

Section 3

Project Description

SECTION 3 : PROJECT DESCRIPTION

3.1 INTRODUCTION

The main objective of the Project is to ensure better connectivity towards Kuala Lumpur city centre from the western corridor of Klang Valley. In order to achieve this, better integration with other existing rails such as KTM, KLJE and MRT1 is crucial. This section provides description of the Project in terms of the proposed alignment and stations, the planning and design basis for selection of the alignment and station locations as well as other aspects which include the operation system and construction methodology.

3.2 PLANNING AND DESIGN BASIS

3.2.1 Planning Basis

The over-arching principle in the development of this proposed rail network is even network coverage, entry into the city centre, location of stations in densely populated areas and ability to sustain future expansion. In addition, these transit system needs to be integrated seamlessly with other public transport mode such as buses and taxis.

Taking into account the travel corridor gap between the western part of the Klang Valley and the city of Kuala Lumpur as identified in the GKL/KV PTMP, PRASARANA has conducted a feasibility study in determining the best route or alignment for the Project based on certain sets of objectives and criteria.

In terms of planning basis, the main objectives of the Project are as follows:

- To be the backbone of public transport system to ensure better geographical coverage and accessibility to the western corridor.
- To facilitate better connectivity and integration with other existing public transport networks.
- To enhance future developments in terms of Transit Oriented Development.
- To increase overall economic viability of the area around the corridor.

The main criteria for selection of the best route or alignment include the following:

Ridership

- Ridership per km based on estimated residential population area within each station catchment area.
- Integration with existing transit such as KTM, KLJE, BRT Federal Highway and bus network.
- Connectivity to future developments (existing and future) and demand areas that have potentially high ridership.

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Environmental and Social Impacts

- Noise and vibration impacts expected during the construction and operation of LRT3, particularly developments located close to the alignment or the stations.
- Social impacts, both positive and negative, are likely to affect the communities. The social benefits include alleviation of traffic congestion, improvements in the air quality and reductions of the travel time. The negative impacts will be mainly from potential land acquisition, relocation and displacement of some of the communities.
- Changes to the landscape along the alignment due to the presence of the elevated structure.

Economic and Financial

- Construction and operational costs as well as economic returns of the Project to assess its commercial viability and sustainability.

Constructability and Engineering

- Construction feasibility for the proposed alignment taking into account the site conditions and constraints.
- Compliance to geometric requirements for the rail design and operation.
- Local authority compliances such as local plan and Suruhanjaya Pengangkutan Awam Darat (SPAD) Public Transport Master Plan.

Based on the Feasibility Study for LRT3, the population along the corridor is expected to reach 2 million people by 2020 and public transport mode share to increase to 40% in 2030. For LRT3, the daily ridership is projected to reach approximately 70,000 by the year 2020 and around 330,000 in 2050.

3.2.2 Design Criteria

The design criteria for the Project are similar to many other transit systems in Malaysia and around the world. These criteria ensure a safe and comfortable environment for passengers (**Table 3-1**).

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Table 3-1 Design Criteria

Horizontal Alignment	Design Criteria and Standards
Radius	≥ 300 m for running lines (desirable) ≥ 130 m for running lines (minimum)
Transition spirals	Required
Alignment through stations	Tangent
Maximum applied cant	150 mm
Maximum deficiency of cant	110 mm
Cant gradient	1:500 absolute maximum 1:1200 minimum
Vertical Alignment	
Vertical grade	3.0% (desirable) 5.0% (maximum)
Grade through stations	0.50%
Vertical radius	50 m (absolute minimum)
Design Speed	
Running line	80 km/h (maximum)
Turnout	35 km/h (absolute minimum)
Depot	50 km/h (desirable) 25 km/h

Source: Feasibility Study for the Proposed Light Rail Transit Line 3 (Bandar Utama to Klang), 2014

3.2.3 Geological and Geotechnical Considerations

The geological and geotechnical data is important for planning and designing of the Project especially for the foundation of the structure. These aspects will be further investigated and evaluated to ensure successful project implementation.

The design of the foundation for the elevated structure, basement structure and underground portion of the alignment and ground treatment will utilise subsurface information to be obtained from the geotechnical investigation.

Site investigation works were carried out to obtain qualitative and quantitative information on the character and engineering/geotechnical parameters of the various subsoil strata, including the bedrock, for the design of the foundations structure. Site investigation was carried out from November 2013 to January 2014 and detailed information on the results of the investigation is in **Section 4.3** of this report.

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3.3 KEY PROJECT COMPONENTS

The Project with a total length of 36 km and 25 stations will connect Bandar Utama, Shah Alam and Klang areas. For the Project description, the alignment is divided into three main segments as described below:

- Segment 1: One Utama Station – Persada PLUS Station (**Figure 3-1**)
- Segment 2: Persada PLUS Station – Bukit Raja Station (**Figure 3-2**)
- Segment 3: Bukit Raja Station – Johan Setia Station (**Figure 3-3**)

The other key components include stations, depot, rolling stock, track work and operation system.

3.3.1 Proposed Alignment

a) Segment 1: One Utama Station – Persada PLUS Station

The whole Segment 1 is situated within the MBPJ area. The alignment starts at the proposed **One Utama Station** near LDP and Sg Kayu Ara crossings (**Figure 3-1**). The station is also an interchange station with the MRT1 in order to take advantage of its proximity to the MRT One Utama Station and MRT Park and Ride. From **One Utama Station**, the alignment traverses southwesterly along the Sg Kayu Ara river reserve, passing by the Damansara Utama residential areas, Taman Kayu Ara Indah, Flat Kayu Ara and Puncak Damansara Condominium. The proposed **Damansara Utama Station** is located within the Sg Kayu Ara river reserve, near the IWK treatment plant.

The alignment continues along the Sg Kayu Ara river reserve before it swings onto the SPRINT Highway near Fella Design building. It then continues along the right hand side (RHS) of SPRINT Highway until after PETRON petrol station where the alignment crosses over to the left hand side (LHS) of the highway at the workshops near the ramp to Lebuh Bandar Utama. It then skirts along the SK Bandar Utama field and crosses over Lebuh Bandar Utama towards the proposed **Tropicana Station** located the open space area after the toll plaza, opposite the Merchant Square Business Centre.

The alignment then crosses to the RHS of NKVE towards Subang where the **Lien Hoe Station** is, near the Persoft Tower and Ambank Bhd Building. From this point onwards, the alignment travels along the RHS of the NKVE, running close to the residential areas such as Damansara Lagenda, Villa Idaman, Vista Subang, Damansara Idaman and Winchester at Ara Damansara. The alignment continues further along the RHS of NKVE until the proposed **Dataran Prima Station** near the Shell Petrol Station next to Damansara Lagenda.

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From **Dataran Prima Station**, the alignment continues along the RHS of the NKVE until after Suria Damansara condominium before it crosses to the LHS of NKVE before the exit to Subang. The alignment continues along the exit towards the Persada PLUS area. The **Persada PLUS Station** is proposed within the Persada PLUS open space area before the Subang Toll Plaza. Some of the apartment buildings and office buildings located near the toll plaza include Kelana D'Putra Condominium and Kelana Square. After the station the alignment crosses over Jalan Lapangan Terbang Subang towards the Glenmarie area in Shah Alam.

The entire Segment 1 of the LRT3 alignment from One Utama Station to Persada PLUS Station will be 7 km long and elevated (**Table 3-2**). The elevated structures and viaducts will be located either on the road median or the side of the existing roads and highway.

b) Segment 2 : Persada PLUS Station – Bukit Raja Station

The whole stretch of Segment 2 is located within the MBSA area and will pass through the Temasya, Glenmarie, Shah Alam (Stadium, Seksyen 11, Seksyen 7, Seksyen 14) and UiTM area (**Figure 3-2**). After the Persada PLUS Station, the alignment crosses Jalan Lapangan Terbang Subang onto Persiaran Kerjaya where the **Station 3 Station** is located on the LHS of Persiaran Kerjaya across the Accentra Glenmarie commercial area. Station 3 will be an interchange station with the Kelana Jaya LRT Line. The alignment continues along Persiaran Kerjaya and passes the Glenmarie Gardens, DRB-HICOM area and Temasya Industrial Park. The proposed **Temasya Station** is proposed on the road median, fronting the Temasya Industrial Park and Temasya Anggun residential area.

After **Temasya Station**, the alignment continues along the road median of Persiaran Kerjaya towards the HICOM Glenmarie Industrial Area where **Glenmarie Station** is proposed near the Shell petrol station. Some of the industries along the alignment include A.M. Marketing Sdn Bhd, Marelli Asia Pacific Sdn Bhd and RS Components Sdn Bhd.

After the **Glenmarie Station**, the alignment continues along the road median until the end of Persiaran Kerjaya and then crosses over Jalan Subang, Sg Damansara and North South Expressway Central Link (ELITE) towards Shah Alam Stadium area where the **Stadium (Grand Central) Station** is proposed near the Shah Alam Stadium car park area. After the **Stadium (Grand Central) Station**, the alignment will travel along the LHS of Persiaran Sukan, which passes mainly the D'Kayangan residential area towards the Stadium roundabout and onto Persiaran Hishamuddin.

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The **Persiaran Hishamuddin Station** is proposed near the Shah Alam Club. The underground segment starts about 800 m before the Persiaran Hishamuddin Station and continues until the Section 11 area. The underground segment mainly follows Persiaran Hishamuddin and Persiaran Dato' Menteri before it resurfaces near the Section 11 residential area. The elevated segment of the alignment then continues to travel along Persiaran Dato' Menteri until it reaches the location of the proposed **Section 14 Station** at the open space area after the Pejabat Pos Besar Shah Alam.

From the **Section 14 Station**, the alignment continues along Persiaran Dato' Menteri and swings towards the SIRIM area after the Persiaran Dato' Menteri and Lebuhraya Kemuning Shah Alam (LKSA) intersection. The alignment travels westerly along the green area bordering the SIRIM area and Federal Highway until the proposed **SIRIM Station**. The **SIRIM Station** is located on a green area along the SIRIM side or RHS of the Federal Highway near the Persiaran Raja Muda flyover.

After the **SIRIM Station**, the alignment continues to travel along the UiTM side or RHS of the Federal Highway until the proposed **UiTM Station** near the existing Shell petrol station. It continues to travel along the the UiTM side or RHS of the Federal Highway before turning onto Persiaran Kayangan. The alignment travels along the median of Persiaran Kayangan, passing along the UiTM entrance and Seksyen 7 commercial area. The alignment then turns onto Persiaran Permai near the signalised cross-junction towards the proposed **I-City Station**, which is next to the SJK (T) Ladang Midlands and Tasik Section 7.

After **I-City Station**, the alignment continues to travel along Persiaran Permai and passes along the residential areas (PKNS apartments) before it turns onto Lebuh Keluli which is mainly an industrial and commercial area – Bukit Raja Selatan Industrial Park and Bukit Raja Business Centre. The proposed **Bukit Raja Station** is located along the median of Lebuh Keluli in front of Bukit Raja Selatan Industrial Area.

For Segment 2 of the LRT3 alignment from Station 3 Station to Bukit Raja Station, about 2 km of the line will be underground (between Persiaran Hishamuddin and Persiaran Dato' Menteri) while the remaining 13 km will be elevated (**Table 3-2**). Both the elevated structures and viaducts will run along the road median or the side of the existing roads and highway.

c) Segment 3 : Bukit Raja Station – Johan Setia Station

The whole segment 3 is located within MPK area and passes through Bukit Raja, Kawasan 17, Jalan Meru, Klang town, Bandar Botanic and Johan Setia areas (**Figure 3-3**).

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After the **Bukit Raja Station**, the alignment crosses North Klang Straits Bypass towards Bandar Baru Klang area into Persiaran Bukit Raja. The alignment follows the Persiaran Bukit Raja, passing along the commercial and residential areas of Bandar Baru Klang. The **Kawasan 17 Station** is proposed near the abandoned Bandar Baru Klang Business Park. The alignment continues along Persiaran Bukit Raja and passes by the KPJ Klang Specialist Hospital, The Palm Garden (under construction), Flat Chempaka and Flat Dahlia as the alignment swings towards the TNB power line reserve at Kawasan 17 area at the end of Persiaran Bukit Raja, before the North Klang Straits Bypass.

Within Kawasan 17 area, the alignment runs parallel to the TNB power line reserve and passes along Pelangi Court apartment and into Jalan Pekan Baru and Jalan Pekan Baru 38. It continues towards Jalan Meru and along the way, it traverses the commercial and residential areas along Jalan Kelicap 41, Jalan Kelicap 44 and Jalan Kelicap 45.

The alignment travels along Jalan Meru, mainly along the road median, and passes by the commercial buildings and shop houses as well as schools (SK Meru 1 & 2, SMK Meru) along both sides of Jalan Meru. The proposed **Jalan Meru Station** is located on the open space area on the RHS of Jalan Meru, after the SMK Meru.

After the **Jalan Meru Station**, the alignment continues along the RHS of the Jalan Meru until the roundabout where the alignment then follows Persiaran Sultan Ibrahim towards the Jambatan Kota Bridge. The alignment crosses Sg Klang at the Jambatan Kota Bridge and enters into Jalan Jambatan Kota.

The **Klang Station** is proposed on the RHS of the Jalan Jambatan Kota, after the bridge adjacent to the KTMB railway track. The alignment continues along Jalan Jambatan Kota and passes mainly institutional buildings such as MPK building, Dewan Hamzah, Pejabat Agama Islam Klang, Kompleks Pejabat Daerah dan Tanah Klang and Prima Klang Avenue as it travels towards Bulatan Simpang Lima.

After Bulatan Simpang Lima, the alignment travels along the RHS of Persiaran Tengku Ampuan Rahimah and passes commercial and residential areas of Taman Selatan as it approaches the proposed **Taman Selatan Station**. The Taman Selatan Station is located on the road median before the Klang Special School on the RHS of the road.

After the **Taman Selatan Station**, the alignment continues along the road median and passes Masjid Al-Rahimiah on the left and Hospital Besar Tengku Ampuan Rahimah on the right side before the proposed **Sri Andalas Station** in front of the Taman Sri Andalas commercial area.

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The alignment continues to travel along the RHS of Persiaran Tengku Ampuan Rahimah and comes to go along the LHS of Jalan Langat until it reaches the proposed **Tesco Bukit Tinggi Station**, across Tesco Bukit Tinggi. After Tesco Bukit Tinggi Station, the alignment continues along the road median of Jalan Langat, passing through the residential and commercial areas of Bandar Bukit Tinggi and Bandar Botanic until it reaches the proposed **AEON Bukit Tinggi Station** situated in front of AEON Bukit Tinggi open space car park area.

After the **AEON Bukit Tinggi Station**, the alignment continues to travel south along the median of Jalan Langat towards Bandar Botanic area where the **Bandar Botanik Station** is proposed. The station is proposed to be on the open space area along LHS of the road where the Botanic Capital commercial area is located. The alignment continues to travel south along LHS of Jalan Langat and passes Kota Bayuemas, Johan Setia area and Bandar Parkland before it terminates at the proposed **Johan Setia Station/depot**. The depot is located on the LHS of the road and directly across the main entrance to Bandar Parkland.

The entire Segment 3 of the LRT3 alignment from Kawasan 17 Station to Johan Setia depot will be 14 km long and elevated (**Table 3-2**). The elevated structures and viaducts will be located either on the road median or the side of the existing roads and highway.

