2. PROJECT DESCRIPTION

Brief Description

2.1 The Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) is proposed to connect Hong Kong, Shenzhen and Guangzhou. It aims at providing a fast and convenient railway service linking the three cities and thereafter major cities in the Mainland, via the Mainland high speed network.

2.2 The Hong Kong Section of the XRL (the Project) is approximately 26 km long, in a dedicated underground railway from the boundary at Huanggang to West Kowloon Terminus (WKT), as shown in **Figure Nos. NOL/ERL/300/C/XRL/ENS/M50/001** to **003**. Boundary crossing facilities will be provided in WKT.

2.3 Ventilation buildings along the railway corridor needed for fire safety will be located at Mai Po, Ngau Tam Mei, Pat Heung, Shing Mun, Kwai Chung, Nam Cheong, Mong Kok West and West Kowloon. Emergency access points (EAPs) will be integrated at these ventilation buildings and also provided in Tai Kong Po for emergency services.

2.4 Stabling sidings and a first-line maintenance facility will be located at Shek Kong Stabling Sidings (SSS) to provide train stabling, minor maintenance and cleaning activities. An emergency rescue station (ERS) will be located next to Shek Kong Stabling Sidings for emergency evacuation of passengers and access by emergency personnel.

2.5 The Project was gazetted under the Railways Ordinance in November 2008. It is expected that the construction of the Project will commence in late 2009, and be completed in 2015. A preliminary construction programme of the Project is provided in **Appendix 2.1**.

Benefits of the Project

2.6 The XRL will form part of the National high-speed railway network, connecting Hong Kong with Guangzhou, with intermediate stations at Futian, Longhua and Humen. With the XRL, the journey time between Hong Kong and Guangzhou will be reduced from about 100 minutes as at present to about 50 minutes. The proposed Mainland section will be connected to the Beijing-Guangzhou Passenger Line and the Hangzhou-Fuzhou-Shenzhen Passenger Line which are part of the National railway system. Hence, through this rail link, Hong Kong can be connected directly with major Mainland cities, such as Beijing and Shanghai. Passengers using the XRL can also reach other major cities in the Pearl River Delta via the Intercity Rapid Transit System. Upon its completion, the XRL will help promote Hong Kong as the gateway to the Pearl River Delta area, further strengthen the economic ties and cooperation between Hong Kong and the Mainland, promote mutual economic prosperity and development, and raise the competitiveness of the region as a whole.

2.7 The high-speed rail service will not only allow Hong Kong to have better social and economic integration with cities in the Pearl River Delta and other major cities in the Mainland, but will also facilitate and promote business and tourism. It is also expected that the Project will create about 5,500 employment opportunities during its construction and another 10,000 during its operation. It is therefore concluded that the Project will generate huge social and economic benefits in terms of employment and development opportunities as a result of better regional integration.

2.8 Transportation by rail over the lifetime of the facility is considered to be more environmentally friendly in terms of energy conservation and gas emissions. During the operation of the Project, the public will be encouraged to use an environmentally friendly public transport, and thus the environment will be benefited by the reduction of air and noise pollution problem and other associated deleterious effects generated by automobile usage. Increasing transport by rail will also provide free access to goods transportation by roads.

Scope of the Project

2.9 The Project comprises the following key elements:

- Approximately 26km of underground railway running from the terminus in West Kowloon to the boundary at Huanggang;
- A terminus in West Kowloon, and its associated building elements such as ventilation facilities, public transport interchange, traction sub-station, and seawater cooling facility;
- Seven tunnel ventilation buildings at Mai Po, Ngau Tam Mei, Pat Heung, Shing Mun, Kwai Chung, Nam Cheong and Mong Kok West, and an EAP at Tai Kong Po;
- Stabling sidings and maintenance facilities located at Shek Kong (Shek Kong Stabling Sidings (SSS)) to provide for train stabling, minor maintenance and cleaning; and
- An emergency rescue station (ERS) located next to the SSS.

2.10 Apart from the above key elements, site explosive magazine, nursery sites, barging facilities, supporting works areas and access roads will be required to support the construction of the Project.

2.11 The information presented below is a summary available from the preliminary design and will be subject to further study at the detailed engineering design stage.

Overall Alignment

2.12 The overall alignment of the Project is shown in **Figure Nos. NOL/ERL/300/C/XRL/ENS/M50/001** to **003** and described below. In developing and selecting alignment options, environmental factors were fully taken into account. Details of the selection of the preferred alignment are described in **Sections 2.29** to **2.41**.

