

Section 4 Project Options

SECTION 4 : PROJECT OPTIONS

4.1 INTRODUCTION

Various project options and design concepts were formulated and considered in selecting the final project design (as described in Section 3 of this report). The options varied according to the physical characteristics and requirements of each route and location. The project options can be divided into:

- No-Project Option
- Alignment Options during the Feasibility Study Stage
- Alignment Options during the Preliminary Design
- Tunnelling vs Elevated Structure Options

The following sections explain how the SSP Line was planned and how the various alignment options that were evaluated before arriving at the preferred alignment (which has been described in Section 3 of this report).

4.2 NO PROJECT OPTION

The SSP Line is part of the three line KVMRT system, the first line (SBK Line) of which is already under construction. The KVMRT is a crucial component of the Greater KL/ Klang Valley Public Transport Master Plan (GKL/KV PTMP) (SPAD, 2011) that seeks an efficient, integrated and well-connected public transport system for the Klang Valley. The GKL/KV PTMP has clearly stated that providing greater accessibility and mobility for the people is a key driver not only in terms of economic growth but also improving quality of life of the people.

The no-project option will not enable the Greater KL/Klang Valley to achieve a 40:60 modal split for public transport and its aspirations for efficient public transportation network. Without substantial investments in urban rail, the traffic congestion could continue to rise, causing billions of ringgit in terms of loss of productivity, air pollution, health hazards and worsen the urban sprawl.

4.3 ALIGNMENT OPTIONS DURING THE FEASIBILITY STAGE

Numerous alignment options were considered for the SSP Line during the Feasibility Study (SPAD, 2012). Various alignment options within a 5 km corridor (**Figure 4-1**) from Sg. Buloh to Putrajaya were investigated.

The preferred alignment then was decided based on an evaluation of various factors including :

- The route should improve connectivity to present and future major developments and to areas that have potentially high ridership;

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- The route must facilitate regeneration in areas such as the Batu Kentonmen area, Tun Razak Exchange development and Jalan Cochrane redevelopment.
- The route should provide connectivity to existing/ planned railway and public transport systems including the KTM Komuter, LRT and monorail lines.
- The route should utilise highway land and other government reserves so as to minimise private land take
- The social and environmental impacts should be kept to a minimum

After a preliminary alignment was identified based on travel demand forecasts and ridership studies, substantial amount of investigations were focused on the following areas (**Figure 4-1**) :

- Selayang Link line
- Jalan Ipoh
- Sentul to Kg Baru (Hospital KL Option)
- KLCC area
- Pasar Rakyat to Kg Pandan (Kampung Pandan Option)
- Kg Pandan to Plaza Phoenix (Pandan Cheras Option)
- Mines to Serdang (Mines Option)
- Putrajaya Spur line

The preferred alignment was proposed at the end of the Feasibility Study (2012) (**Figure 4-1**). The alignment was still deemed tentative since detailed information was still being sourced. The options and preferred alignment during the Feasibility study were also discussed with stakeholders via workshops and meetings.

4.4 ALIGNMENT OPTIONS DURING THE PRELIMINARY DESIGN STAGE

After the feasibility study was completed, MRT Corp, together with the PDP and SPAD, embarked on a thorough review of the alignment to ensure that the proposed alignment is the most optimum. At this stage, with better data and site specific information, the alignment was re-examined in greater detail. After the re-examination, it was determined that the alignment at 8 stretches required further analysis. These 8 stretches are :

- | | |
|------------|-----------------------------------|
| Location 1 | Damansara Damai to Kepong Sentral |
| Location 2 | Jinjang to Batu |
| Location 3 | Batu to Titiwangsa (North Portal) |
| Location 4 | Titiwangsa |
| Location 5 | Titiwangsa to TRX |
| Location 6 | TRX to Serdang |
| Location 7 | Kuchai Lama |
| Location 8 | Serdang to Putrajaya |

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The alignment options and alternatives at these locations were assessed based on various criteria (see **section 4.4.1**) to determine the most optimum alignment.

4.4.1 Alignment Options Evaluation Criteria

The alignment options were evaluated based on five key criteria (**Table 4-1**), namely :

- Ridership
- Social & environmental impacts (Short term)
- Social & environmental impacts (Long term)
- Programme and Construction Risk
- Cost

The criteria (**Table 4-1**) and weightage were agreed during the Peers Review Workshop with various stakeholders in April 2014.

Table 4-1 Alignment Selection Criteria

Criteria
<p>Ridership</p> <ul style="list-style-type: none"> • Catchment spread (existing and likely redevelopment potential) served by proposed station locations • Complimenting existing railway corridors • Interchange quality & quantity • Accessibility for all users to stations & whole journey • Performance – passenger comfort and journey time, service availability • Population density
<p>Social / Environment impacts – Short Term</p> <ul style="list-style-type: none"> • During construction - temporary land take, temporary business closures, settlement, noise and air quality impacts, traffic, severance • Safety to all parties and damage to local properties
<p>Social / Environment impacts – Long Term</p> <ul style="list-style-type: none"> • Permanent social impacts positive or negative. Land acquisition, permanent relocation of residents/business/social cost, any permanent traffic impacts, environmental impacts at portals, vibration impacts in very sensitive areas • Access to railway where supports more inclusivity & integration of communities • Connectivity to public institutions (mosques, schools, hospital, etc) • Integrated Development / Regeneration potential • Visual, noise & air quality impact • Impact on natural environment
<p>Programme and Risk</p> <ul style="list-style-type: none"> • Implementation within the master programme • Risk of programme delay – land acquisition, political, construction difficulties etc
<p>Overall Cost</p> <ul style="list-style-type: none"> • CAPEX • Land cost • OPEX

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A scoring system was used to enumerate the criteria for each of the alignment evaluated. The scores were then added and analysed to determine the best alignment option for each of the stretch studied. In certain cases where the construction risks are too high, the option is assigned as “no go”. Similarly if an option cannot be built within a sensible time frame, it too is assigned as “no go”.

4.4.2 Options for Location 1 : Damansara Damai to Kepong Sentral

Four alignment options (**Table 4-2** and **Figure 4-2**) were analysed along the Damansara Damai to Kepong Sentral stretch.

Option A (alignment proposed in the Feasibility study)

After the Damansara Damai station, Option A runs along Jalan Kuala Selangor, and passes by Prima Damansara and Bandar Sri Damansara. The line then continues along Jalan Kuala Selangor before crossing Jalan Kuala Selangor to the proposed Bandar Menjalara Station near the PJU9 Sri Damansara residential area. The line then continues along Selayang – Kepong Highway towards the proposed Kepong Sentral Station.

Option B

Option B is similar to Option A until the proposed station at Bandar Menjalara. After the station, the alignment swings slightly north near the PJU9 Sri Damansara residential area. The line continues along Persiaran Dagang towards the proposed Kepong Sentral Station.

Option C

Option C is similar to Option A and Option B except that it traverses the northern side of the Jalan Kuala Selangor/Jalan Kepong.

Option D

Option D alignment follows Option C but turns north before the junction to Sri Damansara going slightly into KTMB corridor and exiting into the industrial area before crossing Persiaran Bukit Utama into the inner road at Persiaran Dagang. After that, it follows the Option B alignment.

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Table 4-2 Comparison of options from Damansara Damai to Kepong Sentral

Parameter	Option A	Option B	Option C	Option D
Length (km)	4.9	4.9	4.8	4.9
Cost	Lowest		Highest	
Ridership	45,300	45,300	45,300	45,600
Social impacts	Least number of acquisitions			The highest number of buildings potentially affected.
Construction risks	<ul style="list-style-type: none"> Not feasible as alignment runs at the median of Jalan Kuala Selangor, clashes with DUKE extension 	<ul style="list-style-type: none"> Long span across LDP/ MRR2 junction Require to partly cover 300m of monsoon drain 	<ul style="list-style-type: none"> Relocation 2 x 2.1km water pipes Long span across SYABAS reservoir. Piers within SYABAS compound 	<ul style="list-style-type: none"> No major issue

Option A was deemed not constructable because of the DUKE extension. Option C entails a major logistics challenge of relocating two large (1.85 diameter) water mains over 2 km as well as a Hindu temple. Option D has very high social impacts and may incur significant land acquisition and relocation of residential, offices and industrial factories, and offers the least connectivity.

Option B was chosen as it has the lowest cost, manageable social impacts and the construction risks are not significant.

4.4.3 Options for Location 2 : Jinjang to Batu

Three options along the Jinjang to Batu stretch (**Table 4-3** and **Figure 4-3**) were analysed :

Option A (alignment proposed in the Feasibility Study)

Option A offers a route along Jalan Kepong at the south of the existing flood detention pond (Kolam Takungan Banjir Jinjang). After Jalan Kuching, the alignment traverses along Jalan Ipoh.