Table 3-2 Station to Station – Distances

Station	Station	Type	Distance (km)
One Utama	Damansara Utama	Elevated	0.8
Damansara Utama	Tropicana	Elevated	2.4
Tropicana	Lien Hoe	Elevated	1.0
Lien Hoe	Dataran Prima	Elevated	0.7
Dataran Prima	Persada PLUS	Elevated	2.0
Persada PLUS	Station 3	Elevated	1.0
Station 3	Temasya	Elevated	1.4
Temasya	Glenmarie	Elevated	2.1
Glenmarie	Stadium (Grand Central)	Elevated	1.7
Stadium (Grand Central)	Persiaran Hishamuddin	Elevated /Underground	1.5
Persiaran Hishamuddin	Section 14	Underground /Elevated	2.2
Section 14	SIRIM	Elevated	1.5
SIRIM	UiTM	Elevated	0.9

Source: Prasarana Malaysia Berhad

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Table 3-2 Station to Station – Distances (Cont'd)

Station	Station	Type	Distance (km)
UiTM	I-City	Elevated	1.9
I-City	Bukit Raja	Elevated	1.2
Bukit Raja	Kawasan 17	Elevated	1.3
Kawasan 17	Jalan Meru	Elevated	1.1
Jalan Meru	Klang	Elevated	1.4
Klang	Taman Selatan	Elevated	2.2
Taman Selatan	Sri Andalas	Elevated	1.2
Sri Andalas	Tesco Bukit Tinggi	Elevated	1.2
Tesco Bukit Tinggi	AEON Bukit Tinggi	Elevated	1.2
AEON Bukit Tinggi	Bandar Botanic	Elevated	1.2
Bandar Botanic	Johan Setia	Elevated	1.6

Source: Prasarana Malaysia Berhad

3.3.2 Stations

The LRT3 will have total of 25 stations, one of which will be underground. Out of these, four stations will be integrated with the existing KTM, KJLE, MRT1 and BRT which are as follows:

- **One Utama** Station integration with MRT1 Line
- **Station 3** Station integration with KLJE Line
- **Klang** Station integration with KTM Line
- **SIRIM** Station integration with BRT Line

Summary of the stations in terms of its features, ridership and catchment areas are tabulated in **Table 3-3** while its locations are shown in **Figure 3-1** to **Figure 3-3**. Side platform and island platform types of stations are proposed as shown in **Figure 3-4**. Side platform type station is normally proposed at sites where there are space constraints.

The interchange stations are planned to facilitate transfer of passengers between the proposed LRT3 Line with the existing and future rail lines as well as the BRT Line. In addition, integration with major commercial developments both existing and future, is crucial to ensure direct connectivity via pedestrian bridges or covered walkways for stations located adjacent to these commercial centers to ensure convenience to the pedestrians. With regards to this, opportunities for integration with potential transit oriented developments are also being considered for some of the stations.

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All stations will be fully gated and equipped with Automatic Ticketing Gates, ticket vending machines, LED and plasma displays that show train service information and payphones. Facilities such as lifts, escalators, public telephones, suraus and public toilets will be provided at all stations. Also, bicycle lanes, bicycle parking and other facilities for cyclists will be provided where possible at the stations.

Universal access facilities such as ramps, tactile tiles or tactile guided floor systems, low ticket counter and toilets will also be incorporated at all the stations. The underground station will be equipped with glazed platform screen doors for passengers' safety. The stations will be designed to ensure passengers' convenience, comfort and safety.

Examples of typical station designs with and without the transit oriented developments are shown in **Plate 3-1** and **Plate 3-2**.

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Plate 3-1
Architect's Illustration of a Station Design (Without Transit Oriented Development)



Plate 3-2
Architect's Illustration of a Station Design Integrated with Potential Transport Oriented Development Site

Source: Feasibility Study for the Proposed Light Rail Transit Line 3 (Bandar Utama to Klang), 2014

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Table 3-3 Proposed Stations – Features and Catchment Areas

No.	Station	Type	Height (m)	Park & Ride Facilities	Ridership/year (2020)	Catchment Area
1	One Utama	Elevated	11	No	142,173	Bandar Utama, Taman Tun Dr Ismail, Mutiara Damansara
2	Damansara Utama	Elevated	20	No	88,764	Bandar Utama, Damansara Utama, Kg Sg Kayu Ara
3	Tropicana	Elevated	11	Yes	63,770	Damansara Indah, SS 23, BU 11, BU 12
4	Lien Hoe	Elevated	13	No	38,700	Taman Bukit Mayang Emas, PJU 1, Taman Mayang Jaya, BU 12, Kg Cempaka
5	Dataran Prima	Elevated	13	Yes	140,578	Ara Damansara, Kg Cempaka, SS 2, Taman Megah
6	Persada PLUS	Elevated	16	No	72,263	SS 7, SS 3, Taman Putra Damai
7	Station 3	Elevated	19	Yes	91,313	Glenmarie Courts, SS 7
8	Temasya	Elevated	16	No	17,500	Temasya Glenmarie, Temasya Industrial Park, Subang Jaya SS 15, SS 18
9	Glenmarie	Elevated	16	No	26,540	HICOM-Glenmarie Industrial Park, Sultan Salahuddin Abdul Aziz Shah Polytechnic, Subang Hi-Tech Industrial Park, SS 19, Subang Heights, Taman Mutiara Subang
10	Stadium (Grand Central)	Elevated	19	Yes	30,443	Section 13, 15, 22
11	Persiaran Hishamuddin	Underground	-14	No	38,466	Section 13, 9, 12, 20
12	Section 14	Elevated	16	No	49,673	Section 14, 9, 19, 18
13	SIRIM	Elevated	26	No	16,486	Section 2, 3, 4, 15, 18, 24
14	UiTM	Elevated	16	No	49,199	Section 16, 17, 7, UiTM
15	I-City	Elevated	11	Yes	16,263	Kg Padang Jawa, Section 7

Source: Prasarana Malaysia Berhad

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Table 3-3 Proposed Stations – Features and Catchment Areas (Cont'd)

No.	Station	Type	Height (m)	Park & Ride Facilities	Ridership/year (2020)	Catchment Area
16	Bukit Raja	Elevated	13	No	37,111	Bukit Raja Selatan Industrial Area, Taman Perindustrian Bukit Raja
17	Kawasan 17	Elevated	12	Yes	39,753	Taman Eng Ann, Taman Berkeley, Bandar Baru Klang
18	Jalan Meru	Elevated	8	No	56,530	Kawasan 19, Taman Sri Pinang, Taman Sentosa, Batu Belah, Kg Sg Pinang Dalam, Taman Haji Ismail
19	Klang	Elevated	22	Yes	18,018	Taman Wangi, Taman Kota Jaya, Kg Pandan, Bukit Jaya
20	Taman Selatan	Elevated	13	No	151,591	Taman Selatan, Taman Palm Grove, Taman Sri Pesona, Taman Sri Andalas
21	Sri Andalas	Elevated	10	Yes	123,756	Taman Bayu Perdana, Taman Chi Liung, Kg Teluk Gadong Besar, Taman Bayu Emas, Taman Chi Leong
22	Tesco Bukit Tinggi	Elevated	20	No	64,28	Bandar Bukit Tinggi, Taman Klang Jaya, Taman Klang Ria
23	AEON Bukit Tinggi	Elevated	11	Yes	43,151	Bandar Bukit Tinggi 2, Ambang Botanic
24	Bandar Botanik	Elevated	14	No	32,202	Bandar Puteri Klang, Botanic Capital
25	Johan Setia (Depot)	Elevated	2	Yes	114,844	Bandar Parklands, Kota Bayuemas, Taman Johan Setia Permai

Source: Prasarana Malaysia Berhad

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3.3.3 Depot

The proposed depot will be located at Johan Setia and cover an area of about 28 ha (70 acres) (**Figure 3-5**). The depot will be equipped to serve the needs for the storage and maintenance of the Light Rail Vehicles, power supply equipment, signal equipment telecommunications equipment and automatic fare collections equipment of the railway network.

The depot area will be fully fenced up where restricted or controlled area will properly demarcated and enclosed, separated by barriers with designated exit or entry points. Efficient traffic circulation to/from and within the depot is key aspect for operation and maintenance. In addition, sufficient space will be required to ensure easy movement of heavy trucks for loading and unloading.

The facilities that will be provided at the depot include:

- a) Stabling tracks
- b) Light maintenance pits with fixed roof access platforms and overhead cranes
- c) Lifting tracks with screw jacks and overhead cranes
- d) Heavy repair tracks
- e) Rolling stock workshop
- f) Heavy cleaning platforms
- g) Automatic train wash plants
- h) Plant and equipment for maintenance of the infrastructure

3.4 ROLLING STOCK

The rolling stock is expected to be similar to the existing LRT line where Light Rail Vehicle (LRV) train will be adopted. A maximum of 6-car train set will be adopted with maximum carrying capacity of 1,224 passengers is proposed. It will be a modular type of train, passengers will be able to walk from one end of the train to the complete opposite end without encountering any barriers.

The train can be configured to a 2, 4 or 6 car-vehicle train. The train design life is 30 years. The general dimension of each car is 20 m long x 2.65 m wide x 3.44 m high. Each car will have a minimum of 36 seats and 6 passenger doors (3 doors on each side).

The proposed LRT3 will use full Automatic Train Operation (ATO) driverless system. There will be longitudinal seating arrangement on both sides with stanchions and hold bars provided for standing passengers.

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Among the available technologies that will improve the performance and efficiency of the rolling stock are new and improved propulsion control, higher vehicle acceleration and deceleration (with minimal jerk), light weight car bodies (and equipment), dynamic interface of vehicle control to signaling, greater safety (door warning, door obstruction detection, etc.), third (fourth) rail power, GIGA cell battery bank, improved vehicle articulation, real time information as well as real time monitoring and recording of data.

The design of the rolling stock and the guide way will be based on appropriate international standards, as shown in **Table 3-4**.

Table 3-4 Design Standards for Rolling Stock and Guide Way

Description	Standard
Fire tests on building materials and structures – Part 6: Method of test for fire propagation for products	BS 476: Part 6
Fire tests on building materials and structures – Part 7: Method of test to determine the classification of the surface spread of flame of products	BS 476: Part 7
Fire tests on building materials and structures – Part 20: Method for determination of the fire resistance of elements of construction (general principles)	BS 476: Parts 20: 1987
Fire tests on building materials and structures – Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction	BS 476: Parts 22: 1987
Rubber Hoses and Hose Assemblies	BS ISO 3862:2009
Graphical symbols and signs – Safety signs, including fire safety signs – Part 5: Signs with specific safety meanings	BS 5499 Part 5:2002
Code of practice for fire precautions in the design and construction of passenger carrying trains	BS 6853 : 1999
Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock	BS EN 286 Part 3:1995
Welding – Recommendations for welding of metallic materials – Part 1: General guidance for arc welding	BS EN1011-1:1998
Welding – Recommendations for welding of metallic materials – Part 2: Arc welding of ferritic steels	BS EN 1011-2:2001
Welding – Recommendations for welding of metallic materials – Part 4: Arc welding of aluminium and aluminium alloys	BS EN 1011-4:2000
Railway applications. Structural requirements of railway vehicle bodies	BS EN 12663
Railway applications. Crashworthiness requirements for railway vehicle bodies	BS EN 15227
Railway applications – Electromagnetic compatibility Part 3-2 : Rolling stock - Apparatus	BS EN 50121-3-2

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Table 3-4 Design Standards for Rolling Stock and Permanent Way (Cont'd)

Description	Standard
Railway applications – Electronic equipment used on rolling stock	BS EN 50155:2007
Specification for low-voltage switchgear and control gear, circuit breakers	BS EN 60947-2-2003
Railway applications. Rolling stock equipment, shock and vibration tests	BS EN 61373:1999
Reaction to fire tests for floorings – Part 1: Determination of the burning behaviour using a radiant heat source	BS EN ISO 9239 Part 1:2002
Specification for degrees of protection provided by enclosures (IP code)	BS EN 60529:1992
Electromagnetic compatibility. Part 1: General	EN 50121-1
Electromagnetic compatibility. Part 2: Emissions of the whole railway system to the outside world.	EN 50121-2
Electromagnetic Compatibility. Part 3.1: Rolling stock – Vehicle & complete vehicle	EN 50121-3-1
Compatibility between rolling stock and train detection systems	EN 50238
Railway applications – The specification and demonstration of reliability, availability, maintainability and safety (RAMS)	EN 50126 / IEC 62278
Railway applications – Communications, signalling and processing systems	EN 50128 / IEC62279
Low voltage fuses	IEC 269
Railway applications – Electric equipment for rolling stock	IEC 60077
Electric traction – Rotating electrical machines for rail and road vehicles	IEC 60349:2002
Specification for classification of degrees of protection provided by enclosures	IEC 60529:2001
Electronic equipment used on rail vehicles	IEC 60571:2006
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Vented nickel-cadmium prismatic rechargeable single cells	IEC 60623:2001
Railway applications. Supply voltages of traction system	IEC 60850
Low-voltage switchgear and control gear – Part 2: Circuit-breakers	IEC 60947-2
Preparation of documents used in electrotechnology – Part 1: Rules	IEC 61082-1:2006
Reliability Testing – Compliance tests for constant failure rate and constant failure intensity	IEC 61124
Railway applications – rolling stock – testing of rolling stock on completion of construction and before entry into service	IEC 61133:2006
Power converters installed on board rolling stock	IEC 61287

Source: Prasarana Malaysia Berhad

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Table 3-4 Design Standards for Rolling Stock and Permanent Way (Cont'd)

Description	Standard
Non-destructive testing	ISO 9712:2005
Reaction to fire tests for floorings – Part 2: Determination of flame spread at a heat flux level of 25 kW/m ²	ISO 9239 Part 1: 2002
Resistance to chemicals	DIN 51958
Testing of rubber: determination of tensile strength at break, tensile stress at yield, elongation at break and stress values in a tensile test	DIN 53504 / BS 903 Part 42
Slip resistance	AS/NZS 3661
Fire Tests – Analysis of pyrolysis and combustion gases - Tube furnace method	NF X 70-100: 1986
Standard test method for relative resistance to wear of unglazed ceramic tile by taber abraser	ASTM C501

Source: Prasarana Malaysia Berhad

3.5 TRACKWORK

The track works shall be based on established metro or railway practice and the current state of the art in track work technology. The maximum operational speed shall be 90 kmph and the track work designs shall incorporate engineering solutions, standards, materials and components that have been tested and well proven in service under similar traffic and operation conditions by other modern railways or metro systems for a period of not less than five years.

The track system covers the track network that provides support and guidance to the rolling stock. The track work system will include the following major elements:

- Trackwork system rails including fishplates, drilling and welding
- Rail fastenings including base plates, bolts rail pads and insulators
- Sleepers and rail bearers including non-ballasted track systems
- Track foundations including ballast and any associated drainage and capping layers
- Turnouts and crossovers
- Derailment containment mechanism where required
- Measures to mitigate noise and vibrations
- Ducts lay beneath the track to accommodate railway control and communications equipment wiring
- Stray current collection system where provided within the track form
- Traction system track and cross bonding
- Track permanent markers

SECTION 3 : PROJECT DESCRIPTION

The track form for the main line shall comprise of non-ballasted track. This non-ballasted track support system will be resilient booted mono-block (or twin-block sleeper) support system, which consists of the running rails being fastened to concrete sleepers block to secure the track gauge. This type of track will control ground borne noise and vibrations generated due to the contact between the wheel and the rail.

The running rails will carry the return current and will be electrically insulated from earth to prevent earth leakage currents (stray currents). A third rail will be used for traction power supply distribution.

Ballasted tracks will be used for track installation at the depot for stabling and loop tracks. Ballasted track is an alternative to the slab track, where the rail is mounted onto a wooden or concrete sleeper. The sleeper rests on a bed of ballast (crushed rock) which distributes the loading to the subgrade (the prepared soil on which the track is constructed). The top ballast is placed between the sleepers and on the shoulders to provide stability.