2.13 **Table 2.1** summarises the information of the Project alignment with its horizontal and vertical alignment presented in **Figure Nos. NOL/ERL/300/C/XRL/ENS/M53/200 to 228**.

Table 2.1 Summary of Alignment

Tunnel Sections	Approx. Horizontal Length, km	Approx. outside Tunnel Diameter, m	Type of Tunnel	Approx. Level, mPD (min. to max. meter below local ground)
Tunnels between Boundary to Mai Po Ventilation Building	1.5	9.3	Tunnel Boring Machine (TBM) - Twin bore single track tunnels	-31 to -26 (approx. 25 to 34m below local ground)
Tunnels between Mai Po and Ngau Tam Mei Ventilation Building	2.3	9.3	TBM - Twin bore single track tunnels	-26 to -19 (approx. 25 to 60m below local ground)
Tunnels between and Ngau Tam Mei Ventilation Building and Tai Kong Po Emergency Access Point	2.8	7.7 to 20.4	Drill & Blast (D&B) - Single track twin bore tunnels / twin track single bore tunnel / twin track single bore transition cavern	-20 to -16 (approx. 60 to 30m below local ground)
Tunnels between Tai Kong Po Emergency Access Point and north of Emergency Rescue Station (ERS)	1.1	9.3	TBM - Twin bore single track tunnels	-19 to 4 (approx. 30 to 10m below local ground)
North of ERS to South of ERS	1.6	-	Cut and cover tunnels	-4 to 10 (approx. 10 to 18m below local ground)
Tunnels between south of ERS and Tse Uk Tsuen Works Area	0.4	9.3	TBM - Twin bore single track tunnels	10 to 18 (approx. 18 to 12m below local ground)

Tunnel Sections	Approx. Horizontal Length, km	Approx. outside Tunnel Diameter, m	Type of Tunnel	Approx. Level, mPD (min. to max. meter below local ground)
Tunnels between Tse Uk Tsuen Works Area and Shing Mun Ventilation Building	6.5	7.7 to 19.6	D&B - Single track twin bore tunnels / twin track single bore tunnel / twin track single bore transition cavern	18 to -26 (approx. 12 to 980m below local ground)
Tunnels between Shing Mun Ventilation Building and Kwai Chung adit	2.5	14.8	D&B - Twin track single bore tunnel	-26 to -30 (approx. 60 to 270m below local ground)
Tunnels between Kwai Chung adit and Nam Cheong Ventilation Building	3.0	7.7 to 19.6	D&B - Single track twin bore tunnels / twin track single bore tunnel / twin track single bore transition cavern	-30 to -20 (approx. 270 to 25m below local ground)
Tunnels between Nam Cheong Ventilation Building and Hoi Ting Road Construction Shaft	2.5	9.3	TBM - Twin bore single track tunnels	-20 to -15 (approx. 25 to 20m below local ground)
Tunnels between Hoi Ting Road Construction Shaft and Mong Kok West Ventilation Building	0.2	9.3	Cut and cover tunnels	-15 to -14 (approx. 20 to 24m below local ground)
Tunnels between Mong Kok West Ventilation Building and WKT	0.5	15	Single twin track cut and cover tunnel	-14 to -23 (approx. 24 to 26m below local ground)

West Kowloon Terminus

2.14 The WKT is accommodated within Site A on the South West Kowloon Outline Zoning Plan (OZP) (S/K20/22[1] dated 20 March 2009) with a footprint of about 10 ha. WKT will be located underground immediately to the north of the proposed West Kowloon Cultural District (WKCD) between Kowloon Station of the Airport Express Line on the west and Austin Station of the Kowloon Southern Link (KSL) on the east.

2.15 WKT will be developed as a gateway to the Mainland, with distinctive architecture, landmark features and a user-friendly layout to accommodate co-located HKSAR and Mainland Customs, Immigration and Quarantine (CIQ) facilities. Schematic layout and sections are presented in **Figure Nos. NOL/ERL/300/C/XRL/ENS/M50/023** to **029.**

Ventilation Building, Vent Shaft and EAPs

2.16 The ventilation buildings will not only provide essential ventilation to the tunnel but also act as Emergency Access Point (EAP) for Fire Services Department personnel or MTRCL staff to reach the track level in emergency situations or provide access for maintenance.