Option B

Option B initially follows the same alignment as Option A. The alignment then swings north and traverse along the existing detention pond after which it swings south and runs parallel with the existing KTM line until the the Kampung Batu KTMB Station. It then swings back south to traverse along Jalan Ipoh.

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Option C

Option C offers a route to the north of Jalan Kepong where the alignment crosses the existing detention pond. The alignment then swings south and follows the same alignment as Option B.

Table 4-3 Comparison of options from Jinjang to Batu

Parameter	Option A	Option B	Option C
Length (km)	2.7	3.0	2.9
Cost	Lowest	Highest	
Ridership	97000	101300	99900
Social impacts	Least number of acquisitions	<ul style="list-style-type: none"> • 10 – 20 buildings potentially affected • good economic regeneration potential, due to the integration with the Kampung Batu KTMB Station 	<ul style="list-style-type: none"> • 10– 20 buildings potentially affected • good economic regeneration potential, due to the integration with the Kampung Batu KTMB Station
Construction risks	<ul style="list-style-type: none"> • Potential serious obstruction to the traffic and disturbance to public due to proximity to major roads. 	<ul style="list-style-type: none"> • Alignment & piers within JPS compound • TNB Pylons relocation 	<ul style="list-style-type: none"> • Alignment & piers within JPS compound • TNB Pylons relocation • On-going development beside the pond • Overlaps with u/ground twin box culverts

Option A will face serious construction constraints along the major roads such as Jalan Kepong and Jalan Ipoh. Option A is also not integrated with the Kampung Batu KTMB Station and has the least redevelopment potential. Option C also faces serious construction constraints, particularly with regards to the underground twin box culverts which will require diversion during construction.

Option B has the highest ridership. Although Option B would affect 10-20 buildings, the alignment is away from the main roads. There are no major construction risks. Option B would have good economic regeneration potential, particularly due to the integration with the Kampung Batu KTMB Station.

Therefore, **Option B** was chosen for this stretch.

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4.4.4 Options for Location 3 : Batu to Titiwangsa

Four alignment options (**Table 4-4** and **Figure 4-4**) were analysed along the Batu to Titiwangsa stretch.

Option A - Kentonmen Alignment (alignment proposed in the Feasibility Study)

The alignment heads due east from Batu Station and generally runs alongside the KTM tracks to the tunnelling section. The tunnel then swings under the KTM track alignment to pass under DUKE, and continues to follow the KTM alignment for and then turns south before the Sentul KTM Station.

The Sentul Station is located near the KTM Station and the alignment thereafter moves on to the Jalan Ipoh and Titiwangsa.

Option B Jalan Ipoh Above DUKE

This alignment starts at Batu Station, and follows Jalan Ipoh before crossing over the DUKE. The elevated Jalan Ipoh North Station is located south of DUKE. Beyond this, the track starts to descend with the track level passing below ground close to Jalan Merak. The tracks continue to descend in cut-and-cover tunnel until it reaches a level of about 20m below ground level, suitable for a three-level station at Sentul West.

Option C - Jalan Ipoh Under DUKE

This has the same horizontal alignment as Option B, and has the stations in the same locations. However, the alignment starts to descend before the DUKE and is at ground level as it crosses under it. It continues to descend to Jalan Ipoh North Station where the track level is about 5m below ground. Beyond Jalan Ipoh Station, the alignment continues to descend until it is deep enough for bored tunnelling. The end of the bored tunnels will be less than a kilometer south of DUKE

Option D - Sungai Batu Alignment

The alignment starts at Batu Station, and follows Jalan Ipoh, with an elevated station at Kentonmen. South of Kentonmen Station, the alignment runs alongside Sungai Batu mainly as elevated tracks, but descends close to ground level on approaching the DUKE. It is necessary for this alignment to run under DUKE to allow the tracks to be in bored tunnels before they pass under Jalan Segambut. From here, the alignment runs southwest, under Jalan Ipoh before following the same route as Option A.

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Table 4-4 Comparison of Options from Batu to Titiwangsa

Parameter	Option A	Option B	Option C	Option D
Length (km)	4.02	3.69	3.69	3.74
Cost	Highest		Lowest	
Ridership	122,400	130,000	130,000	125,900
Social impacts	<ul style="list-style-type: none"> • Substantial number of acquisition • Facilitate the development of the Army Camp Site. 	<ul style="list-style-type: none"> • Substantial number of acquisitions • Little opportunity for urban regeneration in the area 	<ul style="list-style-type: none"> • Substantial number of acquisitions • Potential for economic regeneration 	<ul style="list-style-type: none"> • Substantial number of acquisitions • Potential for economic regeneration
Construction risks	<ul style="list-style-type: none"> • Tunnelling under the KTM tracks for over 400m, underpinning of DUKE and TNB pylon. 	<ul style="list-style-type: none"> • need to raise the transmission lines at DUKE Highway • Complex traffic management 	<ul style="list-style-type: none"> • need transfer structure to support TNB pylon. 	<ul style="list-style-type: none"> • flood protection during construction.

Option A affects Kentonmen Army Camp and substantial number of acquisition, which are mainly shoplots, a school, KTM Depot, and YTL site. The proposed alignment will facilitate the implementation of the development of the Army Camp Site. The other options affect large numbers of shop/commercial lots.

For Option B, the traffic management for the cut-and-cover works is expected to be complex, and the TNB transmission lines will need to be raised. Traffic management for Option C will be less complex. Option D, along Sungai Batu, have some concerns about river reserves and flooding during construction.

Option C was chosen because of its lower cost, potential for economic reconnaissance.

4.4.5 Options for Location 4 : Titiwangsa

Two alignment options (**Table 4-5** and **Figure 4-5**) were analysed for the Titiwangsa area.

Option A

Option A continues down Jalan Ipoh until the junction with Jalan Tun Razak, where it passes under the MAA Building, swings to the east and runs south of, and broadly parallel with, Jalan Tun Razak, crossing under Sg Gombak, until it reaches Titiwangsa South Station.

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Option B

Southeast of Sentul West Station, Option B swings eastwards, traverses the north part of the new Sentul Police Station, runs under a stream (Sungai Untut) and two five-storey buildings set back from Jalan Sentul, continues under Sungei Gombak, then turns to run just north of the Ampang Line station to Titiwangsa North Station.

Table 4-5 Comparison of options for the Titiwangsa area

Parameter	Option A (Titiwangsa south)	Option B (Titiwangsa north)
Length (km)	1.2	1.0
Cost	Slightly cheaper	Slightly more expensive
Ridership	48,900	48,900
Social impacts	Could potentially affect more than 20 commercial and residential buildings	Could potentially affect about 10 buildings. However, none of these buildings need to be demolished.
Construction risks	Tunnel passes close to the Dynasty Hotel. A major concern is the flyover carrying Jalan Tun Razak over Jalan Ipoh. The bridge is a three-span continuous structure and will therefore be potentially sensitive to differential settlement. Requires the demolition and pile removal for demolished buildings.	No major issues

Option A is expected to affect more than commercial and residential buildings. Option A tunnels pass close to the Dynasty Hotel; however, a major concern was the flyover carrying Jalan Tun Razak over Jalan Ipoh. The bridge is a three-span continuous structure and will therefore be potentially sensitive to differential settlement.

On the basis on social impacts and construction risks and the fact that Option B will have a significantly improved interchange as it is closer to the LRT station – **Option B was chosen.**

4.4.6 Options for Location 5 : Titiwangsa to Tun Razak Exchange

Three alignment options (**Table 4-6** and **Figure 4-6**) were analysed for the Titiwangsa to TRX.

Option A (Jalan Daud)

Option A traverses southerly from the Hospital KL station and continues under Jalan Daud with a new Kg. Baru South Station located nearby the Kampung Baru LRT Station. The alignment continues south-east, crossing under Sg. Klang, then continuing under Jalan Mayang, then crossing under Jalan Ampang, with KLCC Station located immediately to the south of it. From here, the alignment runs south-east, down Jalan Binjai before turning to the east for the Conlay Station. The alignment then continues slightly east under Jalan Bukit Bintang, and goes to TRX.

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Option B (Kg Baru Central)

Alignment Option B has a station to the north of the hospital site, called General Hospital North. From there, it runs southeast, avoiding the high-rise Hospital Staff Quarters, crossing Jalan Raja Muda, with a station provided in the centre of Kampung Baru. The alignment crosses Sg. Klang and skirts around the northeast corner of Menara Park, curving back south to run west of Mayang Condo, thereafter being similar to Option A.

Option C (Jalan Tun Razak)

This option has a station at General Hospital North. From there the tracks curve to the south then to the east along Jalan Raja Muda where a station, Kg. Baru North, is proposed. It continues east along Jalan Raja Muda, then curves southeast along Jalan Tun Razak. The alignment then follows Jalan Tun Razak before turning south, crossing a large development site, then under the Ampang Park Shopping Centre, to KLCC East Station. The alignment continues due south under Jalan Binjai , thereafter being similar to Option A.

