bang Na, and in Samut Prakan province, namely Samrong Nuea Municipality and Thepharak Administrative Organization.</li> </ul> <p><b>4) Land use</b></p> <p><u>Construction Phase</u></p> <ul style="list-style-type: none"> <li>- The construction activities must be implemented in the construction site, depot and park &amp; ride buildings only.</li> </ul>	

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
4.	Environmental Mitigation Measures (Cont'd)		<p><u>Additional mitigation measures (Cont'd)</u></p> <ul style="list-style-type: none"> <li>- Provide the specific area to store the construction materials so that they are well organized and will not be piled up outside the construction area. Do not place the construction equipment or tools in the location that obstructs the water flow.</li> </ul> <p><b>5) Transportation</b></p> <p><u>Construction Phase</u></p> <ul style="list-style-type: none"> <li>- Install guide way, mesh to prevent material waste, noise walls, sound barriers, and water traps; keep material waste away from the road surface; and ensure safety of people concerned and local people who travel past the construction areas.</li> <li>- Install lighting in areas under the structures of elevated guide way , MRT stations, and footpaths along the existing road networks.</li> <li>- If there are construction activities that will block travel on the footpaths, provide temporary pedestrian ways and install direction signs to ensure the safety of bus users.</li> </ul> <p><b>6) Public Utilities</b></p> <p><u>Construction Phase</u></p> <ul style="list-style-type: none"> <li>- Add relocation plans and the process of implementation of utilities and infrastructure of project</li> </ul> <p><b>7) Flood control and Drainage</b></p> <p><u>Construction period</u></p> <ul style="list-style-type: none"> <li>- In the construction areas for depot, temporary sediment traps in the southern part will be excavated, with a capacity of at least 5,100 cu.m. for rainwater during the construction period before it is released into Canal Khlet and Canal Sarai.</li> </ul>	

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
4.	Environmental Mitigation Measures (Cont'd)		<p><u>Additional mitigation measures (Cont'd)</u></p> <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> <li>- Pump rainwater from rainwater retention ponds of the project to release to Canal Khlet after rain stops.</li> <li>- Check the levels of water in Canal Khlet before releasing it from the project areas. In the case when the level of water in the canal is over 0.50 m below the bank, pump it out. If the water level in the canal reaches 0.10 m from the bank level, wait until the water level decreases before pumping, so this will not affect drainage or flooding outside the project areas.</li> </ul> <p><b>8) Public Health and Safety</b></p> <p><u>Construction Phase</u></p> <ul style="list-style-type: none"> <li>- Provide workers with temporary shelters in the construction areas for daytime rest located in the vicinity of the construction areas.</li> </ul> <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> <li>- Provide waste containers at the entrance and exit of the stations.</li> <li>- Investigate the conditions of solid waste management on a regular basis.</li> <li>- Carry out a public relations program and campaign for encouraging staff in depot and park &amp; ride building to sort solid waste into wet and dry waste before putting it in waste containers. Glass and paper waste have to be sorted out for selling to reduce the amount of solid waste. Hazardous waste, such as batteries must be put in provided waste containers.</li> </ul>	



Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
4.	Environmental Mitigation Measures (Cont'd)		<p><u>Additional mitigation measures (Cont'd)</u></p> <p>9) Occupational health and safety</p> <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> <li>- Provide alarm buttons at the stations or platforms and signs that are clearly visible if an emergency or a fire incident happens at the station or platform; and provide security staff that can reach the scene immediately.</li> <li>- Provide an automatic fire alarm system and automatic fire sprinkler system at the platform and station areas.</li> <li>- Provide fire extinguishers with instructions at the doors between staff rooms, cabins, and stations.</li> <li>- Provide emergency stop buttons on the platform floor, which are pressed when an emergency occurs to stop the train from coming to the station when, for example, a passenger or thing falls onto the rail.</li> <li>- Provide CCTV at the platform and station areas, which are always monitored by staff at the control center.</li> <li>- Provide evacuation routes, which connect the platform to the monorail in an emergency only.</li> <li>- Provide first-aid rooms, with necessary equipment and drugs for emergency use, which must be looked after by a doctor at all times.</li> <li>- Set up a center for coordination with other agencies located near the stations, such as hospitals, police stations, and fire stations.</li> <li>- Provide training and drills for staff working on emergency prevention and security on trains and stations on a regular basis to ensure preparedness at all times.</li> </ul>	