2.17 A total of seven tunnel ventilation buildings will be provided, five in the New Territories and two in the western side of Kowloon. A ventilation building will also be provided to the north of WKT to serve for both station and track fan ventilation. A dedicated EAP is provided at Tai Kong Po for emergency access.

2.18 Two ventilation buildings at the northern and southern ends of the ERS will also provide ventilation to the tunnel and emergency access during emergency situation.

[1] S/K20/23 was exhibited on 29 May 2009.

2.19 Ventilation shafts located on top of the WKT will be integrated with the future topside development to minimise potential visual impacts. As the underground structures of WKT will encroach on eastern portion of WKCD, there will be two ventilation shafts located in WKCD to serve underground stabling tracks.

Shek Kong Stabling Sidings (SSS)

2.20 Stabling sidings will be located at Shek Kong. To comply with the operational requirements, stabling sidings will comprise running maintenance area, stabling area, store, staff accommodation, permanent way facility locomotive shed, fuelling facility, gatehouse and access point, E&M plant building, train wash facility, and traction power feeder substation. Schematic layout and sections are presented in **Figure Nos. NOL/ERL/300/C/XRL/ENS/M50/017** to **020**.

Emergency Rescue Station (ERS)

2.21 The ERS located next to SSS is a depressed box with an open top for a full train length of approximately 500m long, 28m wide and 18m deep. Passengers can escape vertically via staircases from the box to a secure fenced-off holding area. The location and schematic section of ERS are presented in **Figure Nos. NOL/ERL/300/C/XRL/ENS/M50/017** to **018, and NOL/ERL/300/C/XRL/ENS/M50/021** to **022**.

Consideration of Alternatives

2.22 The following sections present the consideration of the alternatives for the following key elements of the Project:

- Alignment;
- Terminus;
- Ventilation building/Emergency Access Point;
- Stabling sidings;
- Emergency rescue station; and
- Train System.

Alignment

Background of Alignment Development

2.23 A Preliminary Project Feasibility Study (PPFS) was conducted from 2006 to 2007 to study the feasibility of using a shared rail corridor with West Rail (WR) and dedicated corridor with the primary focus being to establish whether the XRL would share a rail corridor with West Rail or adopt a dedicated corridor.

2.24 Two alignment options were studied for the purpose of evaluating the pros and cons of dedicated corridor and shared corridor schemes (**Figure No. NOL/ERL/300/C/XRL/ENS/M50/031)**:

- Dedicated corridor scheme: comprising a 25 km tunnel route from WKT via an underground emergency rescue station located east of Shek Kong to the boundary crossing point located west of the Lok Ma Chau Terminus; and
- Shared corridor scheme: comprising a 26 km tunnel route sharing the West Rail corridor from south of Nam Cheong to Kam Sheung Road. The alignment branches off from Kam Sheung Road to cross the boundary west of Lok Ma Chau Terminus.

2.25 During the study, a number of changes in service demand, rolling stock and structural gauge were required to be adopted in the XRL. As a consequence to the above changes, the overall issues associated with the proposed shared corridor scheme are summarised below:

- The evacuation walkway inside the WR tunnel and platforms would be required to be trimmed back to accommodate the mainland train gauge. However, this would increase the stepping gap for the WR passengers to pass over in case of emergency evacuation inside the tunnel and platform. The safety of the WR passengers would therefore be compromised during emergency evacuation and normal daily usage. It was anticipated that the modification works would take approximately three years, affecting about 30,000 passengers every day.
- Increased patronage and long haul train services for serving mainland cities would significantly shorten the usable life of the WR in supporting the XRL service. With the current patronage and service predictions, the shared corridor would be saturated by 2020s. With the commencement of XRL in 2015, the usable life of the shared corridor would be very short, and possibly shorter if the XRL service is welcomed by the public. As such, a dedicated corridor would be required to accommodate the future demand and its construction would need to commence shortly after the operation of the shared corridor.
- Shared corridor would offer low flexibility in both WR and XRL operation. Hourly interruption to either service would be expected with little room for recovery after perturbation. WR operation performance would be significantly inferior to what is currently being achieved and the WR Service Pledge would be difficult to meet. Similarly, XRL operation performance would also be significantly inferior to what one would expect from a modern, premium service railway line. The situation would become unmanageable when long haul train services frequency approaches the capacity limit.
- The shared corridor scheme was considered as cost-ineffective in terms of operation and usable life as discussed above.