Table 4-6 Comparison of options from Titiwangsa to TRX

Parameter	Option A	Option B	Option C
Length (km)	5.18	4.83	5.14 km
Cost	Most expensive		Least expensive
Ridership	261,400	251,500	235,700
Social impacts	<ul style="list-style-type: none"> • A large number of residences will be affected in Kg. Baru 	<ul style="list-style-type: none"> • A large number of residences will be affected in Kg. Baru 	<ul style="list-style-type: none"> • A large number of businesses will be affected in Ampang Shopping Mall
Construction risks	<ul style="list-style-type: none"> • Tunnelling under the existing LRT tunnels. • A major risk is need to run the alignment under the STAR development site. 	<ul style="list-style-type: none"> • Tunnelling under the existing LRT tunnels. 	<ul style="list-style-type: none"> • Tunnelling under the existing LRT tunnels.

Options A and B have the greatest social impacts in terms of the number of houses that will have to be acquired in Kg. Baru. Option C, on the other hand, has lesser social impacts.

Although all Options will entail tunneling under the existing LRT tunnels, Option A will require additional tunneling under a major development site where the construction risks are deemed very high.

On the basis of the social impacts and construction risks, **Option C** was deemed the best alignment for this stretch.

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4.4.7 Options for Location 6 : Tun Razak Exchange (TRX) to Serdang

The stretch between **TRX to Serdang** offered many possibilities for connection – centred around a western (Bandar Malaysia) or an eastern (Pandan) corridors. The western corridor (Bandar Malaysia) offered the potential of connecting to the proposed HSR and the proposed Bandar Malaysia development – hence expected a higher future ridership. Pandan corridor has an existing dense population catchment but with greater construction challenges and social impacts (**Table 4-7** and **Figure 4-7**).

Option A (TRX – Pandan – Cheras – MINES – Serdang)

From the TRX Station, the line crosses below Jalan Tun Razak and SMART Tunnel towards Pandan area and will surface before the Pandan Jaya LRT Station. The elevated segment continues southeasterly towards Pandan Indah, Pandan Mewah, Taman Bukit Teratai area. After Bukit Teratai area, the line will cut through the hills and passes Taman Bukit Segar and Taman Cheras Hartamas towards Cheras Sentral.

After Cheras Sentral, the line will continue further south towards Serdang and passes several residential areas such as Taman Len Seng, Damai Perdana, Alam Damai, Bukit Belimbing and MINES. After MINES, the line then crosses the Kuala Lumpur Seremban Expressway towards Serdang and Seri Kembangan area where Bukit Serdang Station is proposed within UPM area.

Option B (TRX – Shamelin Perkasa – Bandar Malaysia – Salak South – Serdang)

From the TRX Station, the line crosses below Jalan Tun Razak and SMART Tunnel and travels along Jalan Perkasa and will surface before Shamelin Perkasa. From here onwards, the elevated alignment will run parallel to the existing Ampang LRT Line and crosses the Kuala Lumpur - Seremban Highway before entering the proposed Bandar Malaysia site or TUDM Sg Besi area. The line continues within the Bandar Malaysia and travels southerly passing through Kuchai Lama, Bandar Baru Sri Petaling and Sg Besi areas as it moves towards Serdang, Seri Kembangan and UPM area.

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Table 4-7 Comparison of options from TRX to Serdang

Parameter	Option A	Option B
Length (km)	21.5	17.9 (3.6 km shorter)
Cost	Higher	Lower
Ridership	198,000	217,000 Connectivity to HSR
Social impacts	Higher number of acquisition (Affecting a forest reserve, cemetery and houses in Taman Len Seng)	Lower number of acquisition (Potentially affecting 2 temples and several blocks of government buildings)
Construction risks	<ul style="list-style-type: none"> • Tunnelling under the SMART Tunnel • 2km of SCL tunnel • Total of 8 long span crossings • 3 TNB transmission lines affected 	<ul style="list-style-type: none"> • Tunnelling under the SMART Tunnel • Total of 18 long span crossings • 2 TNB transmission lines affected

Option B has the benefits of connecting to the future HSR station and hence reaching a larger catchment resulting in larger ridership. Social impacts are less for Option B since the route affects less number of significant properties. Option 2 alignment also avoids impacting the forest reserve and cemetery, is shorter and hence has a lower construction cost.

On the basis of the ridership, cost and social impact, **Option B** was deemed the best alignment for this stretch.

a) Refinement of Option 2 (TRX – Chan Sow Lin – Bandar Malaysia – South Portal)

Option B was further analyzed for the stretch between TRX to the South Portal. Several options (**Table 4-8** and **Figure 4-8**) were considered for this stretch:

Option C

After TRX Station, the line will cross Jalan Tun Razak towards Royal Selangor Golf Club (RSGC) and continue southeasterly to Shamelin Perkasa, Taman Maluri and Miharja areas, running broadly parallel to the existing Ampang LRT Line. After the proposed Miharja Station, the line will pass through the Chan Sow Lin industrial area and crosses the Maju Expressway, BESRAYA Extension Expressway and Kuala Lumpur – Sg Besi Highway towards the Bandar Malaysia North Station located within the proposed Bandar Malaysia or current TUDM Sg Besi area. It continues within the Bandar Malaysia area until the proposed South Portal area near Taman Desa.

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Option D

After the TRX Station, the underground segment will continue southerly towards the Jalan Cochrane redevelopment area, passes near the PPR Laksamana apartments towards the Fraser Business Park area, running almost parallel to the Kuala Lumpur – Sg Besi Highway and crosses the BESRAYA Extension Expressway before entering the Bandar Malaysia area. The line continues underground within the Bandar Malaysia area until the proposed South Portal area near Taman Desa.

Option E

After TRX Station, the line continues toward the Cochrane redevelopment area but swing rights, avoiding the redevelopment. It goes along the Jalan Kampung Pandan and then the Maju Expressway, before coming to the Chan Sow Lin LRT Station. The line continues underground within the Bandar Malaysia area until the proposed South Portal area near Taman Desa.

Table 4-8 Comparison of options from TRX to South Portal

Parameter	Option C	Option D	Option E
Length (km)	8.1	5.9	5.9
Cost	Similar	Similar	Similar
Ridership	217,000 (TRX to Serdang)	204,000 (TRX to Serdang)	204,100 (TRX to Serdang)
Social impacts	Affects temple near south portal	Shorter length than option 2 resulting in reduced journey time.	Shorter length than option 2 resulting in reduced journey time.
Construction risks	Tunneling underneath the SMRT Tunnel Tunneling under or over line 1	Tunneling underneath the SMRT Tunnel Tunneling under or over line 1	Tunneling underneath the SMRT Tunnel Tunneling under or over line 1

Options D and E have a shorter length compared to Option C and as such reduce the journey time. With options D and E there is a more direct connectivity between KL city center (TRX, KLCC) and the future HSR station as there are less stations in-between.

Compared to D, Option E has better connectivity to Chan Sow Lin station.

On the basis of improved journey time and connectivity, **Option E** was deemed the best alignment for this stretch.

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4.4.8 Options for Location 7 : Kuchai Lama

Three options were assessed for this stretch, from after the Desa Water Park to Kampung Baru Salak Selatan (**Table 4-9** and **Figure 4-9**).

Option A

After the oxidation pond, the line moves right to skirt the northern edge of the industrial area and then joins Jalan Kuchai Lama. It then continues on towards Kampung Baru Salak Selatan, first crossing Maju Expressway and then going along the Sungai Besi Highway, passing Kampung Baru Salak Selatan on its right.

Option B

After the oxidation pond, the line continues south and goes through the industrial area, before veering left to cross the Maju Expressway and then goes along the Sungai Besi Highway, the same as Option A.

Option C

This option is similar to Option B, except that it continues straight southwards after the oxidation pond, going close to the Kuala Lumpur-Seremban Expressway. After passing through the industrial area, the line crosses the Maju Expressway and passes through Kampung Baru Salak Selatan before joining the Sungai Besi Highway.

Table 4-9 Comparison of options at Kuchai Lama

Parameter	Option A	Option B	Option C
Length (km)	2.2	2.0	2.0
Cost	Similar	Similar	Slightly lower
Ridership	10,200	10,000	9,500
Social impacts	High	Low	Medium
Construction risks	<ul style="list-style-type: none"> • 1 TNB transmission line affected • 3 long span crossings 	<ul style="list-style-type: none"> • 1 TNB transmission line affected • 3 long span crossings 	<ul style="list-style-type: none"> • 1 TNB transmission line affected • 3 long span crossings

Option A has the greatest social impacts due to acquisition of the Ajinomoto factory which has been present in Kuchai Lama industrial area for several decades and negative impact to the national economy if acquired (strategic foreign investor).

For Option C the station is located further away from catchment and main road, resulting in the lowest ridership compared to Options A and B.