The nominal track gauge shall be 1,435 mm for straight tracks and curved tracks with radius greater than 130 m. The track gauge shall be widened on sharp curves and for tracks on curves with radius less than or equal to 130 m, the track gauge shall be widened to a value consequent of track geometry, up to a maximum of 1,445 mm. The track gauge will be widened on sharp curves and the track centre spacing will be minimum 4,200 mm and will be widened according to actual alignment geometry and vehicle dynamic envelope. The proposed overall track specifications are as listed in **Table 3-5**.

Table 3-5 Overall Track Specifications

No.	Characteristic/Particular	Value/Standard
1	Track Gauge	Standard: 1435 mm
2	Rail Profile	UIC 54 (EN-13674-1) Steel quality – Grade 900A/UIC code 860
3	Track Type	Ballastless – Main line Ballasted – Depot
4	Distance between Track Centre (min)	4200 mm
5	Minimum Radius	130 m – Main line 50 m – Depot
6	Maximum Grade	3% – Main line 5% – Connecting Line

SECTION 3 : PROJECT DESCRIPTION

Table 3-5 Overall Track Specifications (Cont'd)

No.	Characteristic/Particular	Value/Standard
7	Rail Support/Fixation	Concrete block sleepers, embedded to slab With rubber boots
8	Rail Fastening	Elastic fastener (rail clip) Clamping force: 20 kN Rail creep resistance: Static 15kN Dynamic 9.5 kN
9	Rail Joints	CWR (Flash Butt or Thermit Welding)
10	Turn Out (Main Line)	TO # 6 minimum Grade 900 A to UIC Code 860
11	Track Slab	Cast In-Situ/Pre-cast

Source: Prasarana Malaysia Berhad

Special considerations will also be given to specific environment or conditions through which the LRT3 will be operating. For example, the need to provide special noise and/or vibration attenuating track forms to protect adjacent noise and/or vibration sensitive receptors from any adverse impacts during operation.

3.6 SYSTEM OPERATION

In terms of operation hours, the LRT3 system will operate daily from 6.00 am to 12.00 am (midnight) during normal condition. The proposed peak hour frequency for the train will be at minimum 2 minutes. The maximum design train speed will be about 90 km/hr. The maximum operation speed will be 80km/hr. Based on average speed, the total expected travel time from One Utama Station to Johan Setia Station is about 51 minutes.

3.6.1 Operations Control Centre

The Operations Control Center (OCC) located at the Johan Setia depot will be the main control hub for the line.

The functions of the OCC include:

- To monitor, control and dispatch train service;
- To monitor the equipment as well as control and handle train service at the degraded and emergency mode operations;
- Provide access to station public announcement systems to conduct pre-recorded or live public announcements to inform and guide passengers;
- To coordinate with maintenance departments for maintenance activities, recoveries and engineering works;

SECTION 3 : PROJECT DESCRIPTION

- Collect real time information from vehicles;
- House the Intrusion Detection and Access Control System, the Automatic Train Supervision (ATS), Supervisory Control and Data Acquisition (SCADA), Passenger Information Display System (PIDS), among others;
- Control communication to stations via the control room which is connected by direct line telephone circuits to the station control rooms; and
- Provide monitoring of CCTV cameras at all stations.

3.6.2 Signaling and Train Control System

The signaling and train control system for the LRT3 will be an Automatic Train Control (ATC) system. This system will be based on state of the art, proven in use, communications based train control technology, using continuous bidirectional digital communications between intelligent trains and a network of distributed trackside computers designed for very high system reliability and availability.

The ATC system will supply core functions of the Automatic Train Protection (ATP), ATO and ATS. It adopts the simple structure and high performance ATP by radio communication system that is a bidirectional radio communication-based train control (CBTC) system equipped with the distance measurement function and based on a radio network.

The system consists of the following:

- ATS (traffic control system): to be installed in the OCC
- EI (Electronic Interlocking System): to be installed in the station and depot
- Station Computer (radio CBTC): to be installed in the station and test track
- Vehicle computer (radio CBTC): to be installed one piece in front and rear each on trains

Basically, the characteristics of the system are:

- Composite train location detection pattern using a radio distance measurement function and vehicle tacho-generator pulse, which enables moving block through highly accurate location detection.
- A system that enables high-speed and high capacity communication for continuous bidirectional communication between station computer and vehicle computer.

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3.6.3 Traction Power Supply System

Similar to the current LRT system, electrical utility company TNB will supply 33 kV AC power to the train operator who will convert it to 750 V DC power for train traction power.

For the power system demand, the following assumptions were made to estimate the annual energy consumption of the traction power supply system:

- 3.6 kilowatt-hours (kWh) per car per kilometer
- 100,000 kms per train
- 2-car trains (initial operations, at 2 minutes headway) (54 2-car trains)
- Sub-total = $3.6 \times 100,000 \times (54 \times 2) = 38,880,000$ kWh (for 54 2-car trains)

Traction Power Substations will house major equipment of the power supply system, some of which are:

- Transformer-rectifier units
- DC switchgears
- AARU & Negative Cubicle
- Blue Light Relay Panel

Preferably, Traction Power Substations will be located at passenger stations so that additional right of way requirements can be avoided. There will be about 18 Traction Power Substations along the whole alignment.

3.6.4 Supervisory Control and Data Acquisition

SCADA system has been proposed to monitor and control the functions of all equipment during operation. The SCADA system will provide supervisory control of traction power and auxiliary power supply equipment, facilities electromechanical equipment as well as that of other systems and subsystems.

SCADA transmissions shall include:

- Traction power and auxiliary power alarm, indication and control signals.
- Electrical/mechanical status indication and alarms.
- Fire detection signals.
- Communications systems control, status/indications and alarms.
- Any other interfaces and capabilities required for safe, efficient and effective remote operations.

SECTION 3 : PROJECT DESCRIPTION

3.6.5 Passenger Information Display System

The Passenger Information Display System (PIDS) shall provide operational and safety related messages to the passengers at all stations. The PIDS signs shall be placed at the platforms and concourse areas of all stations.

The PIDS shall provide automatic software-generated announcements that include:

- Information about the route, final destination, time of arrival of the next three trains approaching a particular platform.
- Information on service interruptions or delays.
- Emergency Instructions such as for evacuation.
- Prohibitive instructions such as “No Smoking, Eating, or Drinking”;
- News, sports, weather (as may be required).
- Commercial advertising (as defined).
- Day, Date and Time synchronised to a master clock.
- Other pre-recorded messages to be determined by the management.

3.6.6 Ticketing

All stations will be fully gated and capable of operating without staff being present to man ticket vending machine and Automatic Ticketing Gates (ATG). The LRT3 shall use smart cards (contactless tickets and/or token) as payment and operates on a closed tag-on tag-off methodology.

Entry tag-on and exit tag-off operational and transaction data shall be recorded by the ATG and transmitted to the Station Computer System. The gate line shall comprise entry barriers, exit barriers, reversible barriers and wide barriers for baggage and wheelchair access. In an emergency situation, gates shall open automatically when the emergency egress button is pressed.

The Ticket Vending Machines will be installed in the unpaid areas in all the stations. It shall accept cash coins, cash bills, credit card and possibly online debit, online credit card payment and pre-payment online for passengers to purchase valid transport tokens and non-personalised smart card tickets. The Add Fare Machine shall be installed in the unpaid area and allows the recharging of smartcards.

3.6.7 Feeder Bus System and Park and Ride Facilities

Feeder buses are important as it helps the LRT3 to serve a wider catchment area. For LRT3, the proposed feeder bus system will use a 12-m electrical buses. The bus will also be equipped with facilities to serve the physically challenged people.

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The feeder buses are currently being planned to ensure better connectivity for the proposed LRT3. The number of feeder buses required for each station and proposed routes to serve specific catchment area has been identified. Proposed distance to be covered by the bus routes ranges from 5 km to 13 km and time taken for such distances is between 15 minutes to 40 minutes. Examples of individual feeder bus routes for a few of the stations are shown in **Figure 3-6a** to **Figure 3-6c**.

About 20% to 30% of passengers may wish to park their cars or motorcycles at the LRT station, making the need for Park and Ride facilities crucial. The stations at which these facilities are proposed were chosen based on adjacent land availability. Some Park and Ride facilities will utilise existing carpark areas such as at the Shah Alam Stadium carpark. **Table 3-6** shows the estimated required parking bays for the stations with Park and Ride facilities.

Table 3-6 Parking Bays for Park and Ride Stations

Station	Year 2020	Year 2030
Tropicana	156	334
Dataran Prima	231	525
Station 3	264	526
Stadium (Grand Central)	228	465
I-City	144	330
Kawasan 17	138	361
Klang	121	242
Sri Andalas	119	259
AEON Bukit Tinggi	151	708
Johan Setia	163	452
TOTAL	1716	4202

Source: Feasibility Study for the Proposed Light Rail Transit Line 3 (Bandar Utama to Klang), 2014

3.7 CONSTRUCTION METHODS

The key construction activities involved in this Project during pre-construction and construction stage are:

- Relocation of utilities
- Viaduct construction
- Elevated station construction
- Underground station construction
- Underground tunnel guideway construction
- Depot construction

SECTION 3 : PROJECT DESCRIPTION

3.7.1 Relocation of Utilities

Before the commencement of the construction works, utilities located along the alignment will be detected and piloted. This exercise is conducted in order to facilitate and further determine the utilities that need to be relocated along the alignment. The types of utilities include TNB transmission line, water and sewer mains, electrical cables, gas pipes and other underground cables.

A total of about 32 potential relocation works have been identified (**Table 3-7**). The actual relocation works will depends on the location of pier identified during the detailed design stage.

Table 3-7 Potential Utilities Relocation

Type of Utility	Potential Relocation
TNB transmission line	24
Water pipeline	8
Total	32

Source: Feasibility Study for the Proposed Light Rail Transit Line 3 (Bandar Utama to Klang), 2014

3.7.2 Viaduct Construction

The elevated structures and viaducts will generally be located on the road median and the road side. Two types of viaduct which are dual track guide way and single track guide way, will be constructed depending on the station platform type. Single track guide way will be constructed for island platform while dual track guide way for side platform. The width for dual track guide way and single guide way is about 8.0 m and 5.2 m respectively.

Generally, the viaduct will consist of reinforced concrete (RC) structures. However, for segments where very long spans are required or reinforced concrete structures cannot be adopted, prestressed concrete structures have been found to be more suitable than reinforced concrete structures for long spans and heavy loads.

The viaduct construction will involve the following major structure components:

Sub-structure

In view of the large imposed loads from the structure and train, the pier columns supporting the guideway will be on the pile foundation (sub-structure). The sub-structure consists of pile and pile cap. Design of sub-structure will depend on the geotechnical conditions and site constraints.

SECTION 3 : PROJECT DESCRIPTION

The LRT3 Line traverse highly developed area, various method of pile construction will be considered and cast-in-situ reinforced concrete bored piles is found to be most suitable method. If the pier is located in the river, the pile cap top shall be at least 1.5 m below the deepest river bed.

However, the type of pile to be used at different locations will depends on the detailed soil investigation results during the detailed design stage.

Superstructure

The superstructure will mainly consist of segmental box girder structure as it is the most economical, less construction time and currently being used in the existing LRT system. This segment will be pre-cast at the factory and transport to the site for installation.

The pre-cast segment of 2.5 m to 3.0 m will be erected using standard span method for the span varying from 27 m to 36 m (**Figure 3-7**). Balanced cantilever method will be adopted if the span ranges from 50 m to 70 m and where it involves major highways or river crossings (**Figure 3-7**).

For this Project, balanced cantilever method is expected to be carried out at 20 potential locations as tabulated in **Table 3-8**.

Table 3-8 Potential Locations for Balanced Cantilever Method

No.	Major Road/Highway/River
1	SPRINT Highway
2	New Klang Valley Expressway (NKVE)
3	Persiaran Tropicana
4	New Klang Valley Expressway (NKVE)
5	New Klang Valley Expressway (NKVE)
6	New Klang Valley Expressway (NKVE)
7	New Klang Valley Expressway (NKVE)
8	Jalan Lapangan Terbang Subang
9	Persiaran Kerjaya
10	Jalan Subang
11	Sg Damansara
12	North South Expressway Central Link (ELITE)
13	Lebuhraya Selat Klang
14	Persiaran Sultan Ibrahim
15	Sg Klang
16	Jalan Langat
17	Lebuhraya Shah Alam

Source: Feasibility Study for the Proposed Light Rail Transit Line 3 (Bandar Utama to Klang), 2014

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3.7.3 Elevated Station Construction

Elevated station will be designed to accommodate site conditions and constraints. The platform arrangement can be either side platform or island platform. For this Project, the elevated stations will be designed as island platform where possible for ease of operation, passenger comfort and less duplication.

Elevated station construction consists of the following major key works:

- Construction of pile cap, column and crosshead
- Installation of pre-cast beam that will be launched using mobile or crawler crane
- Construction of concourse and platform level
- Architectural finishes and mechanical and electrical works

The station would have a framed structure with concrete column, beams and floors. To suit the requirements of the surroundings, the roof of the station shall be either structural steel with metal cladding or RC framed structure with RC slab.

The type of piles to be used will be evaluated on a case by case basis. Bored cast-in-situ piles are suitable because their construction can be carried out with minimal disturbance to the surroundings. The use of micro piles may be considered in the event where the oncoming vertical and lateral loads are less and where space is a constraint.

3.7.4 Underground Station Construction

Cut and cover construction method will be adopted for the underground station. Two types of cut and cover methods are being considered:

- Cut and cover bottom-up construction method
- Cut and cover top-down construction method

In both methods, excavation will be carried out to the required level for installation of excavation support or retaining walls such as diaphragm wall, Contiguous Bored Pile walls and others. This will be followed by dewatering of the trench (if required). For top-down method, construction will commence from the highest basement or topslab and gradually move down to the lowest basement slab. Back filling works will be carried out over the completed top slab and the surface of the soil will be reinstated. At the lowest basement slab, concreting of foundation, beams or slab sand encase steel plunge column with reinforce concrete will be carried out to form permanent column (**Figure 3-8**).

SECTION 3 : PROJECT DESCRIPTION

For bottom up method, construction will commence from the bottom base and gradually move upwards to the top slab. In this method, the tunnel station structure will be completed before backfilling to final grade and restoring ground surface (**Figure 3-9**).

3.7.5 Underground Tunnel Guideway Construction

The tunnel guide way construction methods are similar to the underground station. In both methods, the main differences are that tunnel top floor and tunnel foundation and base slab will be constructed instead of installed. This is followed by construction of tunnel structure upwards and backfilling to final grade and restoring the ground surface (**Figure 3-10** and **Figure 3-11**).

The estimated volume of excavated material is 30,000 m³ based on the assumption that the depth and width of excavated material is 15 m by 10 m. The excavated material will be stockpiled at the designated area on-site before transported and disposed off at approved landfill site. Potential landfill sites identified at this stage is at Bukit Tagar Sanitary Landfill.

Based on the estimated quantity of excavated material, the estimated number of trucks to transport the fill material to the depot area is 50 trips per day. This is calculated based on 10 trucks with an average of 5 trips per day.

3.7.6 Depot Construction

The depot is located at Johan Setia and covers an area of about 28 ha (70 acres). The construction of the depot will involve the following works:

- Site clearing
- Earthworks
- Construction of buildings and supporting infrastructure and utilities

3.7.6.1 Site Clearing

Site clearing will involve the removal of shrubs and vegetation within the Project boundary by means of bulldozers or equivalent machineries.

The total volume of biomass expected to be generated from site clearing works of about 6.2 tonnes per hectare for naturally regenerated secondary forest after shifting cultivation. The total volume of biomass generated from the site clearing is estimated at 174 tonnes (based on the 28 ha). The wastes will be stockpiled for decomposition at the designated area or spread within the Project site area for soil erosion measures.