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
5.	Environmental Monitoring Programs	<p>1) Surface Water/Wastewater Quality</p> <p><u>Operation Phase</u></p> <p>- 13 Stations</p> <p>1. Nam Kaeo Canal    2. Lat Phrao Canal  3. Chan Canal        4. Saen Saeb Canal  5. Hua Mak Canal    6. Prawet Burirom Canal  7. Tachang Canal    8. Khlet Canal  9. Bang Na Canal    10. Samrong Canal  11. Retention pond, Pond No.1  12. Retention pond nearby Srinagarindra road, Pond No.1  13. Retention pond nearby Srinagarindra road, Pond No.2</p> <p>- <b>Indexes</b></p> <p>1. Temperature                      2. Suspended Solids  3. Conductivity                        4. pH  5. Dissolved Oxygen                6. Phosphate  7. BOD                                    8. Oil &amp; Grease  9. Fecal Coliform Bacteria        10. Sulfide  11. TKN - Nitrogen  12. Total Coliform Bacteria</p> <p>- <b>Period</b> The analysis of shall be conducted forth a year, for five consecutive years. If the measurement results are not significantly different, this shall be conducted twice a year.</p> <p>2) Air Quality</p> <p><u>Operation Phase</u></p> <p>- 26 Stations</p> <p>1. Judicial Training Institute    2. Pibool Upphatham School  3. Chok Chai 4 Police Station Flat  4. Thanormpitvithaya School    5. Bangkok Suksa School  6. Big C Superstore (Lat Phrao)  7. Wat Mae Phra Kularb Tip (Maria Rosa Mystica Church)  8. Vejthani Hospital                9. The Mall Bang Kapi</p>	<p><u>Change of environmental quality monitoring stations</u></p> <p>1) Surface Water/Wastewater Quality</p> <p><u>Operation Phase</u></p> <p>- 7 Stations</p> <p>1. Lat Phrao Canal            2. Saen Saeb Canal  3. Phra Khanong Canal    4. Samrong Canal  5. Khlet Canal  6. Retention pond nearby Srinagarindra road, Pond No.1  7. Retention pond nearby Srinagarindra road, Pond No.2</p> <p>- <b>Indexes</b></p> <p>1. Temperature                      2. Suspended Solids  3. Conductivity                        4. pH  5. Dissolved Oxygen                6. Phosphate  7. BOD                                    8. Oil &amp; Grease  9. Fecal Coliform Bacteria        10. Sulfide  11. TKN - Nitrogen  12. Total Coliform Bacteria</p> <p>- <b>Period</b> The analysis of shall be conducted twice a year, for five consecutive years. If the measurement results are not significantly different, this shall be conducted once a year.</p> <p>2) Air Quality</p> <p><u>Operation Phase</u></p> <p>- 10 Stations</p> <p>1. Pibool Upphatham School    2. Vejthani Hospital  3. Klongkalantan School        4. Darul Amin Mosque  5. Si lam Temple                      6. Chulavej Hospital  7. Under Phawana station (YL-02)  8. Under Chok Chai 4 station (YL-03)  9. Under Lat Phrao 101 station (YL-07)</p>	<p>- Because of monorail system will apply throughout the route alignment, the environmental impact assessment of operation period on noise and vibration has decreased. And also the route alignment and stations are located in the commercial and residential zone. The environmental monitoring stations of project will be reduced, but still remaining the major stations.</p>

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
5.	Environmental Monitoring Programs (Cont'd)	<p>10. Fatthullbalee Mosque    11. Sudnaree Kindergarten  12. Huamak Municipality School  13. Jamiul Idhard Mosque (Hua Mak Yai)  14. Huamak School            15. Klongkalantan School  16. Suraomai School        17. Khajonsiri Temple  18. Darul Amin Mosque    19. Dusit Thani College  20. Bangkok Metropolitan Land 21. Si lam Temple  22. Big C Srinagarindra (former Carrefour Srinagarindra)  23. Klongkratumratutit School  24. Siritwutti Wittaya school    25. Chularat 2 Hospital  26. Chulavej Hospital</p> <p><b>- Indexes</b>  1. TSP      2. PM – 10      3. PM - 2.5  4. CO      5. NO<sub>2</sub>          6. Wind speed and Direction</p> <p><b>- Period</b> The analysis of shall be conducted forth a year, for five consecutive years. If the measurement results are not significantly different, this shall be conducted twice a year</p> <p><b>3) Noise Level</b>  <u>Operation Phase</u>  <b>- 26 Stations</b>  1. Judicial Training Institute    2. Pibool Upphatham School  3. Chok Chai 4 Police Station Flat  4. Thanormpitvithaya School    5. Bangkok Suksa School  6. Big C Superstore (Lat Phrao)  7. Wat Mae Phra Kularb Tip (Maria Rosa Mystica Church)  8. Vejthani Hospital                9. The Mall Bang Kapi  10. Fatthullbalee Mosque        11. Sudnaree Kindergarten  12. Huamak Municipality School  13. Jamiul Idhard Mosque (Hua Mak Yai)  14. Huamak School                15. Klongkalantan School  16. Suraomai School               17. Khajonsiri Temple  18. Darul Amin Mosque        19. Dusit Thani College</p>	<p>10. Under Samrong station (YL-23)</p> <p><b>- Indexes</b>  1. TSP      2. PM – 10      3. PM - 2.5  4. CO      5. NO<sub>2</sub>          6. Wind speed and direction</p> <p><b>- Period</b> The analysis of shall be conducted twice a year, for five consecutive years. If the measurement results are not significantly different, this shall be conducted once a year.</p> <p><b>3) Noise Level</b>  <u>Operation Phase</u>  <b>- 6 Stations</b>  1. Pibool Upphatham School    2. Vejthani Hospital  3. Klongkalantan School        4. Darul Amin Mosque  5. Si lam Temple                    6. Chulavej Hospital</p> <p><b>- Indexes</b>  1. Leq (24 ชม.)                    2. Ldn  3. Lmax                                4. L<sub>10</sub>, L<sub>90</sub></p> <p><b>- Period</b> The analysis of shall be conducted twice a year, for five consecutive years. If the measurement results are not significantly different, this shall be conducted once a year.</p>	