Option B was deemed the best alignment for this stretch on the basis of less social impacts and good accessibility and station location to serve Kuchai Lama.

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4.4.9 Options for Location 8 : Serdang to Putrajaya

Two corridors were assessed for this stretch, one along an eastern Putrajaya corridor and the other along a western Putrajaya corridor (**Figure 4-10**). Although the Feasibility Study has proposed the eastern corridor, it was decided to investigate the western corridor option in greater detail during the preliminary design/EIA stage due to the potential connectivity to the ERL and Putrajaya Sentral.

a) Option A: Eastern corridor

After the Seri Kembangan Industrial Area, the alignment travels southward and passes areas such as UPM, UNITEN and IOI Resort. It ends in Presint 1 and Presint 15 in Putrajaya. Three options were considered along this corridor, all beginning at the UPM grounds near Serdang Raya. One option terminates at the Alamanda Shopping Complex in Presint 1 while the two other options end in Presint 14 and Presint 15.

b) Option B: Western corridor

After the Seri Kembangan Industrial Area, the alignment travels southwest and passes areas like Taman Universiti Indah, Taman Equine, Taman Putra Permai and Bandar 16 Sierra. It then travels south into Cyberjaya and Putrajaya, passing by areas like Presint 11, Presint 9, the Skypark development and Limkokwing University before ending at Putrajaya Sentral.

Option B (Western corridor) was selected based on higher ridership potential and integration with other public transport networks at Putrajaya Sentral.

c) Refinement of western corridor

Four alignment options (**Table 4-10** and **Figure 4-11**) were analysed along the Serdang to Putrajaya stretch :

Option A

After the station near Bukit Serdang, the alignment travels west, traversing along MARDI area, Jabatan Pertanian area, Taman Universiti Indah, Taman Equine Pinggiran Putra and then along Jalan Putra Permai, passing Pusat Bandar Putra Permai. After this, the line continues south along Persiaran Alpinia and Persiaran Sierra Utama, passing through 16 Sierra. It then crosses the Maju Expressway and goes into Cyberjaya. The line then continues south past the Skypark development and then heads east past Limkokwing University, crossing the Putrajaya-Cyberjaya Expressway and ends at Putrajaya Sentral.

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Option B

For this option, the alignment follows the same route as Option A from Bukit Serdang Station until 16 Sierra. After 16 Sierra, it continues slightly southwest and crosses the Maju Expressway and then the Putrajaya-Cyberjaya Expressway. The alignment runs parallel to the Putrajaya-Cyberjaya Expressway, passing by the Garden Residence in Presint 11 and Presint 9, until it ends at Putrajaya Sentral.

Option C

This option is similar to Option A from Bukit Serdang until 16 Sierra, after which the alignment continues to travel south and then southwest. The main difference with Option A is the locations of the stations.

Option D

This option is similar to Option A up to Taman Putra Permai. The alignment then turns left to travel southwards and crosses the Maju Expressway. It then goes through Presint 11 and goes past the Garden Residence, after which it crosses Persiaran Utara to go through Presint 9. The alignment then ends at Putrajaya Sentral.

Table 4-10 Comparison of options from Serdang to Putrajaya

Parameter	Option A	Option B	Option C	Option D
Length (km)	13.5	12.9	13.4	12.7
Cost	Lowest	Highest		
Ridership	109,300	92,700	110,800	94,500
Social impacts	<ul style="list-style-type: none"> • Temple and petrol station affected • Hypermarket and parking lot affected • Private lots at 16 Sierra affected • Developing area affected 	<ul style="list-style-type: none"> • Temple and petrol station affected • Hypermarket and parking lot affected • Private lots at 16 Sierra affected • Poor access to station 	<ul style="list-style-type: none"> • Temple and petrol station affected • Hypermarket and parking lot affected • Private lots at 16 Sierra affected 	<ul style="list-style-type: none"> • Bazaar Rakyat affected • Presint 11 parking lot affected • 1 temple affected • Residential houses affected
Construction risks	<ul style="list-style-type: none"> • Long span crossing of SKIP, LDP, SKVE, MEX, B15, Lingkar Putrajaya • 1 Transmission line affected 	<ul style="list-style-type: none"> • Long span crossing of SKIP, LDP, SKVE, MEX, B15, ERL, Persiaran Utara, Lingkar Putrajaya 	<ul style="list-style-type: none"> • Long span crossing of SKIP, LDP, SKVE, MEX, B15, ERL 	<ul style="list-style-type: none"> • Sharing corridor with SKIP Highway • Long span crossing of SKVE, MEX, ERL, Persiaran Utara • Transmission line & JPS ponds affected • Underground round utilities at Taman Putra Permai affected

SECTION 4 : PROJECT OPTIONS

Option B has the lowest ridership and it bypasses major catchment areas in Cyberjaya such as the future Skypark area and Limkokwing University.

Option A has a higher ridership compared to Options D and Option B. It serves major catchment areas such as 16 Sierra, Cyberjaya North and Cyberjaya City Centre as well as is integrated with a transport hub at Putrajaya Sentral where the alignment can serve as an interchange with the future HSR.

Option C has the highest ridership and is integrated with Putrajaya Sentral on the eastern side, which is more desirable in terms of interchange design.

Therefore, **Option C** was deemed the best alignment for this stretch on the basis of highest ridership and provides a seamless integration with ERL at Putrajaya Sentral.

4.5 TUNNELLING VS ELEVATED STRUCTURE OPTIONS

The Project Proponent has considered the advantages and disadvantages of building elevated rail lines *viz* tunnelled lines. The key factors considered include the availability of land, constructability, social and environmental impacts and construction costs

A key decision for the SSP Line is the extent of elevated track. It would be inappropriate for the railway to be either completely elevated or completely underground. An elevated railway through the centre of Kuala Lumpur would significantly detract from the quality of the streetscape, and would almost certainly be impracticable in any event. On the other hand, a completely underground alignment would increase both the capital and operating costs of the line. The railway needs to be cost-effective, and a fully underground alignment would be difficult to justify financially or economically. A secondary point is that travel on the railway is more pleasant above ground.

Where to make the transition from elevated to underground is an important question because transitions take up a great deal of space, and it is difficult to find suitable locations.

4.5.1 Transition Location – North

To the north of the central KL area, very few practicable options for the transition have been identified: in the worse case, extends the elevated tracks as far as Kampong Baru, where the transition from elevated to underground would be a major constraint for the planned redevelopment of Kampong Bharu, and would, in the meantime, cause massive social impacts. Furthermore, it is considered inappropriate to extend elevated rail in so close to the city centre.

SECTION 4 : PROJECT OPTIONS

At the other extreme, the transition could be on Jalan Kepong, west of Kampung Batu Station. This would extend the underground by more than 3 km and the extra costs involved are hard to justify.

The two remaining options for the transition ramp are:

- Parallel to the KTM Line at Kentonmen, adjacent to the Army Camp,
- Within Jalan Ipoh, with the portal approximately opposite Jalan Segambut.

The first option is relatively easy to justify as it is next to an existing railway. The Jalan Ipoh option has an elevated alignment along this busy road for a distance of 2.5km before descending in the ramp down to underground. The only locations where sufficient space has been identified to accommodate the ramp are on the southbound carriageway of Jalan Ipoh, with the portal located either just to the north or the south of the Jalan Segambut junction.

Based on these factors, Jalan Ipoh near Jalan Segambut was chosen as the northern elevated – underground transition point.

4.5.2 Transition Location – South

A logical location for the transition south of the central KL area, the future Bandar Malaysia and HSR Station is near Taman Desa area, south of the East–West Link Expressway. The area is relatively clear site with some slip roads connecting East–West Link Expressway, Kuala Lumpur – Seremban Highway and Desa Waterpark.

To the north of East–West Link Expressway, the underground alignment is constrained by the clearance above the SMART tunnel and below the highway and existing KTM and ERL Lines. After these constraints and south of East–West Link Expressway, the alignment rises above ground in an open area adjacent to existing slip roads to the highways. Two access roads to Dese Waterpark will be relocated to avoid the alignment. The alignment continues to rise to connect to Kuchai Lama which is an elevated station.

Based on these factors, Taman Desa area was chosen as the southern elevated – underground transition point.