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3.7.6.2 Earthworks

The depot site is located on peat soil with existing ground level ranging from RL 5.0 m to RL 15.0 m. The earthworks will involve the removal of existing peat soil or unsuitable material prior to the filling work.

Based on the preliminary soil investigation conducted during Feasibility Study, maximum of about 3.0 m of existing soil will be removed prior to filling work. Based on this estimated quantity of excavated material is about 2 million m³. The excavated material will be stockpiled temporarily at the site prior to disposal at the Bukit Tagar Sanitary Landfill.

The depot area will be raised to proposed platform level of 8 m. The estimated quantity of filling material is about 5 million m³. At this stage, the location of the borrow area has not been identified. However, the borrow area will be identified and described during the Environmental Management Plan (EMP) preparation stage.

The estimated number of trucks to transport the fill material to the depot area is 120 trips per day. This is calculated based on 20 trucks with an average of 6 trips per day.

At this stage, it is assumed that all the peat soil will be removed at 3 m depth and therefore the necessity of the ground treatment will be determined. However, this is subjected to the soil investigation result to be carried out during the detailed design stage. The details of the ground treatment method will be described in the EMP.

3.7.6.3 Construction of Buildings and Supporting Infrastructure and Utilities

The construction of the facilities within the depot site will entail erection works of the buildings, installation of mechanical and electrical components as well as construction of ancillary infrastructures.

The major activities during the construction stage would involve both substructure and superstructure construction which includes piling, structural, concreting and infrastructural works.

The construction of the infrastructure and utilities such as internal roads, drains, water pipes, sewerage pipes, telecommunication lines and electricity cables, would involve mostly localised excavation.

Approximately 2,000 workers are expected to be involved during peak period of the construction stage. In view of the nature of the works involved, most of the workers involved in the construction works except for depot construction are expected to off-site, most likely at the adjacent residential areas. Workers quarters or “kongsi-house” are expected to be built for workers at the depot site.

SECTION 3 : PROJECT DESCRIPTION

3.8 PROJECT OPTIONS

Various project options and design concepts were considered and evaluated in selecting the optimum project design. The options varied according to the physical characteristics and requirements of each route and site conditions. The project options can be divided into:

- No-Project Option
- Alignment Options

The various project options are briefly described below and will be further elaborated in the following section.

3.8.1 No Project Option

The National Land Public Transport Master and the GKL/KV PTMP have clearly stated the importance of an efficient, integrated and well-connected public transport system, particularly for the urban areas which are the major employment centers. Improved accessibility, connectivity and integration of the existing public transport are crucial to reduce the traffic congestion. Providing greater accessibility and mobility for the people has been identified as a key driver not only in terms of economic growth but also improving quality of life of the people as envisioned by the government.

Based on the Urban Rail Development Plan (URDP) 2010, for more efficient and effective public transport it is important that public transport network accessibility be brought closer to the people and the target is to ensure that 80% of the population is within 400 m of public transport network. URDP 2010 has also identified increasing travel demand due to growing population along the western corridor of Klang Valley, namely, Klang, Shah Alam and Petaling Jaya where the current KTM is not expected to be able to accommodate such increase. This is further exacerbated by the already congested roads and highway networks.

The proposed Project has been planned and designed to integrate with the other transit systems such as the KLJE, KTM, MRT1 and the proposed BRT Federal Highway in order to significantly improve the public transport network so that the 40:60 modal split for public transport can be achieved. Such integration is critical in ensuring efficient and well-connected public transport system for the Klang Valley area.

SECTION 3 : PROJECT DESCRIPTION

3.8.2 Alignment Options

Various alignment options were considered and evaluated in the Feasibility Study, preliminary design and during the EIA prior to selecting the preferred alignment. Four main criteria have been adopted for the evaluation process as follows:

- Ridership (Catchment area in terms of population and employment concentration) as well as proposed developments within the catchment is critical
- Environmental and social impacts
- Engineering and constructability
- Economic and financial benefits

The initial study corridor generally encompassed the areas of Kelana Jaya, Shah Alam and Klang, with an area of approximately 65 km² (**Figure 3-12**). An additional corridor of 8 km² was added on in Petaling Jaya to connect the LRT3 to the MRT1 for a seamless integration. Different alignment routes were considered and studied to fit in the corridors.

Prior to selection of the preferred alignment, several rounds of evaluation were carried out starting with the initial corridor, which led to 10 alignment options (**Figure 3-13**). The corridor extends from Klang, Shah Alam, Kelana Jaya and Petaling Jaya areas.

The evaluation process in the selection of the preferred alignment can be summarised as follows:

Stretch of Alignment	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
	Feasibility study stage			Preliminary design/EIA stage	
Klang to Kelana Jaya	10 alternative alignments	5 alternative alignments	1 combined alignment	Feedback from stakeholders	Proposed alignment
Extension to MRT1 from Kelana Jaya	4 alternative alignments	2 alternative alignments			

SECTION 3 : PROJECT DESCRIPTION

3.8.2.1 Alignment Options during the Feasibility Study Stage

a) Selection of the Kelana Jaya/Bandar Utama Alignment

To connect the LRT3 to the MRT1, (**Figure 3-14**), four options have been considered for the Kelana Jaya – Bandar Utama alignment. All four alignment options will start at the Station 3 Station and ended at three alternative locations, Dataran Sunway, One Utama and Section 16. All alignment options will be integrated with MRT1 and each option is described in detail as follows:

Option 1: One Utama

The alignment crosses over Jalan Lapangan Terbang Subang from Station 3 Station, passes Subang Toll Plaza and runs along the NKVE towards the Damansara Toll Plaza and into the SPRINT Highway.

After the Damansara toll, the alignment will traverse towards Bandar Utama area via Lebuh Bandar Utama and subsequently along Persiaran Bandar Utama until the proposed One Utama Station. The proposed One Utama Station will be integrated with MRT 1 One Utama Station.

Option 2: Dataran Sunway

Similar to Option 1, from Station 3 Station the alignment crosses over Jalan Lapangan Terbang Subang and passes the Subang Toll Plaza and runs along NKVE until the Tropicana Golf and Country Resort. The alignment then heads towards Persiaran Surian and Dataran Sunway area to integrate with the MRT1 Dataran Sunway Station.

Option 3: Section 16 via SS2

The alignment crosses over Jalan Lapangan Terbang Subang from Station 3 Station towards SS 7 area and near Paradigm Mall before heading into Jalan Bahagia. From Jalan Bahagia, the alignment will pass SS 4 and SS 3 areas and into Jalan SS 2/24, Jalan Universiti, Jalan 17/1 before it crosses SPRINT Highway to integrate with the MRT 1 at Section 16 Station.

Option 4: Section 16 via SS1/Section 14

Similar to Option 3, the alignment crosses over Jalan Lapangan Terbang Subang towards Jalan SS 7/2 and near the Subang Country Club. The alignment then follows Jalan SS 8/4 and Jalan SS 8/39 before its goes into SS 1 area via Jalan SS 1/11 and Jalan S 1/39. From here, the alignment continues along the existing Kelana Jaya LRT Line before it follows Jalan Dato' Abdul Aziz and Jalan 17/1 before crossing SPRINT Highway to connect with MRT 1 at Section 16 Station.

SECTION 3 : PROJECT DESCRIPTION

Option 1 (One Utama Station) was chosen during the Feasibility Stage as it was found the most suitable in terms of ridership, connecting with other transit systems, environmental and social impacts, economic and financial impacts as well as constructability and engineering.

b) Selection of the Shah Alam Alignment

For Shah Alam alignment, five alignment options were considered before preferred alignment was derived. All five alignments will start at the Persiaran Hishamuddin (Club Shah Alam Selangor) and ended at Section 7 commercial area along Persiaran Permai (**Figure 3-15**).

Option 1

This option follows Persiaran Hishamuddin and Persiaran Dato' Menteri, then crosses the Lebuhraya Kemuning Shah Alam (LKSA) to continue into SIRIM area. After SIRIM area, the alignment runs along the Federal Highway before turning into Persiaran Kayangan and subsequently onto Persiaran Permai.

Option 2

Similar to Option 1, the alignment follows Persiaran Hishamuddin and Persiaran Dato' Menteri, then crosses the LKSA and continues into SIRIM area. At SIRIM area, the alignment turns right onto Persiaran Raja Muda and then Persiaran Institut, passing through Seksyen 2 and Section 3 areas on its right. The alignment then turns left to pass through UiTM area and Seksyen 7 area on its right as it heads towards Persiaran Permai.

Option 3

This option follows Persiaran Hishamuddin and Persiaran Dato' Menteri, then crosses the LKSA to continue along Persiaran Dato' Menteri, passing Seksyen 2 on its left. Just before Seksyen 3, it turns left onto Persiaran Masjid and then passes through UiTM area to join Persiaran Permai.

Option 4

Goes along Persiaran Hishamuddin but instead of going straight ahead at the roundabout to join Persiaran Dato' Menteri, it turns right at the roundabout to go along Persiaran Kayangan, passing by Seksyen 9 on its right and Seksyen 10 on its left. It turns left to go along Persiaran Masjid, passing Seksyen 5, 4 and 3 on its right before turning right, keeping onto Persiaran Masjid and then turns left onto Persiaran Kayangan and then right again onto Persiaran Permai.

SECTION 3 : PROJECT DESCRIPTION

Option 5

Similar to Option 4, it goes along Persiaran Hishamuddin and turns right at the roundabout to go along Persiaran Kayangan. It continues along almost the entire length of Persiaran Kayangan, passing by Seksyen 9 and 6 on its right and Seksyen 10, 5, 6 and 7 on its left before turning right onto Persiaran Permai.

Option 1 was chosen based on the following advantages:

- In terms of ridership, it provides access to Shah Alam town centre and was the shortest route among the other options, thus reducing travel time. There is also the possibility of providing access to the south of Federal Highway (Seksyen 16). It provides a station close to UiTM campus.
- In terms of integration with other transit systems, this alignment provides accessibility to public sectors and the university as well as reaches out to the industrial community across the Federal Highway. There could be negative socio-cultural implications due to proximity to the palace and high-end residential areas (Seksyen 11and 12) but these can be mitigated and minimised.
- As for visual impacts along this alignment, there will be minimal crossing through populated areas. Also, the alignment will compliment the character of the Federal Highway as a fast lane zone and will be a minimal distraction to protocol roads.

c) Selection of the Klang Alignment

Two alignment options were considered for the Klang stretch from Jalan Tengku Kelana to Persiaran Tengku Ampuan Rahimah. Both options cross the Sg Klang via Jambatan Mussaeddin or Jambatan Kota Bridge (**Figure 3-16**).

Option 1

The alignment continues into Jalan Pos Baharu after the roundabout and then runs along the Jambatan Mussaeddin where the proposed Klang Station will be located on the southern side of Sg Klang. The alignment then continues along Jalan Tengku Kelana and Persiaran Tengku Ampuan Rahimah.

SECTION 3 : PROJECT DESCRIPTION

Option 2

This option has two proposed stations to cater to the Klang Town area. The alignment continues into Persiaran Sultan Ibrahim at the roundabout and the proposed Bazaar Klang Station is located just after the roundabout. The alignment then continues into Jalan Jambatan Kota bridge and subsequently into Jalan Jambatan Kota, and passes by MPK. The proposed Klang Station is by the Pejabat Daerah dan Tanah Klang on Jalan Jambatan Kota. After that the alignment joins Persiaran Tengku Ampuan Rahimah.

Option 1 was chosen during the Feasibility Study based on the following advantages:

- Good integration with the KTM station since the distance between proposed LRT3 station and KTM station is about 100 m.
- Businesses and residents of the Tengku Kelana area would benefit as it the alignment will make it more convenient to go to Little India of Klang. There is also the possibility that the streetscapes of Jalan Tengku Kelana and Little India will be upgraded and enhanced.
- Those attending the church, mosque and Hindu temple along Jalan Tengku Kelana have the option of using LRT3.
- Students (SMK Convent, SK Convent 1 and 2) can use the LRT3 to get to school.

3.8.2.2 Alignment Options during EIA Stage

Alignment options at selected stretches were investigated during the post feasibility study/EIA stage. The stretches included the Bandar Utama, Bukit Raja and Jalan Tengku Kelana (**Figure 3-17** to **Figure 3-19**) were further refined from the proposed alignment. Feedback from stakeholders, obtained during the FGDs conducted (see **Section 5** of this report), were useful inputs into the examination of alignment options.

a) Options for the Bandar Utama Alignment

Three alignment options were considered for Bandar Utama area (**Figure 3-17**). This stretch is from One Utama Station to Tropicana Station.

Option 1 (recommended in the Feasibility Study)

The goes along Persiaran Bandar Utama and turns left onto Lebuh Bandar Utama and goes along it until it reaches the SPRINT Highway. The alignment turns right to join the SPRINT Highway and passes the Damansara Toll on its right.

SECTION 3 : PROJECT DESCRIPTION

Option 2

For Option 2, alignment goes along Persiaran Bandar Utama and then turns left onto Jalan Masjid. It goes along Jalan Masjid until it reaches the SPRINT Highway, where it turns right onto the highway, passing the Damansara Toll on its right. However, this option is not feasible mainly because Jalan Masjid is a narrow two lane road with no median and there isn't any suitable location for a station.

Option 3

Option 3, the alignment goes along the length of Sg Kayu Ara from the LDP until the SPRINT Highway where it turns right onto the highway.

Option 3 was chosen because it would have the least social impacts and most ridership.

b) Options for the Bukit Raja – Kawasan 17 Alignment

Two alignment options were further examined (**Figure 3-18**).

Option 1 (recommended in the Feasibility Study)

The alignment turns right onto Lebuhraya Selat Klang from Lebuh Keluli. It travels along the highway and then turns left to join Jalan Pekan Baru 38.

Option 2

For the alternative alignment for Bukit Raja, instead of turning right onto Lebuhraya Selat Klang from Lebuh Keluli, the alignment cuts straight across Lebuhraya Selat Klang and travels a little more south than the preferred alignment and joins Jalan Pekan Baru 38 again, like the preferred alignment.

Option 2 was chosen as it will serve the population and businesses along Persiaran Bukit Raja.

c) Options for the Klang Alignment

Four alignment options were re-examined for this stretch (**Figure 3-19**).

Option 1 (recommended in the Feasibility Study)

Option 1 alignment runs along the Jambatan Mussaeddin where the proposed Klang Station will be located on the southern side of Sg Klang. The alignment then continues along Jalan Tengku Kelana and Persiaran Tengku Ampuan Rahimah.

SECTION 3 : PROJECT DESCRIPTION

Option 2

Option 2, the alignment to go along Jalan Jambatan Kota instead of Jambatan Musaeddin, which would avoid going through Little India. The alignment continues along Jalan Jambatan Kota and joins Persiaran Tengku Ampuan Rahimah.

Option 3

Option 3, the alignment to go from Jalan Meru to join Jalan Nanas, then continue across the Sg Klang after which it joins Jalan Raya Barat goes along it until it joins Persiaran Tengku Ampuan Rahimah. The distance between the KTM Klang and the LRT3 station for this option would be too inconvenient for passengers as it is about 750 m.

Option 4

Option 4, the alignment to go from Jalan Meru, veer left into the bus station area and then go across the Sg Klang. Then it goes along Jalan Kota Raja and then Jalan Raja Jumaat before joining Persiaran Tengku Ampuan Rahimah. For this option there is space constraint, no road median and high land acquisition.

Option 5

Option 5, the alignment to go underground, requiring about a 12 km underground tunnel. The cost for this will be very high, requiring approximately RM 14.5 billion.

Based on the stakeholder feedback, the need to protect very old buildings in the Tengku Kelana area and costs, Option 2 was chosen to minimise social impacts.