2.26 In view of the above, the dedicated corridor scheme was therefore selected for further study.

2.27 Following the selection of the dedicated corridor scheme, MTRCL proceeded with further planning and project design. Two dedicated alignment corridors were further studied:

- Base Scheme utilizing a direct route from Kowloon to the Shenzhen boundary; and
- Alternative Scheme to the west of Base Scheme, utilising the existing West Rail stabling facilities at Pat Heung as far as possible.

2.28 Both schemes shared a common southern alignment within the Kowloon area, starting at the WKT passing beneath Jordan Road, the Kowloon Southern Link, Hoi Wang Road, Cherry Street, West Kowloon Corridor, Tai Kok Tsui, densely populated areas of Sham Shui Po and Cheung Sha Wan. This southern alignment was referred to as alignment option S1. For the northern section of the alignment, the Base Scheme (alignment option N3) proceeded north passing across the middle of the Kam Tin Valley, under Lam Tsuen Country Park, through Ngau Tam Mei to the boundary. The Alternative Scheme, from Shing Mun moved west to follow an alignment parallel with West Rail before moving north, passing beneath the San Tin Highway and Mai Po wetland towards the boundary crossing.

Criteria for Options Development

2.29 The Project alignment was divided into northern and southern sections. The criteria presented in **Table 2.2** were adopted for the consideration of alignment options for southern and northern sections.

Table 2.2 Criteria for Option Development

Criteria	Description
Engineering Factors	
Implementation Programme	Minimisation of construction period. Shorter construction period would be preferable as it could minimise disruption period to the community
Operations safety, flexibility and maintainability	• Ease of fire fighting and evacuation • Flexibility for stabling requirement
Constructability	• Avoidance/minimisation of constructing soft ground tunnel due to safety and building settlement issues • Avoidance/minimisation on construction risks due to uncertain ground condition and long tunnel
Land acquisition	Minimisation of affected areas to avoid disruption to local community
Environmental Factors	
Ecology	Avoidance/Minimisation of impact on wetlands, sites of conservation importance (including Country Parks, Conservation Areas, Mai Po Inner Deep Bay Ramsar Site, and species of conservation interest)
Other Environmental considerations	Avoidance/Minimisation of • Airborne and ground-borne noise impact associated with the trains pass-bys • Landscape and visual impact associated with the above-ground structures; and impact on any significant landscape and heritage resources • Indirect impact (e.g. vibration impact) on historical buildings • Direct impact on graded buildings and known Archaeological Sites
Other Factors	
Avoidance/Minimisation of issues/constraints	• Minimisation of project areas encroaching into developed area • Minimisation of interface issues with other projects
Disruption to the community	• Minimisation of impact to local communities including residential households • Minimisation of structural impact on the buildings along the alignment • Minimisation of impact to business operations

2.30 A Preliminary Design Study (PDS) was conducted to further review the PPFS Base Scheme and Alternative Scheme, and identified alternative route options, basing on the criteria presented in **Table 2.2**.

Alignment Options

2.31 During the investigation of possible alignment options, no-dig zones for above-ground works were identified, including in Mai Po Inner Deep Bay Ramsar Site, Deep Bay Wetland Conservation Area and Country Parks. In addition, avoidance of a tunnel transition structure in Mai Po Inner Deep Bay Ramsar Site, for enabling compatibility between the Mainland and Hong Kong tunnel layout/sizing configurations, was also achieved in the engineering design, by adopting two single small bored tunnels instead of a single large bored tunnel.

2.32 A total of 3 alignment options for the southern section and 4 alignment options for the northern section were developed in the PDS stage. The identified alignment options are described in **Table 2.3** and presented in **Figure Nos. NOL/ERL/300/C/XRL/ENS/M50/032 to 033**.