NOT TO SCALE

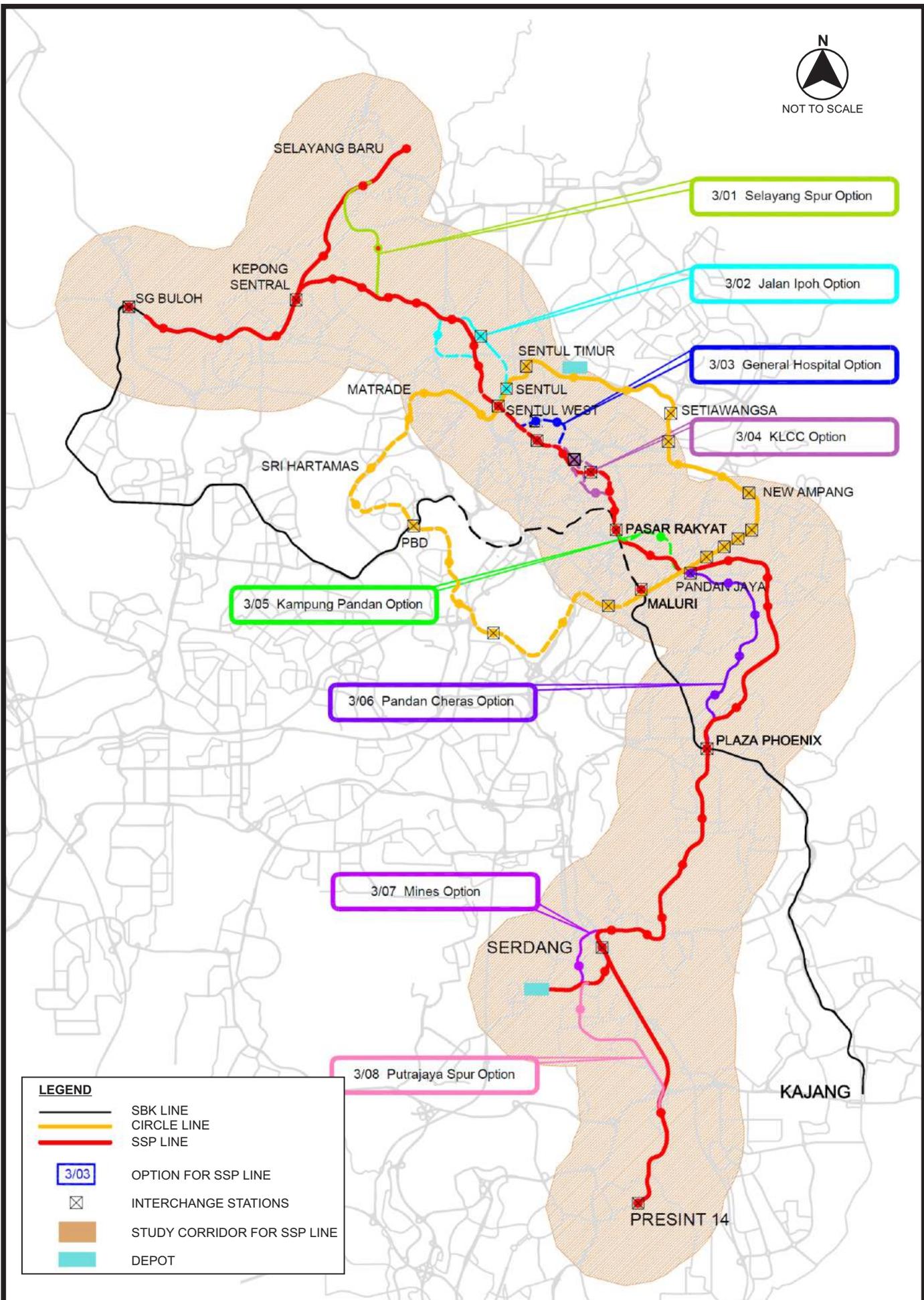
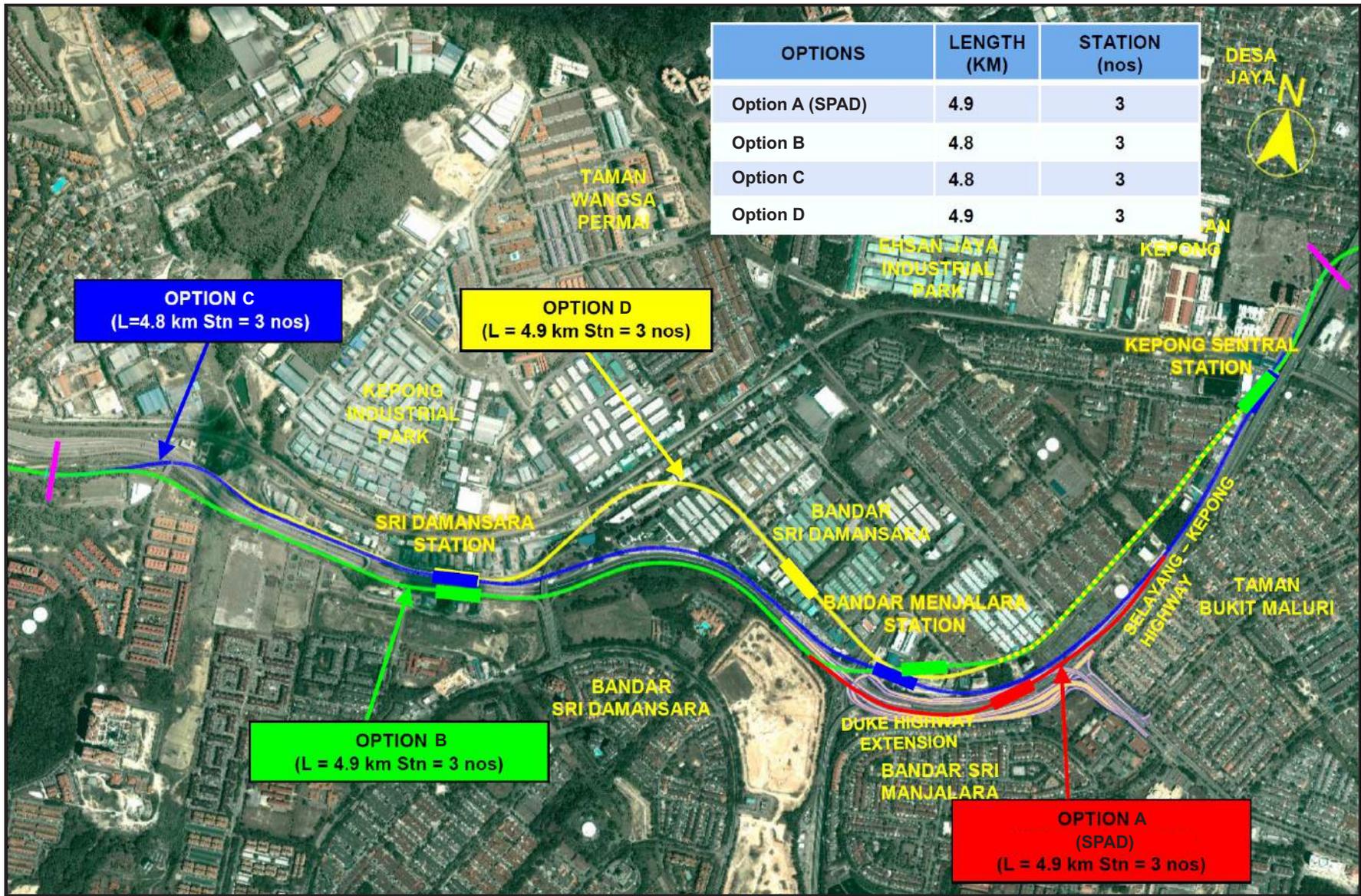