3.9 PROJECT IMPLEMENTATION SCHEDULE

The construction of the Project is scheduled to commence in 2016 after all regulatory approvals have been obtained. The construction period is expected to be 51 months.

The testing and commissioning of the system is expected to be carried out from May 2020 until August 2020. The LRT3 is expected to be operational by 2020.

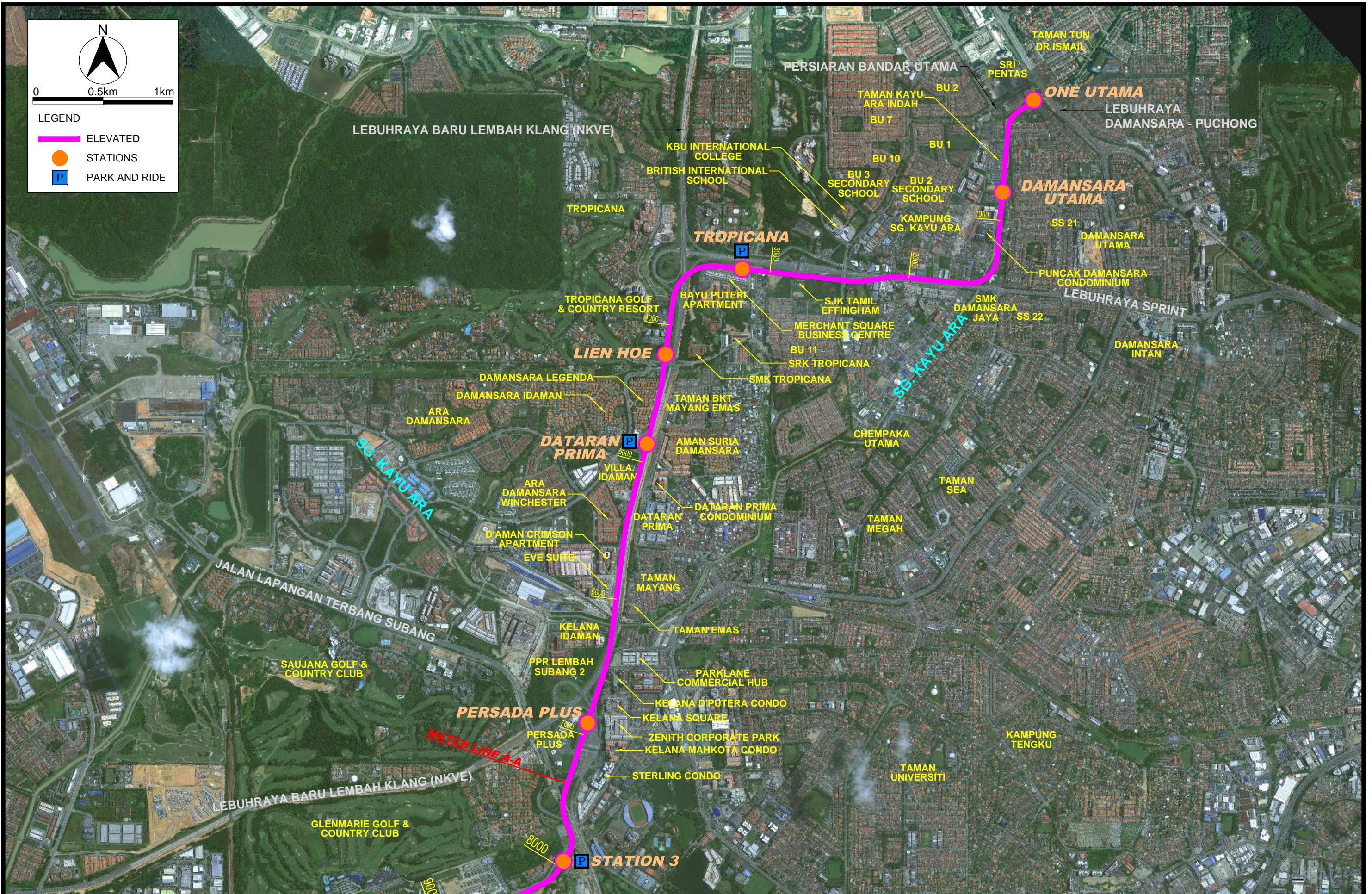


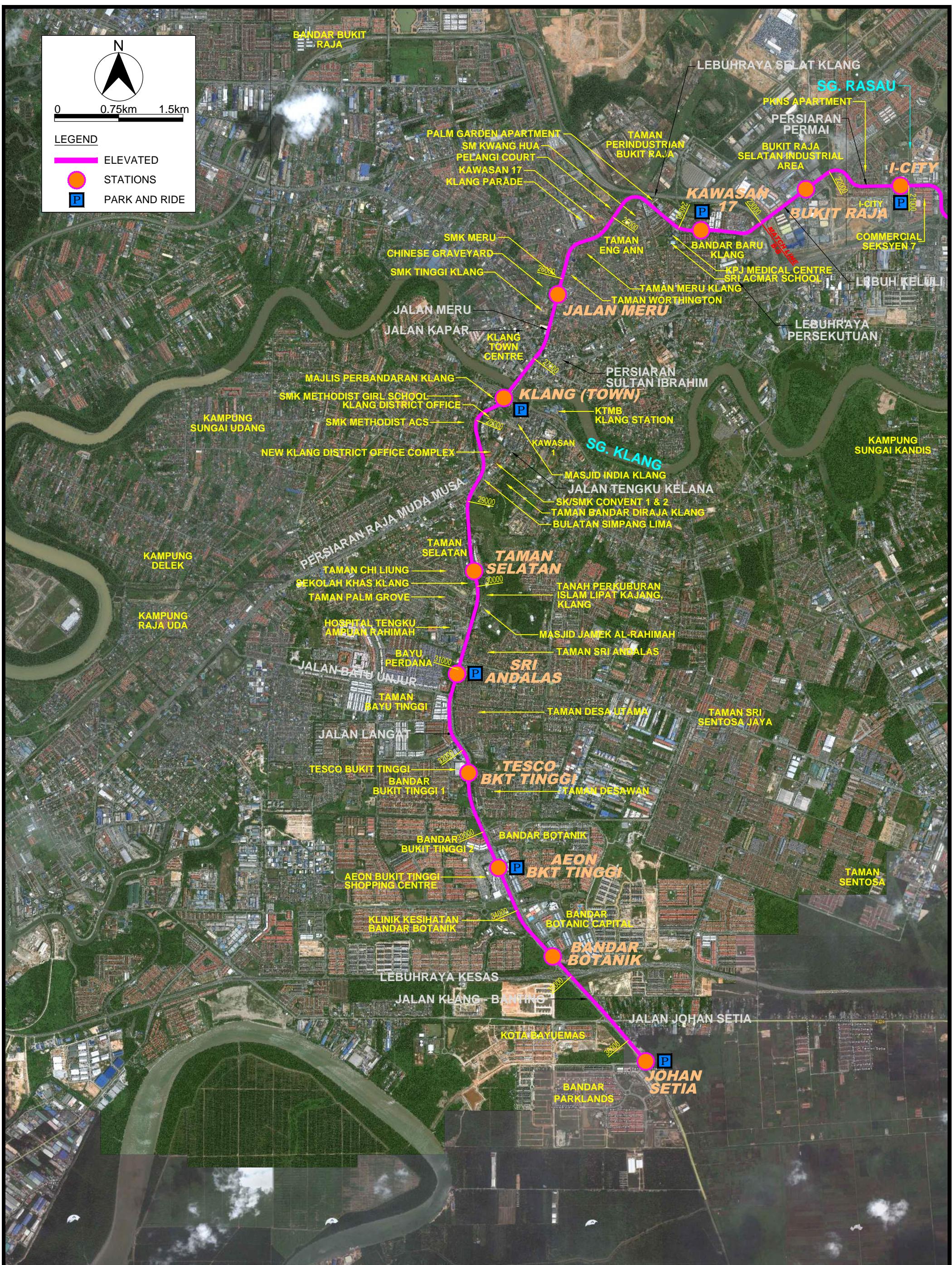
Figure 3-1

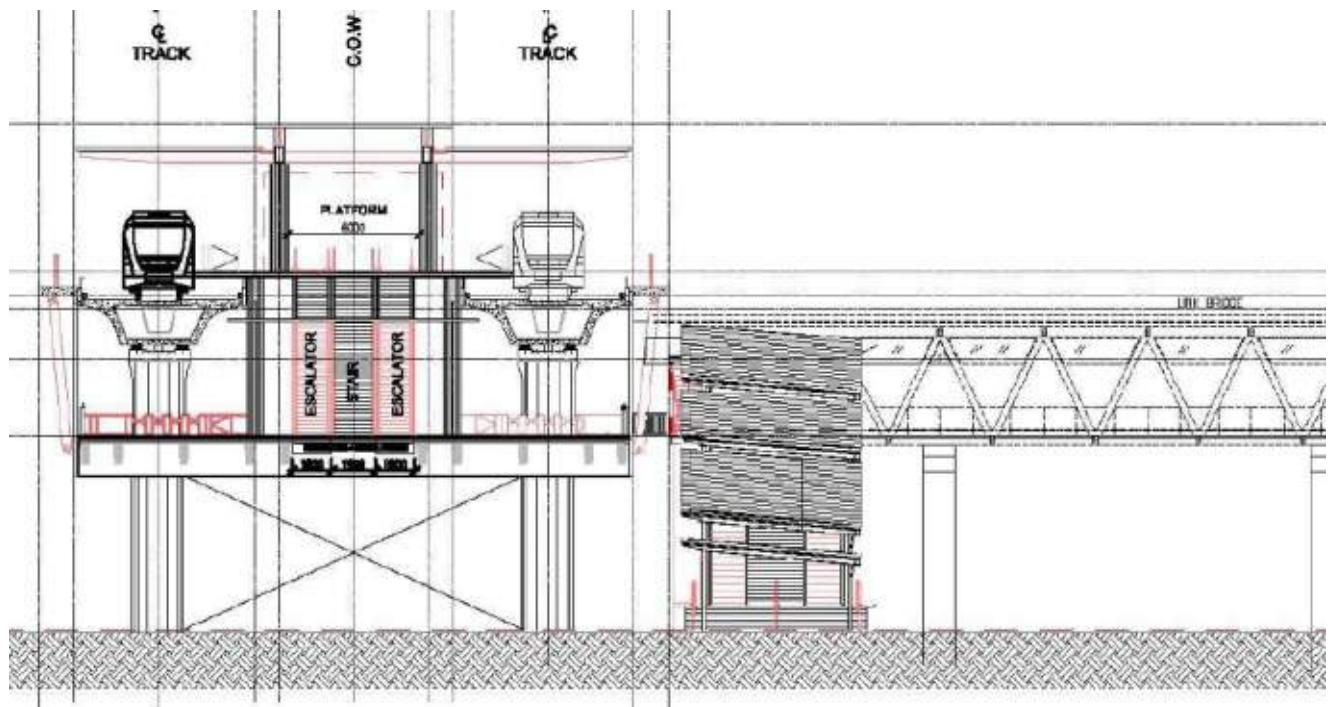
Segment 1 : One Utama Station - Persada PLUS Station