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
5.	Environmental Monitoring Programs (Cont'd)	<p>20. Bangkok Metropolitan Land 21. Si lam Temple  22. Big C Srinagarindra (former Carrefour Srinagarindra)  23. Klongkratumratutit School  24. Siriwutti Wittaya school 25. Chularat 2 Hospital  26. Chulavej Hospital</p> <p><b>- Indexes</b></p> <p>1. Leq (24 hr.) 2. Ldn  3. Lmax 4. L<sub>10</sub>, L<sub>90</sub></p> <p><b>- Period</b> The analysis of shall be conducted forth a year, for five consecutive years. If the measurement results are not significantly different, this shall be conducted twice a year.</p> <p><b>4) Vibration</b>  <u>Operation Phase</u>  <b>- 26 Stations</b></p> <p>1. Judicial Training Institute 2. Pibool Upphatham School  3. Chok Chai 4 Police Station Flat  4. Thanornpitvithaya School 5. Bangkok Suksa School  6. Big C Superstore (Lat Phrao)  7. Wat Mae Phra Kularb Tip (Maria Rosa Mystica Church)  8. Vejthani Hospital 9. The Mall Bang Kapi  10. Fatthullbalee Mosque 11. Sudnaree Kindergarten  12. Huamak Municipality School  13. Jamiul Idhard Mosque (Hua Mak Yai)  14. Huamak School 15. Klongkalantan School  16. Suraomai School 17. Khajonsiri Temple  18. Darul Amin Mosque 19. Dusit Thani College  20. Bangkok Metropolitan Land 21. Si lam Temple  22. Big C Srinagarindra (former Carrefour Srinagarindra)  23. Klongkratumratutit School  24. Siriwutti Wittaya school 25. Chularat 2 Hospital  26. Chulavej Hospital</p>	<p><b>4) Vibration</b>  <u>Operation Phase</u>  <b>- 6 Stations</b></p> <p>1. Pibool Upphatham School 2. Vejthani Hospital  3. Klongkalantan School 4. Darul Amin Mosque  5. Si lam Temple 6. Chulavej Hospital</p> <p><b>- Indexes</b></p> <p>1. Peak Particle Velocity (PPV) in mm/sec  2. Frequency in Hz</p> <p><b>- Period</b> The analysis of shall be conducted twice a year, for five consecutive years. If the measurement results are not significantly different, this shall be conducted once a year</p>	

Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
5.	Environmental Monitoring Programs (Cont'd)	<p>- <b>Indexes</b></p> <ol style="list-style-type: none"> <li>1. Peak Particle Velocity (PPV) in mm/sec</li> <li>2. Frequency in Hz</li> </ol> <p>- <b>Period</b> The analysis of shall be conducted for a year, for five consecutive years. If the measurement results are not significantly different, this shall be conducted twice a year.</p> <p><b>5) Transportation</b> <u>Operation Phase</u></p> <p>- <b>14 Stations</b></p> <ol style="list-style-type: none"> <li>1. Ratchada - Lat Phrao Intersection</li> <li>2. Phawana Intersection</li> <li>3. Chok Chai 4 Intersection</li> <li>4. Pradit Manuntham Intersection</li> <li>5. Bang Kapi Intersection</li> <li>6. Lam Sali Interchange</li> <li>7. Krung Thep Kritha Intersection</li> <li>8. Rama IV Srinagarind Interchange</li> <li>9. Phatthanakan Intersection</li> <li>10. On Nut Intersection</li> <li>11. Udomsuk Intersection</li> <li>12. Si lam Interchange</li> <li>13. Thepharak Intersection</li> <li>14. Samrong Intersection</li> </ol> <p>- <b>Indexes</b></p> <ol style="list-style-type: none"> <li>1. Number, types and directions of vehicles at the measurement points at different intersections that serve as the routes for transporting construction materials and equipment for the analysis of traffic volume on the highways.</li> <li>2. Statistics of accidents.</li> <li>3. Causes and levels of severity of accidents.</li> </ol>	<p><b>5) Transportation</b> <u>Operation Phase</u></p> <p>- <b>6 Stations</b></p> <ol style="list-style-type: none"> <li>1. Phatthanakan Intersection</li> <li>2. On Nut Intersection</li> <li>3. Udom Suk Intersection</li> <li>4. Si lam Interchange</li> <li>5. Thepharak Intersection</li> <li>6. Samrong Intersection</li> </ol> <p>- <b>Indexes</b></p> <ol style="list-style-type: none"> <li>1. Number, types and directions of vehicles at the measurement points at different intersections.</li> <li>2. Statistics of accidents.</li> <li>3. Causes and levels of severity of accidents.</li> </ol> <p>- <b>Period</b> Measurement and data recording shall be carried out twice a year, each covering three consecutive days: working days and holidays during.</p>	



Table 2.2 - 1 The Summary of Change Of the Project from the approved report by National Environment Board (NEB), 2012 (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
5.	Environmental Monitoring Programs (Cont'd)	- Period Measurement and data recording shall be carried out forth a year, each covering three consecutive days: working days and holidays during.		

Table 2.2 - 2 The comparing the station's location between the former study and the details of change

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
1	<b>The MRT Yellow Line Project (Ratchada/Lat Phrao - Phatthanakan) 10 Stations</b>			
	(1) Y-01 Ratchada	Km.0+235, it can connect to Park & Ride Building and the M. R. T. Chaloem Ratchamongkhon Line Project	YL - 01 Ratchada (Km.0+000) is located on Ratchada road and in front of Park & Ride Building	- Nothing changes
	(2) Y-02 Phawana	Km.1+383, it is located near Soi Lat Phrao 41 or Soi Phawana	YL - 02 Phawana (Km.1+314) is moved to put across Soi Phawana Intersection	- To serve the passenger from the other side of Soi Phawana Intersection
	(3) Y-03 Chok Chai 4	Km.2+803, it is located near Soi Chok Chai 4	YL - 03 Chok Chai 4 (Km.2+606) is located at Chok Chai 4 (Soi Lat Phrao 53) and add the new station, YL - 04 at Soi LatPhrao 71 (Km.4+211)	- Nothing changes for YL - 03 Chok Chai4, but add the new station (YL-04 Lat Phrao 71) for connecting the Grey Line Project
	(4) Y-04 Chalong Rat	Km.4+833, it is located betweenr Soi Lat Phrao 79 and Soi Lat Phrao 81 and nearby Chalong Rat Expressway	YL - 05 Lat Phrao 83 (Km.5+006) is located between Soi Lat Phrao 83 and Soi Lat Phrao 85	- To move the station for the best location from Lat Phrao 71
	(5) Y-05 Wang Thong Lang	Km.5+738, it is located betweenr Soi Lat Phrao 87 and Soi Lat Phrao 91	YL - 06 Mahat Thai (Km.6+118) is located betweenr Soi Lat Phrao 91 and Soi Lat Phrao 95 nearby Foodland Supermarket	- To move the station far from Chalong Rat Station about 1 kilometer
	(6) Y-06 Lat Phrao 101	Km.7+098, it is located near Lat Phrao Fresh Market and Soi Lat Phrao 101	YL - 07 Lat Phrao 101 (Km.7+022) is located at Lat Phrao 101	- To move the station far from Mahat Thai Station
	(7) Y-07 Happylan	Km.8+523 is located near Makro Superstore (Bang Kapi) and The Mall Department Store (Bang Kapi)	YL - 08 Bang Kapi (Km.8+262) is located near Makro Superstore (Bang Kapi) and The Mall Department Store (Bang Kapi)	- To move the station far from Lat Phrao 101 Station and serving the passenger from nearby department store and community
	(8) Y-08 Lam Sali	Km.9+594, Lam Sali Intersection is the interchange station from Yellow Line to Orange Line	YL - 09 Lam Sali (Km.9+411) is located at Lam Sali Intersection (south side)	- Nothing changes
	(9) Y-09 Si Kritha	Km.10+846, located around Si Kritha Intersection	YL - 10 (Km.10+710) Si Kritha Intersection (south side) and the interchange bridge project will construct in the future	- Nothing changes
	(10) Y-10 Phathanakan	Km.12+390, it is the terminal of Yellow Line Project where is located between Praram IX Interchange and Phathanakan Intersection and also connect to MRT Dark Yellow Line Project (Phatthanakan-Samrong section) and Airport Rail Link (State Railway of Thailand)	YL - 11 Phathanakan (Km.12+257) is located at the level crossing of railway and Phathanakan road	- To move the location of station far from the level crossing, accessibility ease for passenger and being the interchange station to Airport Rail Link