Figure 4-1

Feasibility Study Corridor and Alignment Options for SSP Line

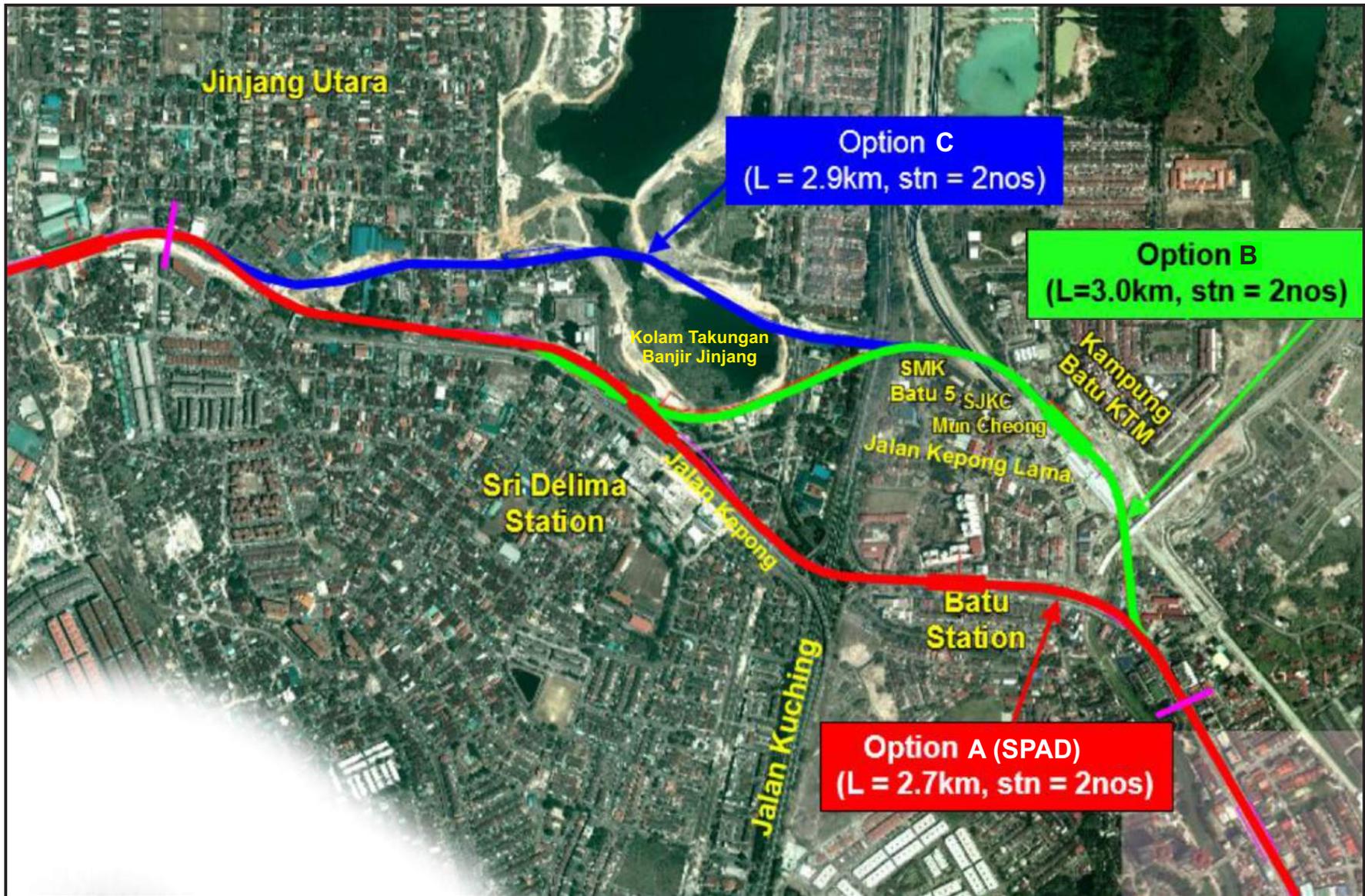


Source : MMC Gamuda KVMRT



Figure 4-2

Alignment Options for Damansara Damai to Kepong Sentral

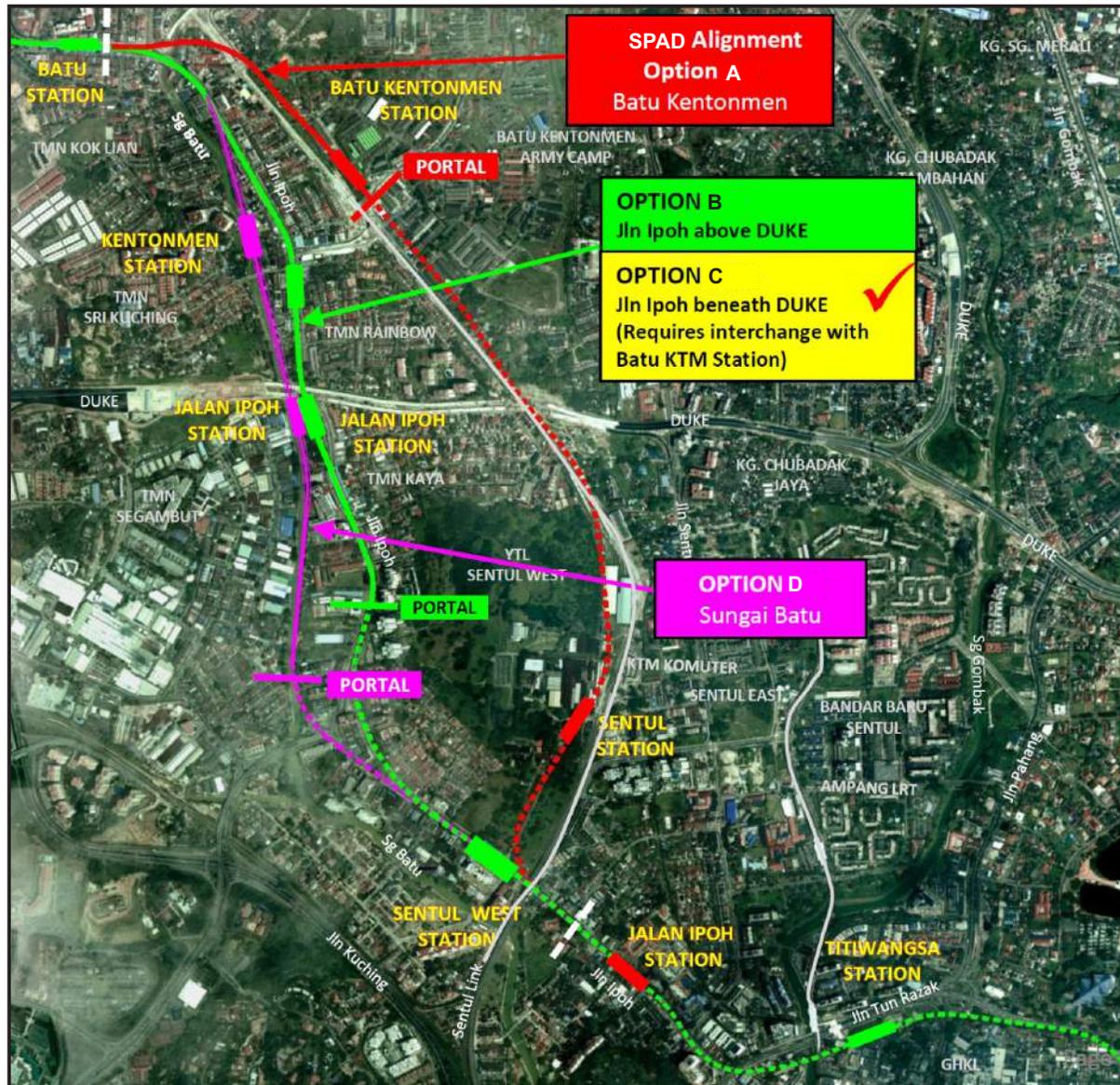


Source : MMC Gamuda KVMRT



Figure 4-3

Alignment Options for Jinjang to Batu

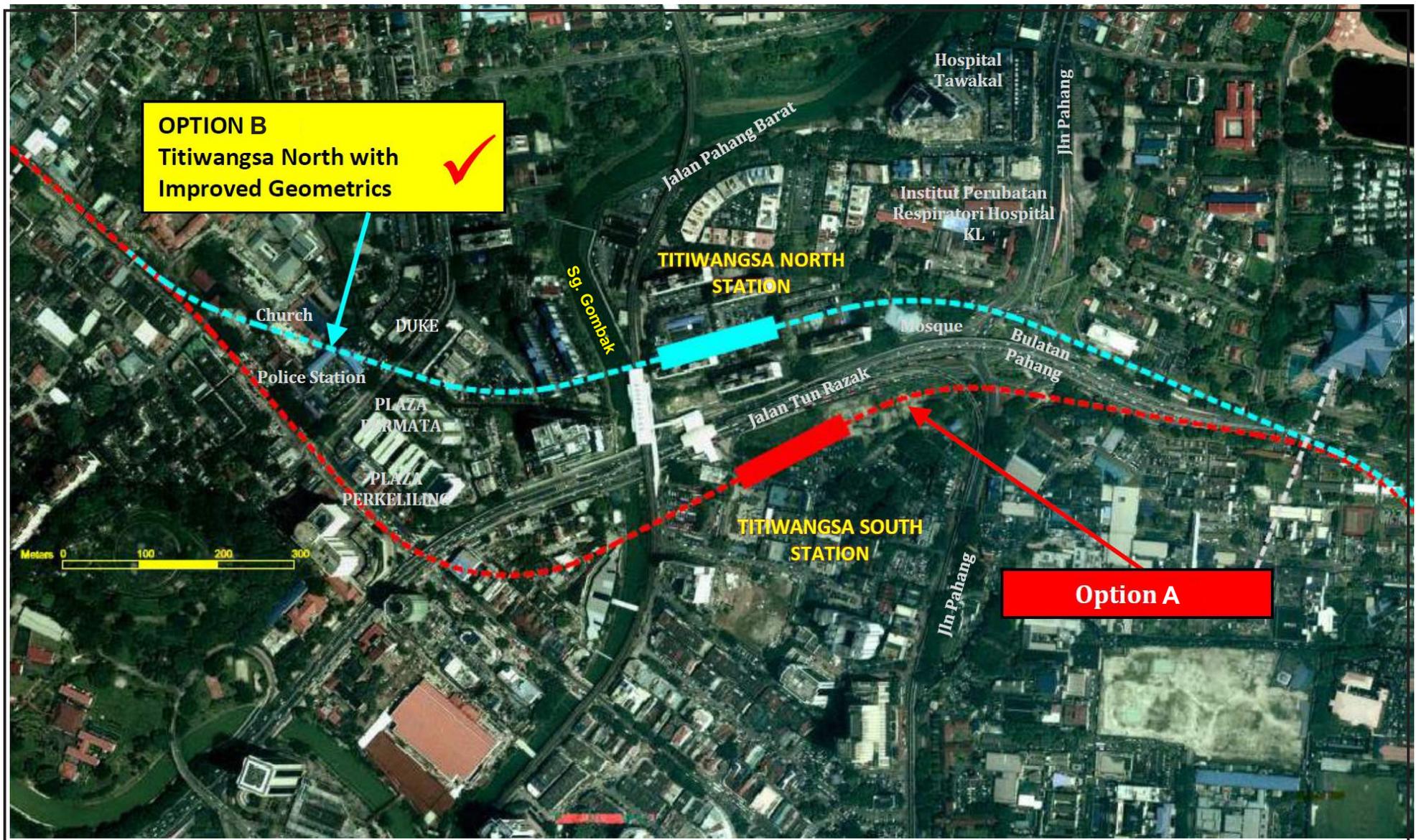


Source : MMC Gamuda KVMRT



Figure 4-4

Alignment Options for Batu to Titiwangsa