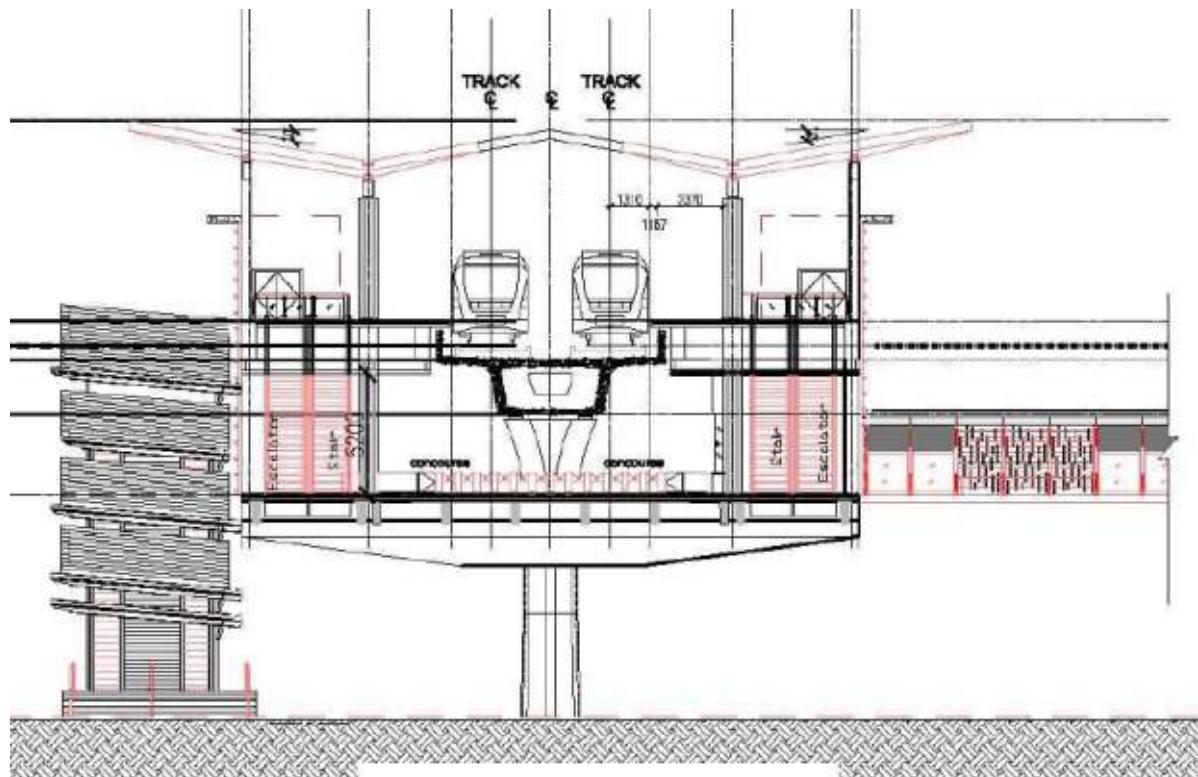
Figure 3-2

Segment 2 : Station 3 Station - Bukit Raja Station





ISLAND PLATFORM



SIDE PLATFORM

Source : Prasarana Malaysia Berhad



Figure 3-4

Typical Side and Island Platform Station



Figure 3-5

Depot Area at Johan Setia



TROPICANA STATION



PERSADA PLUS STATION

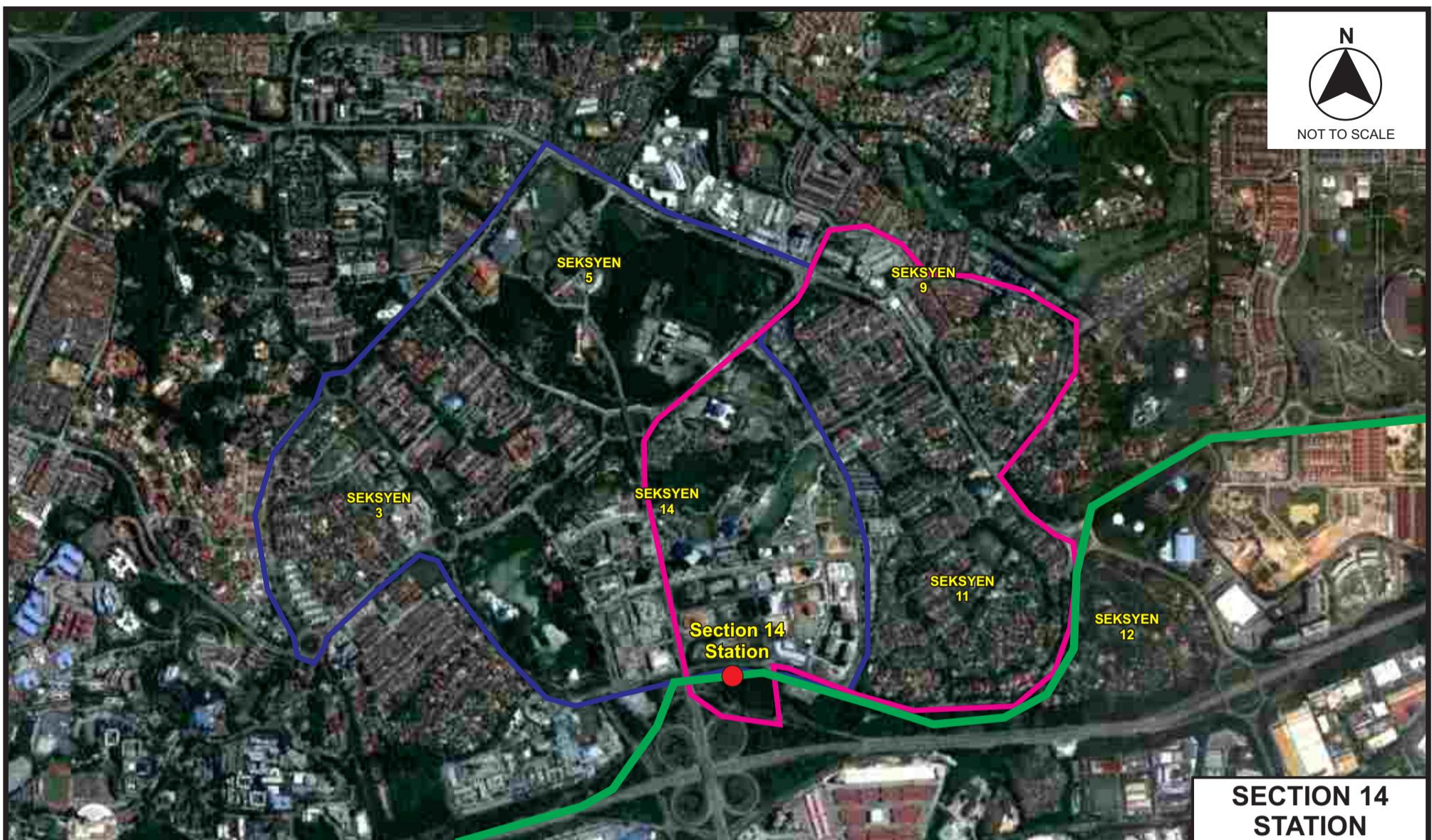
LEGEND		
	ALIGNMENT	
	PROPOSED FEEDER BUS LOOP A	
	PROPOSED FEEDER BUS LOOP B	

Source : Feasibility Study For The Proposed Light Rail Transit Line 3 (Bandar Utama to Klang)

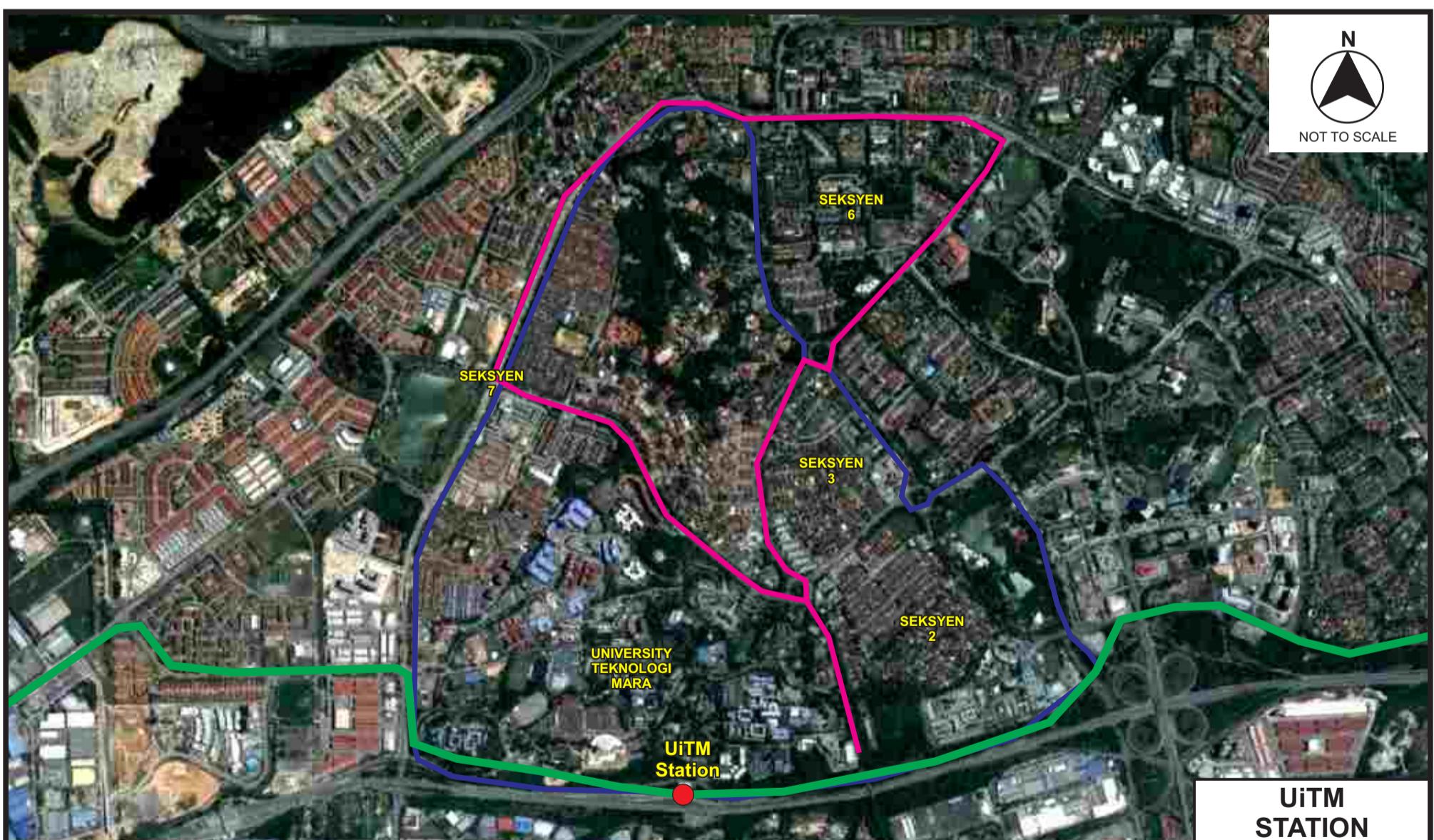


Figure 3-6a

Example of Individual Bus Route (Tropicana and Persada PLUS)



**SECTION 14
STATION**



**UiTM
STATION**

LEGEND		
	ALIGNMENT	
	PROPOSED FEEDER BUS LOOP A	
	PROPOSED FEEDER BUS LOOP B	

Source : Feasibility Study For The Proposed Light Rail Transit Line 3 (Bandar Utama to Klang)



Figure 3-6b

Example of Individual Bus Route (Section 14 and UiTM)



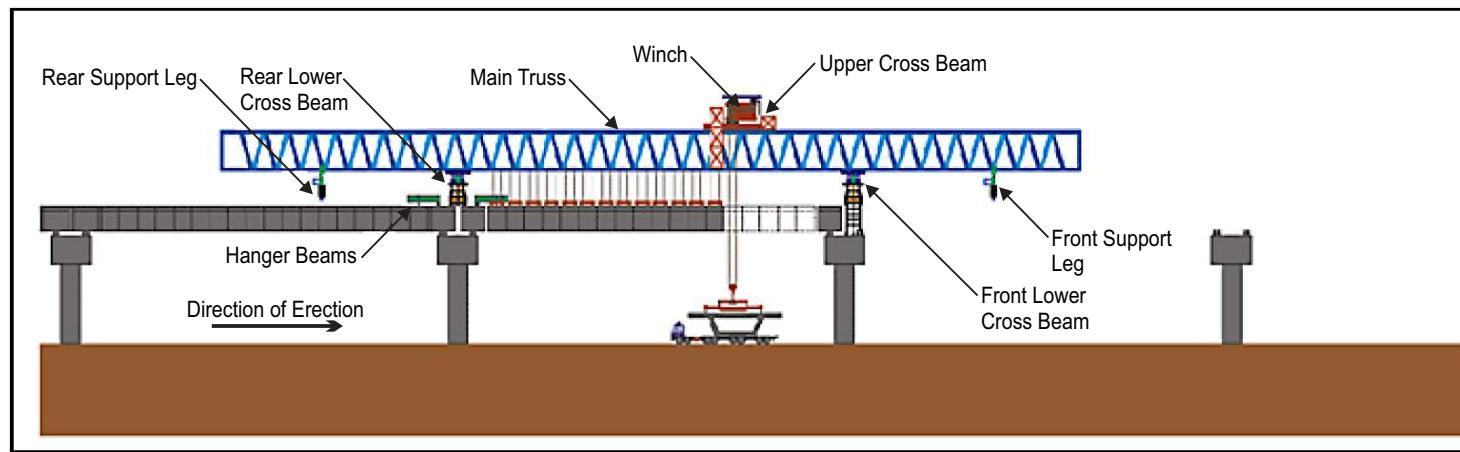
LEGEND		
	ALIGNMENT	
	PROPOSED FEEDER BUS LOOP A	
	PROPOSED FEEDER BUS B	

Source : Feasibility Study For The Proposed Light Rail Transit Line 3 (Bandar Utama to Klang)

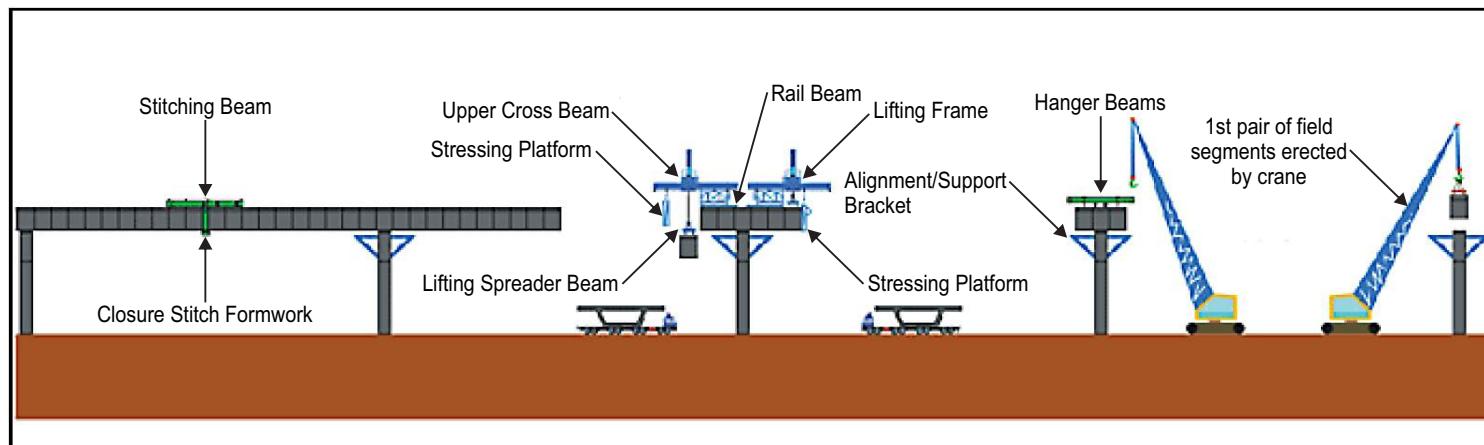


Figure 3-6c

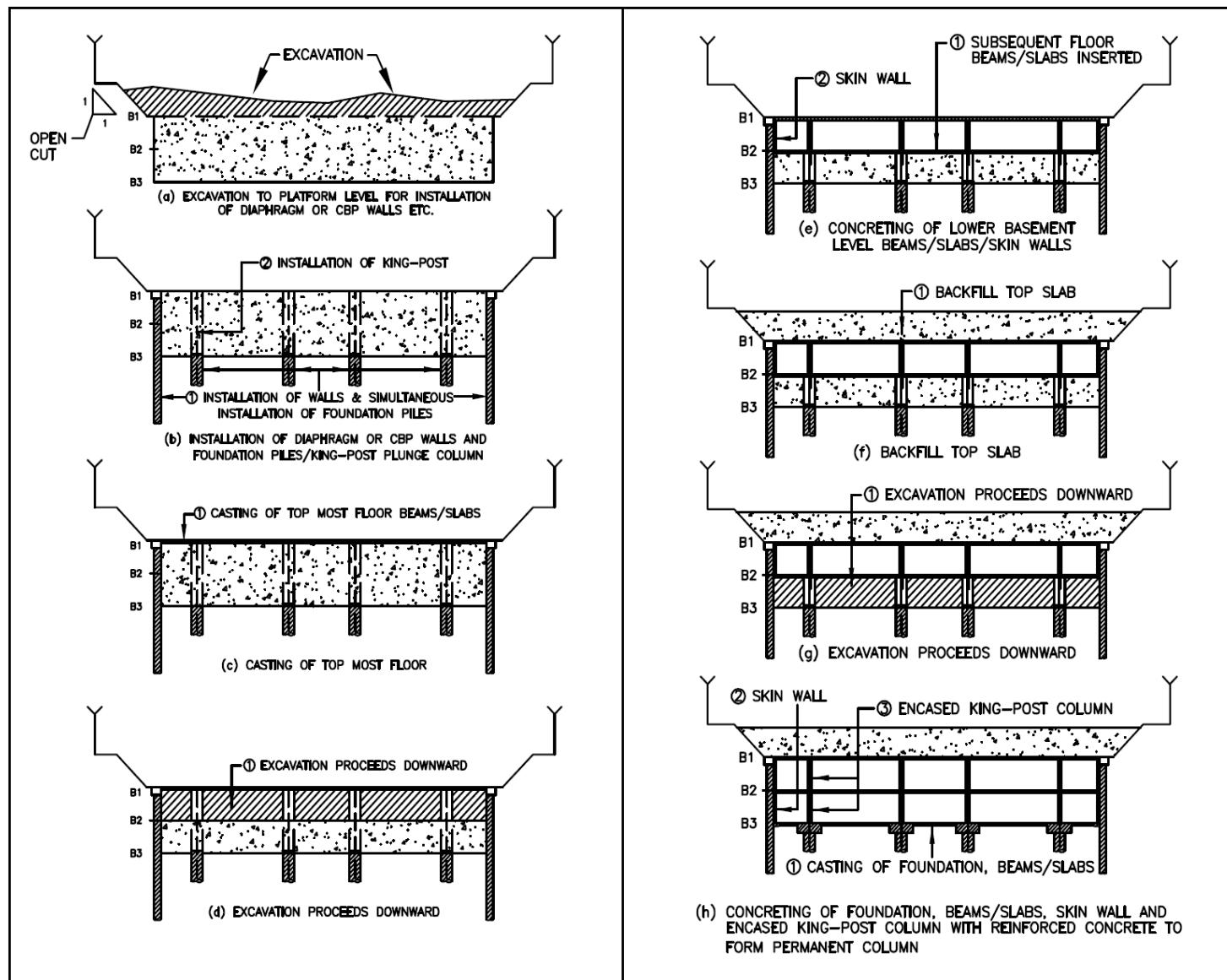
Example of Individual Bus Route (Sri Andalas and AEON Bukit Tinggi)