Table 2.2 - 2 The comparing the station's location between the former study and the details of change (Cont'd)

No.	Items	Approval report of NEB on January 16, 2012	Changes in Project Details	Reasons for Changes
2	The MRT Dark Yellow Line Project (Phatthanakan - Samrong) 11 Stations			
	(1) Y - 10 Phatthanakan	Km.12+050 is located near Praram IX Interchange. It can connect Airport Rail Link and MRT Yellow Line Project (Lat Phrao-Phatthanakan)	YL - 11 Phatthanakan (Km.12+257) is located at level crossing with Phatthanakan road and add the new station YL-12 Kalantan (Km.13+527) in front of Thanya Shopping Park and Ban Klang Muang Village Srinagarindra	- Moving YL - 11 Phatthanakan and add the new station YL-12 Kalantan for serving the future passenger
	(2) Y - 11 Si Nut	Km.15+221 is located on Srinagarindra Road intersecting of On Nut Road on the South of Si Nut Intersection.	YL - 13 Si Nut (Km.15+124) is located at Si Nut Intersection (south-side) and add the new station YL - 14 Srinagarindra 38 (Km.16+261) at Soi Srinagarindra 38 (near Krungthai Bank)	- Nothing changes, but add the new station YL-14 Srinagarindra 38 for serving the future passenger
	(3) Y - 12 SuanLuang Ro 9	Km.17+570 is located on Srinagarindra Road and between Seacon Square Department Store and Seri Center	YL - 15 SuanLuang Ro 9 (Km.17+411) is located between Seacon Square Department Store and Paradise Park	- Nothing changes
	(4) Y - 13 Si Udom	Km.19+134 is located on Srinagarindra Road and nearby Si Udom intersection	YL - 16 Si Udom (Km.18+982) is located at Si Udom intersection (south side)	- Nothing changes
	(5) Y - 14 Si lam	Km.20+503 is located on Srinagarindra Road intersecting with Bang Na - Trat Road.	YL - 17 Si lam (Km.19+985) is located at Si lam Interchange before Bang Na - Trat Road (north side)	- For connecting to Depot and Park & ride Building.
	(6) Y - 15 Si La Salle	Km.21+541 is located on Srinagarindra Road and nearby Si Lasalle intersection	YL - 18 Si Lasalle (Km.21+421) is located at Si Lasalle intersection (south side)	- Nothing changes
	(7) Y - 16 Si Bearing	Km.22+980 is located on Srinagarindra Road and nearby Si Bearing intersection	YL - 19 Si Bearing (Km.22+861) is located at Si Bearing intersection (south side)	- Nothing changes
	(8) Y - 17 Si Dan	Km.24+250 is located on Srinagarindra Road and nearby Si Dan intersection	YL - 20 Si Dan (Km.24+220) is located nearby Si Dan intersection (north side)	- Nothing changes
	(9) Y - 18 Si Thepa	Km.25+691 is located on Thepharak Road in front of Rinrada Health Club, near Thepharak Intersection intersecting with Srinagarindra Road	YL - 21 Si Thepa (Km.25+331) is located nearby Si Thepa intersection (east side)	- To serve passenger demand from the areas of Srinagarindra road and Thepharak road
	(10) Y - 19 Thippawan	Km.27+017 is located on Thepharak Road and nearby Samrong Nua intersection	YL - 22 Thippawan (Km.26+951) is located at Soi Thippawan	- To solve the traffic of Thippawan Village
	(11) Y - 20 Samrong	Km.28+817 is located on Thepharak Road around the road corner intersecting with Sukhumvit Road and also connects to the MRT Green Line Extension (Bearing-Samut Prakan Section)	YL - 23 Samrong (Km.28+691) is located nearby Suthepa intersection (Sukhumvit-Thepharak) and Thepharak fresh market.	- Nothing changes