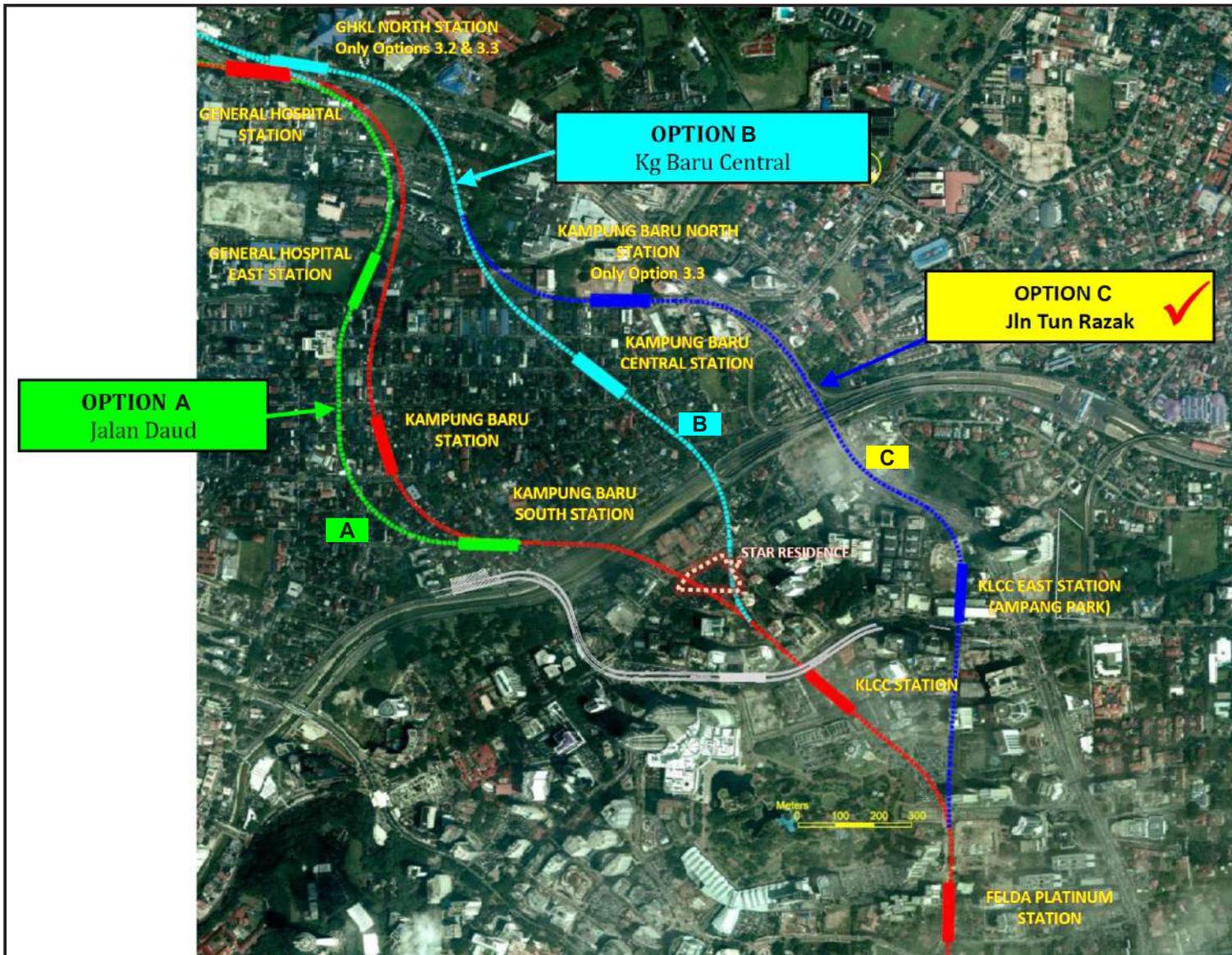


Source : MMC Gamuda KVMRT



Figure 4-5

Alignment Options for Titiwangsa

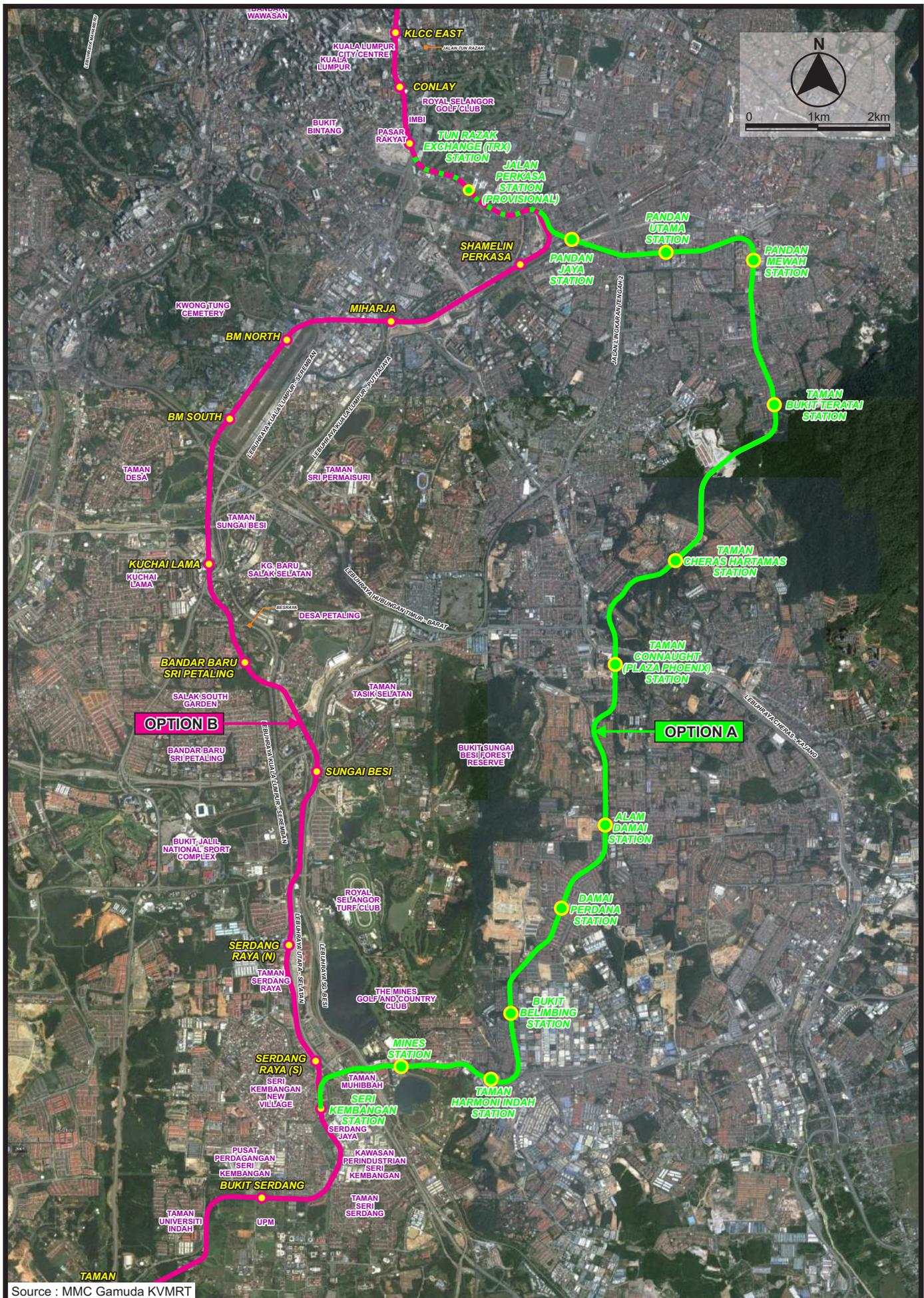


Source : MMC Gamuda KVMRT



Figure 4-6

Alignment Options for Titiwangsa to TRX



Source : MMC Gamuda KVMRT



Figure 4-7

Alignment Options for TRX to Serdang



Source : MMC Gamuda KVMRT



Figure 4-8

Alignment Options for TRX to South Portal



Source : MMC Gamuda KVMRT



Figure 4-9