STANDARD SPANS ERECTION



BALANCE CANTILEVER ERECTION FOR SPECIAL CROSSING

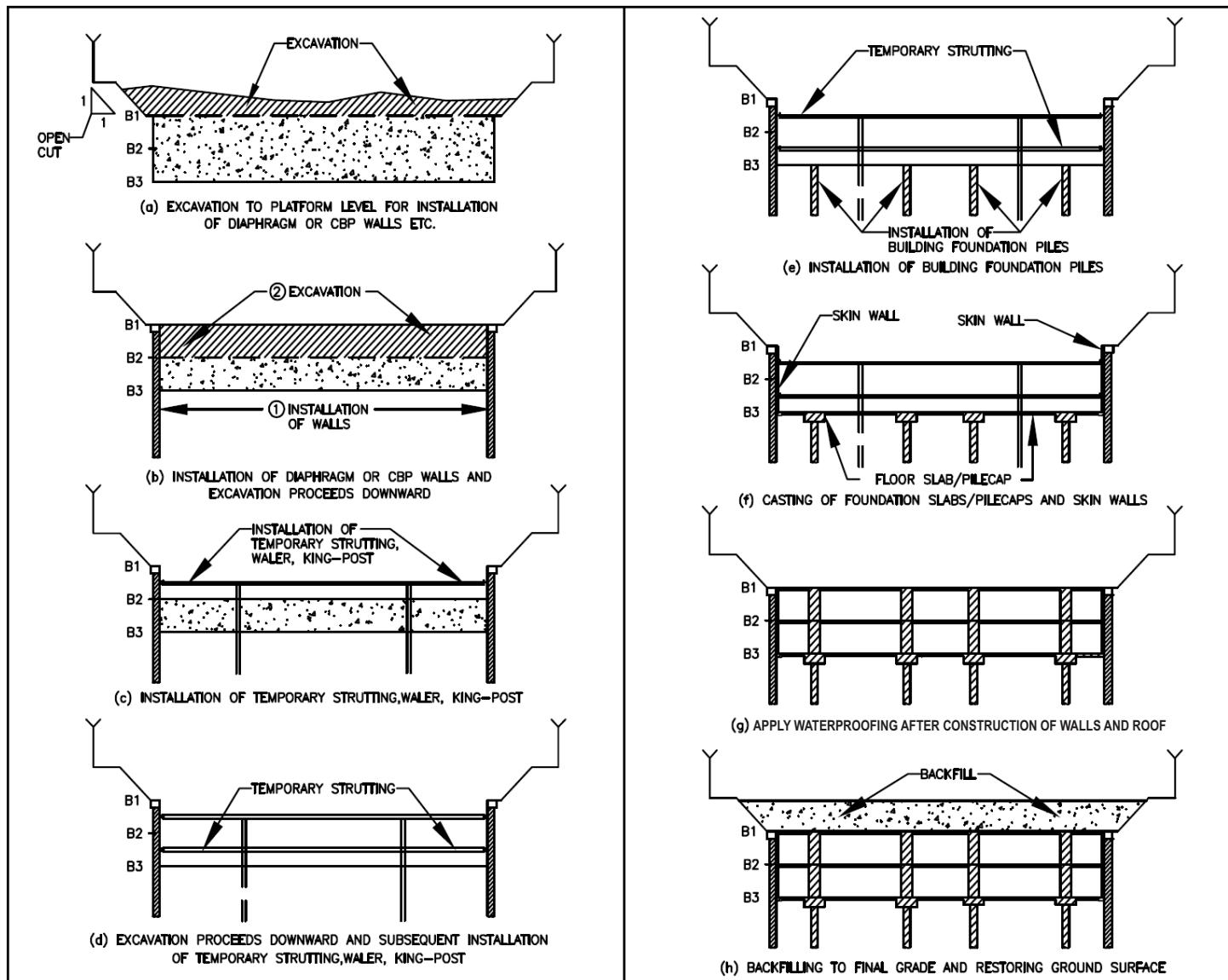


Source : Feasibility Study For The Proposed Light Rail Transit Line 3 (Bandar Utama to Klang)



Figure 3-8

Top-down Construction Method for Tunnel Station

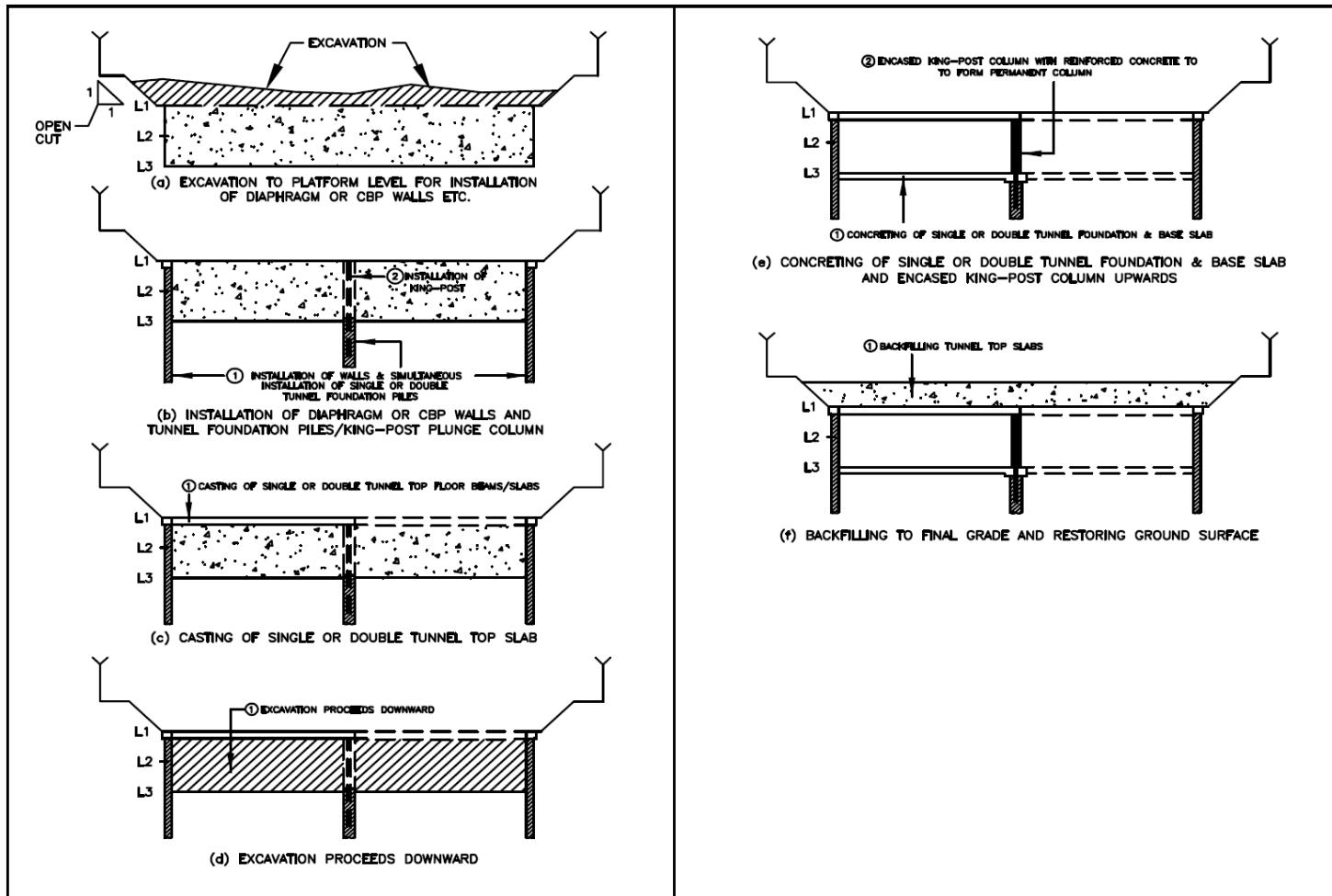


Source : Feasibility Study For The Proposed Light Rail Transit Line 3 (Bandar Utama to Klang)



Figure 3-9

Bottom-up Construction Method for Underground Station

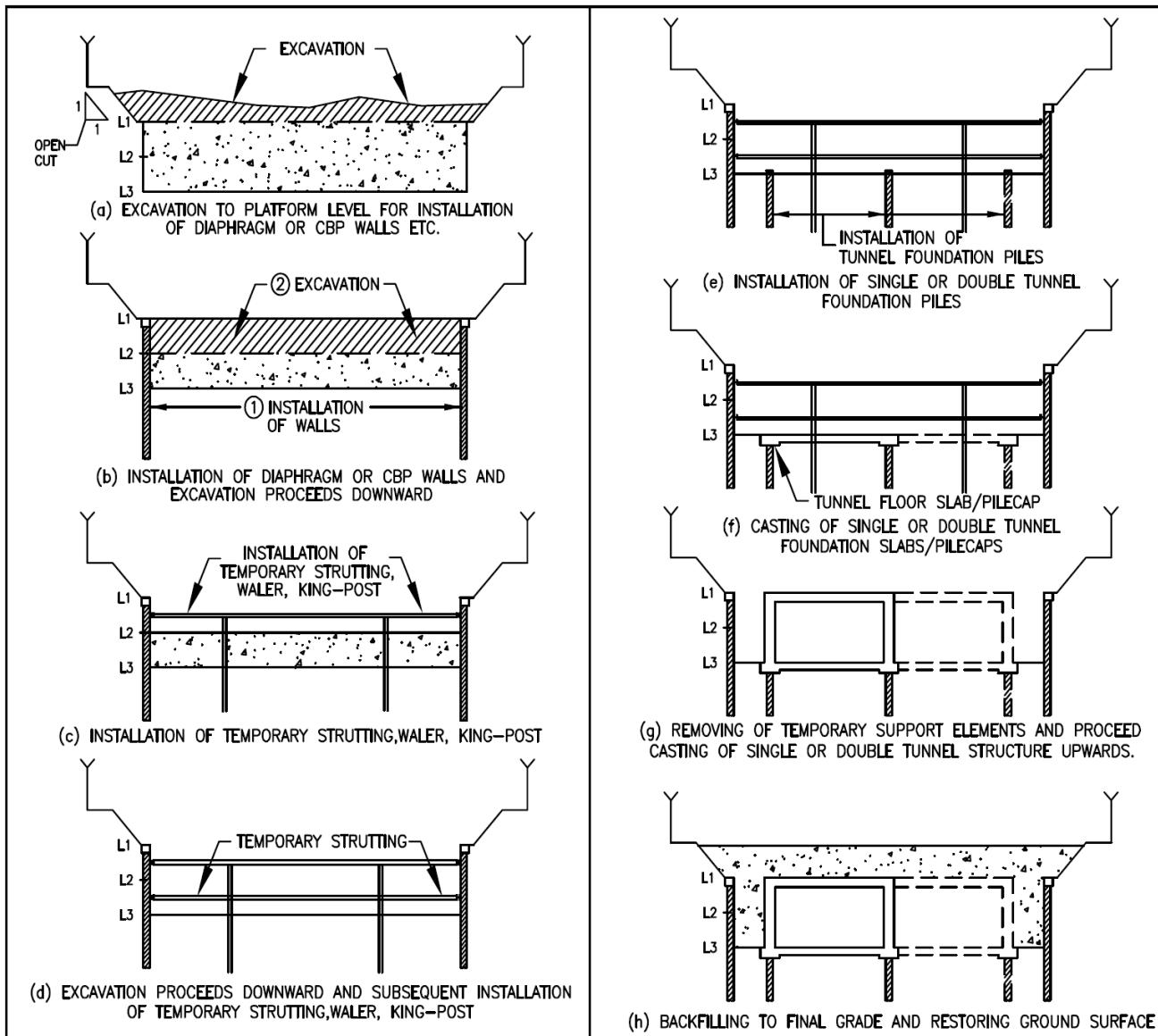


Source : Feasibility Study For The Proposed Light Rail Transit Line 3 (Bandar Utama to Klang)



Figure 3-10

Top-down Construction Method for Underground Tunnel Guideway



Source : Feasibility Study For The Proposed Light Rail Transit Line 3 (Bandar Utama to Klang)



Figure 3-11

Bottom-up Construction Method for Underground Tunnel Guideway

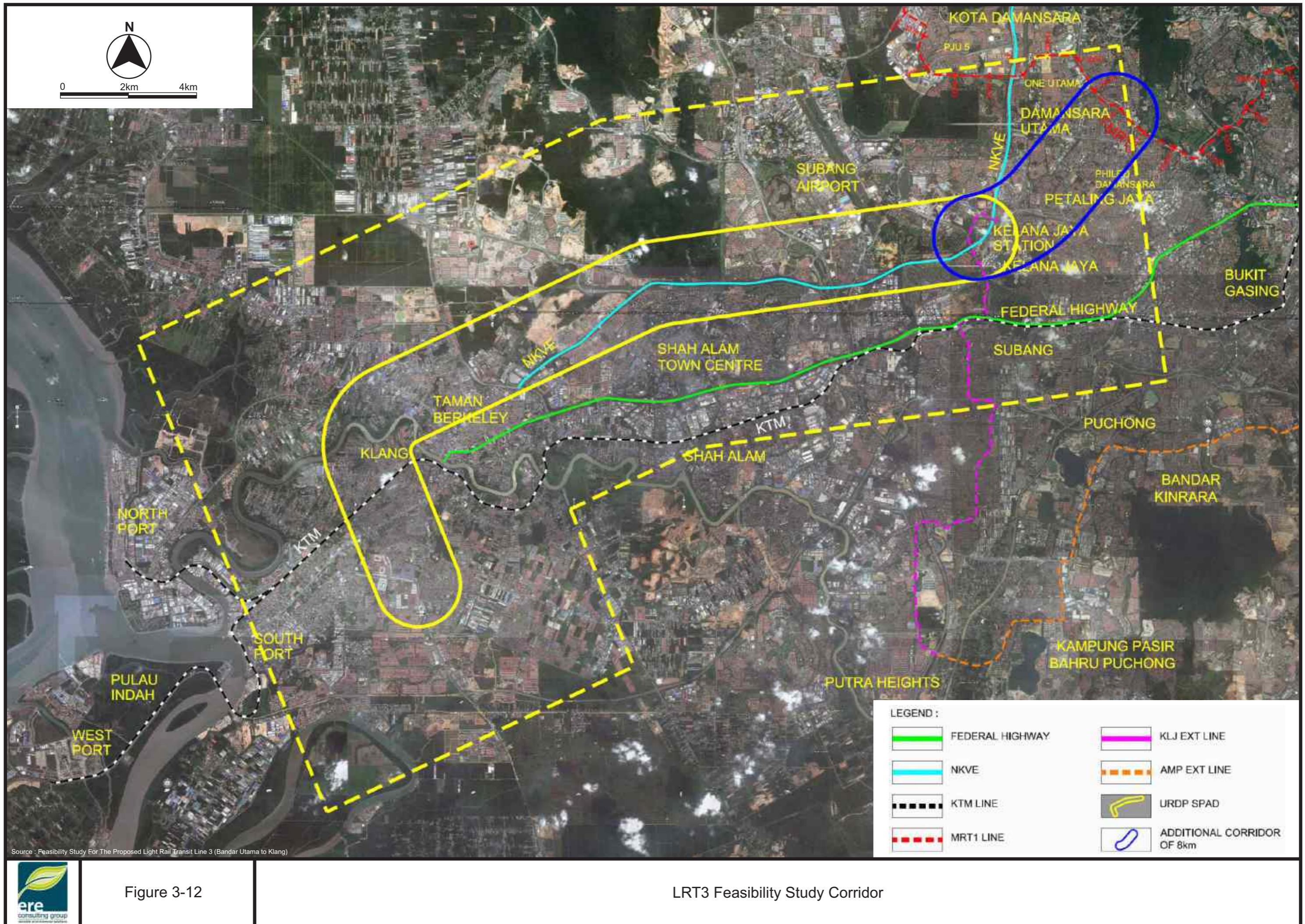
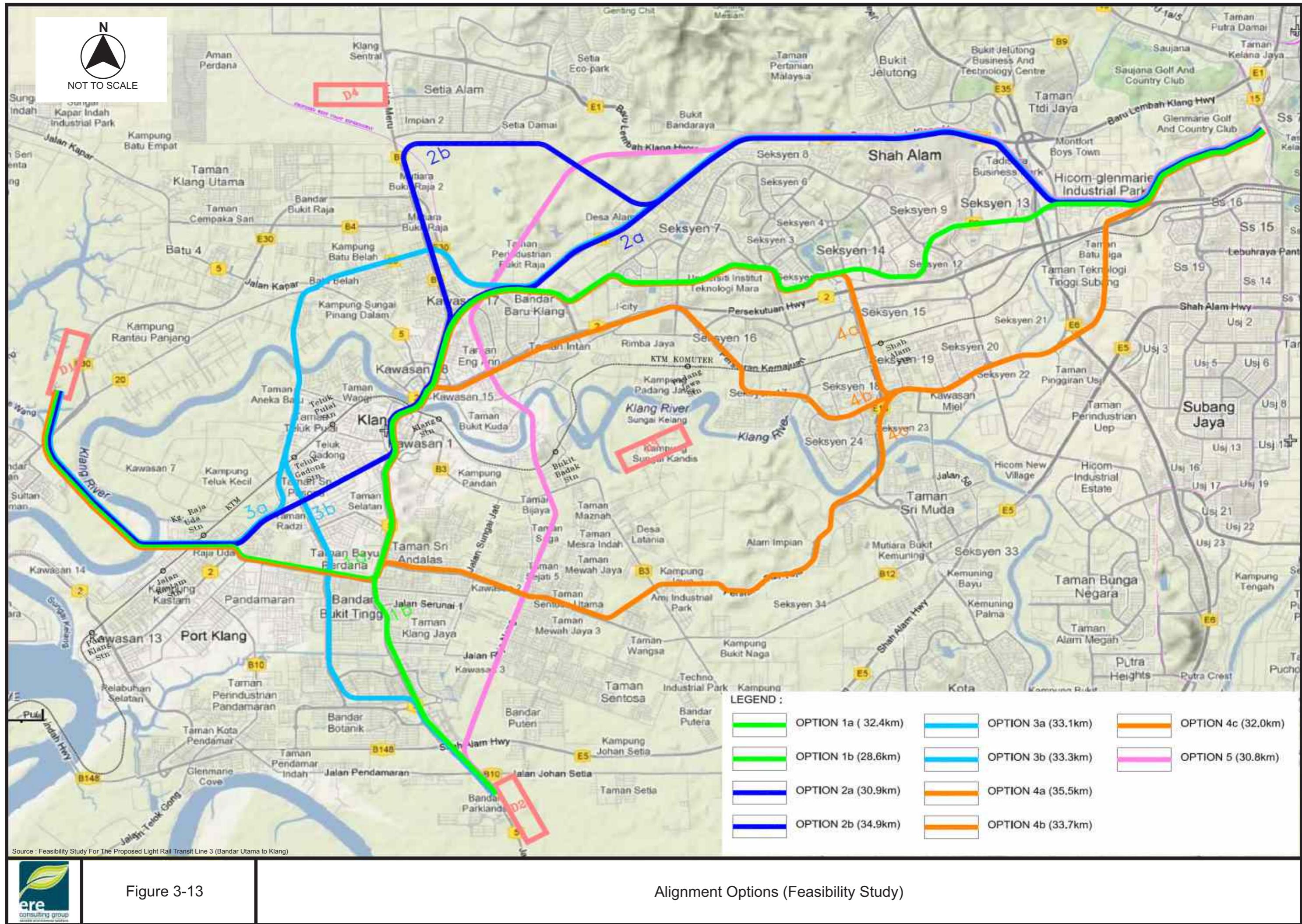


Figure 3-12

LRT3 Feasibility Study Corridor



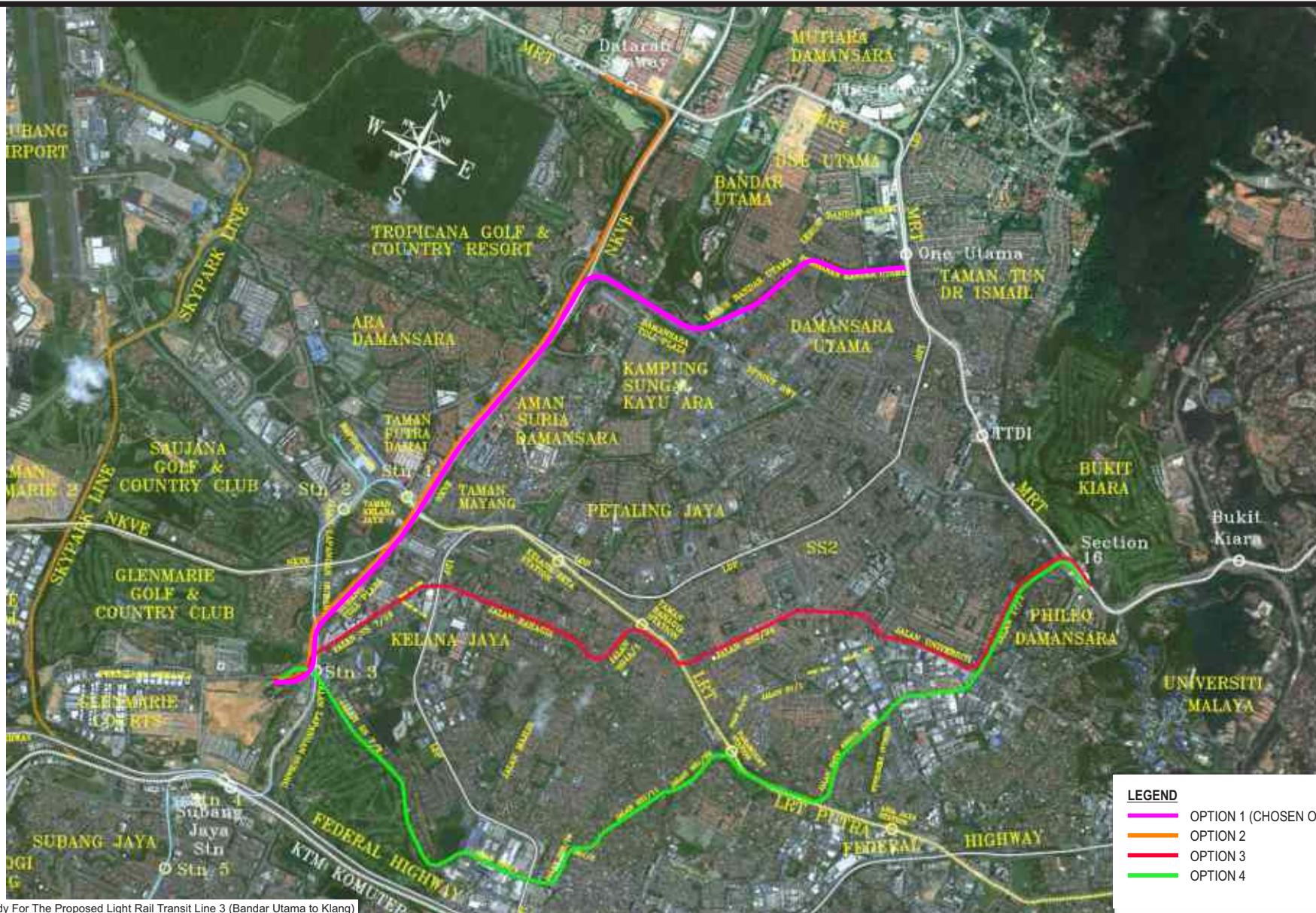


Figure 3-14

Kelana Jaya to Bandar Utama Alignment Options (Feasibility Study)

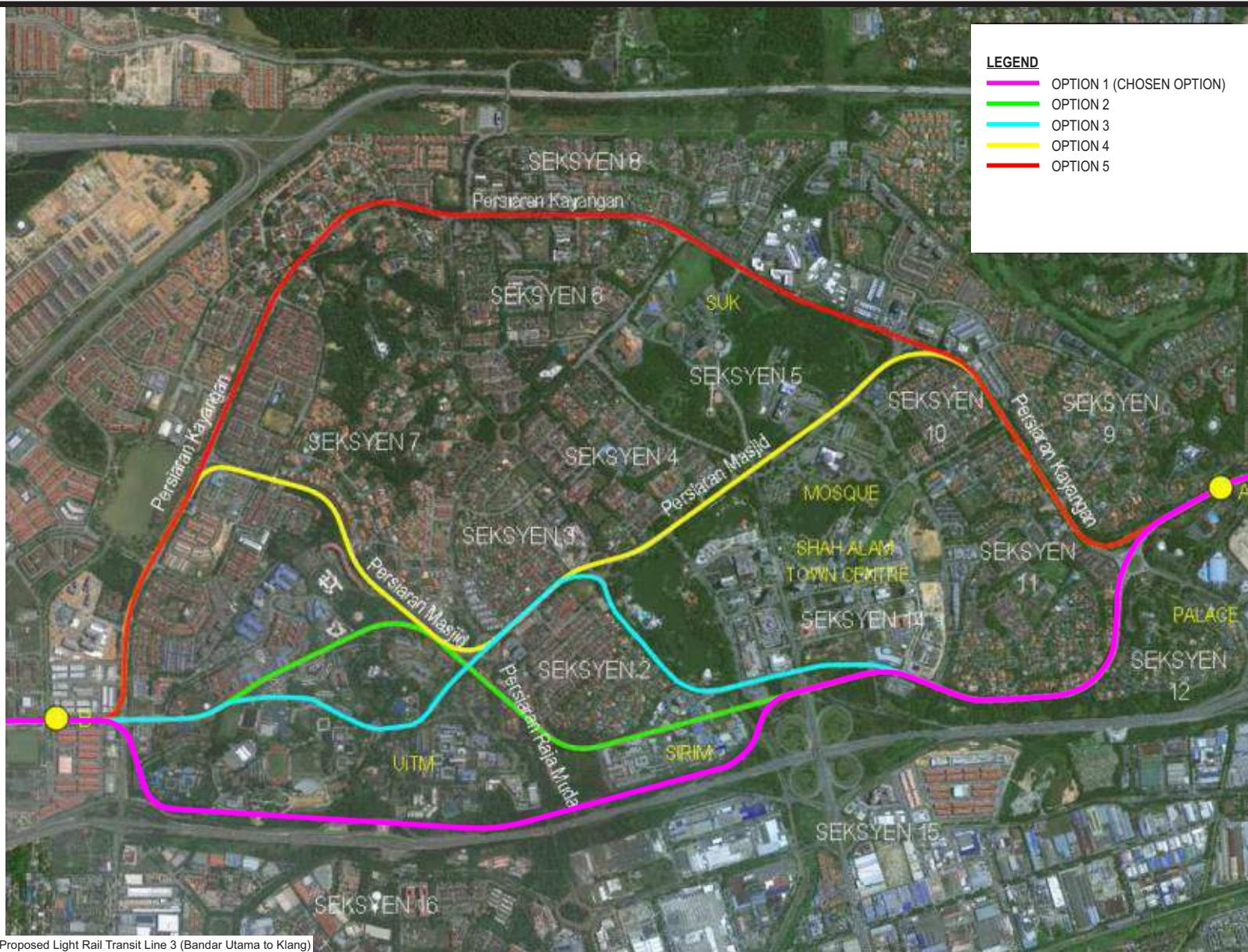


Figure 3-15

Shah Alam Alignment Options (Feasibility Study)

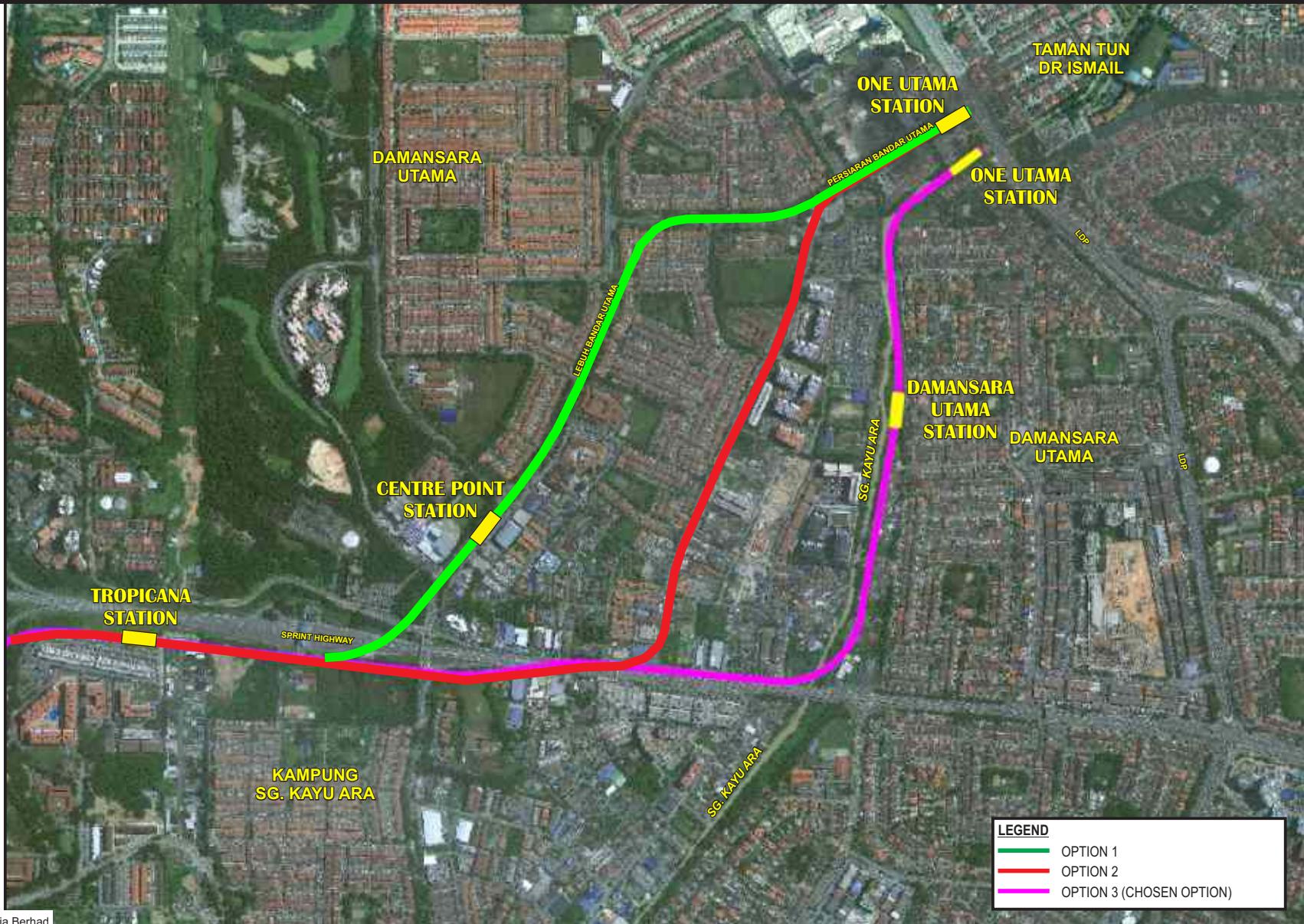


Source : Feasibility Study For The Proposed Light Rail Transit Line 3 (Bandar Utama to Klang)



Figure 3-16

Klang Alignment Options (Feasibility Study)



Source : Prasarana Malaysia Berhad



Figure 3-17

Bandar Utama Alignment Options (EIA Stage)



Figure 3-18

Klang Alignment Options (EIA Stage)



Figure 3-19

Bukit Raja Alignment Options (EIA Stage)