Alignment Options for Kuchai Lama

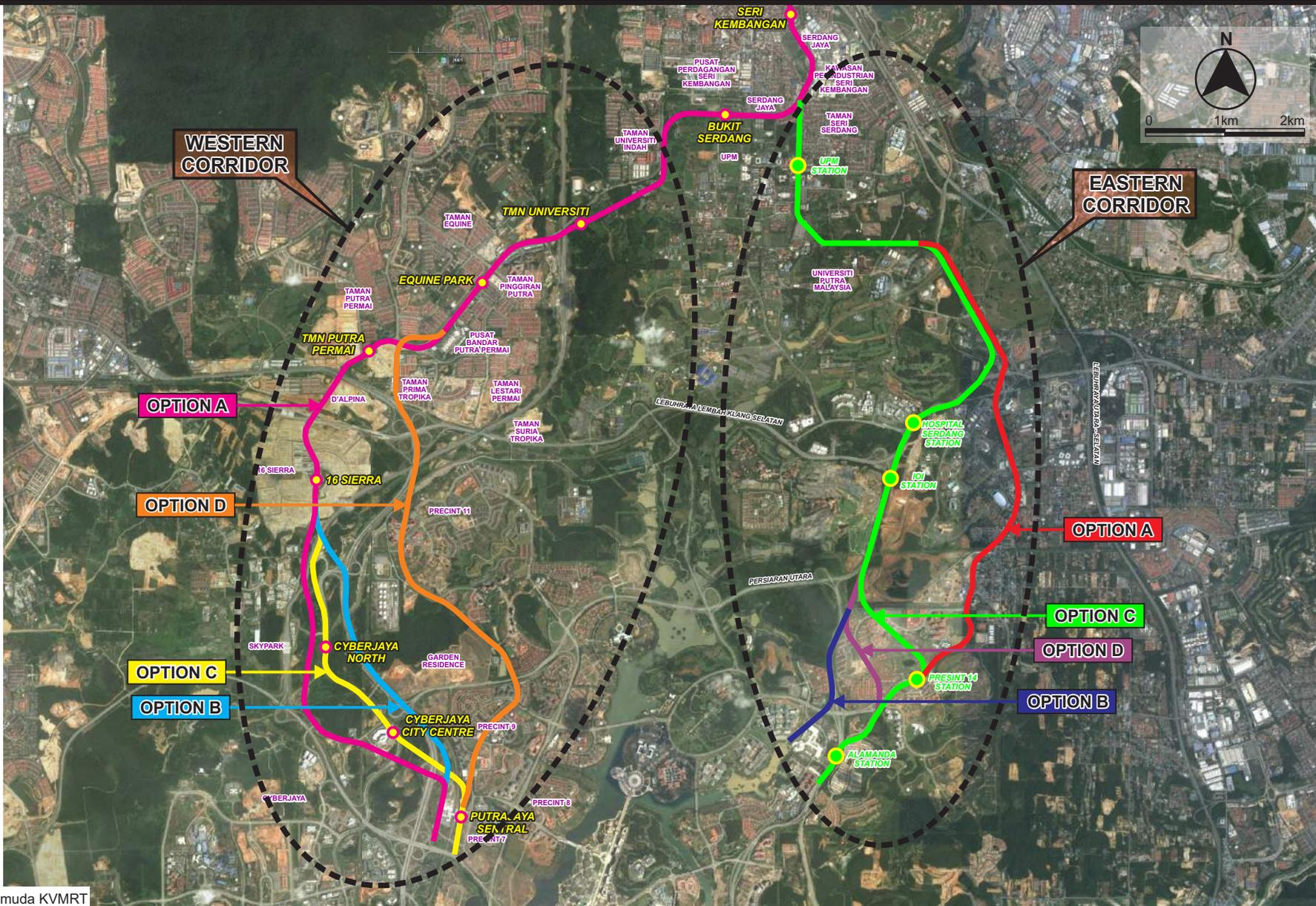


Source : MMC Gamuda KVMRT



Figure 4-9

Alignment Options for Kuchai Lama

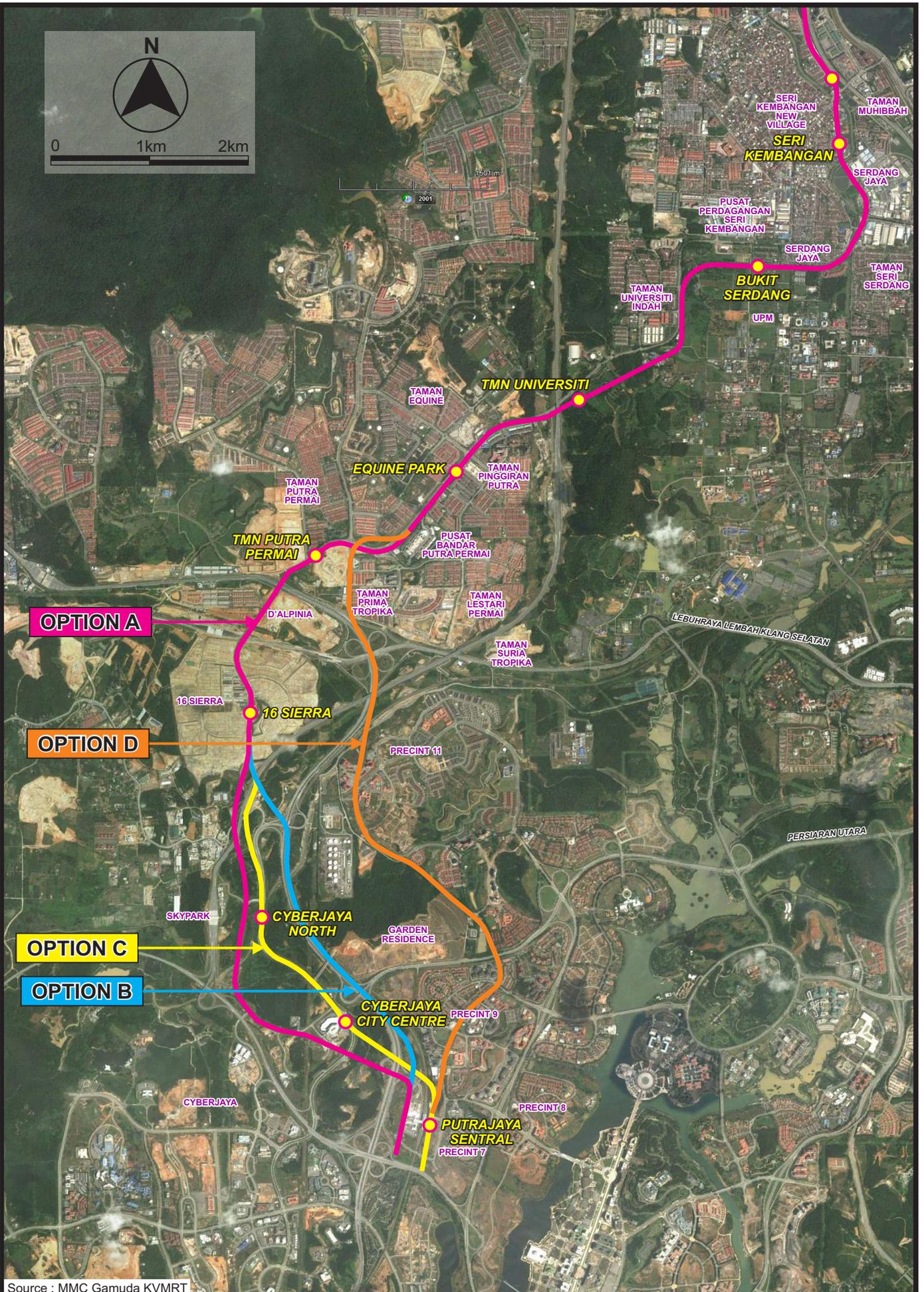
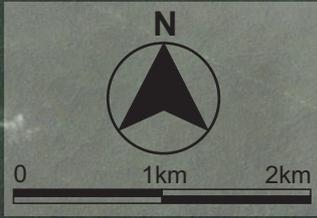


Source : MMC Gamuda KVMRT



Figure 4-10

Alignment Options for Serdang to Putrajaya
Eastern and Western Corridors



Source : MMC Gamuda KVMRT



Figure 4-11

Alignment Options for Serdang to Putrajaya Western Corridor