Table 2.3 Alignment Options

Option	Approx. Length (km)	Description
Southern Section		
S1 (Base Scheme)	9	The southern alignment starts at West Kowloon, passing beneath Jordan Road, Kowloon Southern Link, Hoi Wang Road, Cherry Street, West Kowloon Corridor, Tai Kok Tsui, densely populated areas of Sham Shui Po and Cheung Sha Wan, beneath Lion Rock Country Park and Kowloon Byewash Reservoir
S2	10	A new alignment for the southern section adopting a westerly alignment through Kowloon, beneath Tai Kok Tsui, Nam Cheong, avoiding the need to pass under the developed area of Sham Shui Po
S3	11	A new alignment for the southern section running along Lin Cheung Road and turn further west after passing Nam Cheong Station and then turn east sharply after passing the proposed Lai Chi Kok DSD Transfer Scheme to Po Lun Street. After leaving Po Lun Street, the SW2 alignment goes north and follows the route of SW1 heading to Futian.
Northern Section		
N1 (Alternative Scheme)	21	This scheme, from Shing Mun trends west to follow an alignment parallel with West Rail before trending north, adjacent to the San Tin Highway and the boundary crossing
N2	13	A northern alignment located 500m to the west of the PPFS Base Scheme to place the ERS facility in land zoned for agriculture use
N3 (Base Scheme)	17	This scheme provided north passing across the middle of the Kam Tin Valley, under Lam Tsuen Country Park, through Ngau Tam Mei to the boundary
N4	14	A northern alignment located east of the PPFS Base Scheme minimizing the length of soft ground tunnelling with the tunnel alignment within rock

Evaluation of Alignment Options

2.33 Based on criteria developed in **Table 2.2**, evaluation of each alignment option was conducted. A summary of options assessment are presented in **Table 2.4**.

Table 2.4 Evaluation of Alignment Options in Preliminary Design Study

Criteria	Alignment Option						
	Southern Section			Northern Section			
	S1 (Base Scheme)	S2[1]	S3	N1 (Alternative Scheme)	N2[1]	N3 (Base Scheme)	N4
Engineering Factors							
Implementation Programme	Not assessed	Not assessed	Not assessed	• Significantly greater length of tunnel, requiring longer construction period of about 70 months	• Construction period of about 64 months	• Construction period of about 76 – 82 months	• Construction period of about 64 months
Operations safety, flexibility and maintainability	Not assessed	Not assessed	Not assessed	• Access for fire fighting and escape for evacuation is more difficult due to the deeper ERS	• Better performance with the ease of fire fighting for an open box ERS • Dual access from Kam Tin Road and Kam Sheung Road	• Better performance with the ease of fire fighting for an open box ERS	• Difficult in fire fighting due to only part of the box ERS open
Constructability	• High risk of deep weathering material in Sham Shui Po areas • Deep alignment with complex tunnelling issues • High risk of extensive ground improvement works in urban Kowloon	• Lower risk of deep weathering • Complex interface with Lai Chi Kok Interchange	• High risk for intervention for TBM maintenance at high air pressure of above 3.4 Bar • Difficult to construct for alignment under a lot of foundations and existing railway lines	• Extensive soft/mixed ground tunnelling • Complex to construct and higher construction risk	• Moderate soft ground tunnelling • Complex to construct and higher construction risks	• Moderate soft ground tunnelling • Complex to construct and higher construction risks	• Relatively less soft ground tunnelling • Less complex to construct and lower construction risks
Land Acquisition	• Acquire Land for permanent ventilation buildings	• Acquire Land for permanent ventilation buildings	• Acquire Land for permanent ventilation buildings	• Mainly agricultural land • Some structures affected	• Mainly agricultural land • Fewer structures affected	• Mainly open storage • Some structures affected	• Mainly open storage • Slightly fewer structures affected

Criteria	Alignment Option						
	Southern Section			Northern Section			
	S1 (Base Scheme)	S2(1)	S3	N1 (Alternative Scheme)	N2(1)	N3 (Base Scheme)	N4
	• Very few business to be affected • No private land required	• Very few business to be affected • Only one CLP spare equipment building to be resumed	• Very few business to be affected • No private land required				
Environmental Factors							
Ecology	Not anticipated	Not anticipated	Not anticipated	Potential impact on: • natural ecologically important stream KT12(2) and surrounding Greater Painted-snipe habitat at Cheung Po • Wooded area in CA near Tai Wo • Bat roosting site east of Pat Heung Maintenance Centre	Potential impact on: • Wooded area within/immediately outside Conservation Area (CA) near Tse Uk Tsuen • Stream and agricultural habitats in Shek Kong	Potential impact on: • Fung Shui Wood of high ecological values near Pat Heung Temple (a graded building)	Potential impact on: • Wooded area in Conservation Area near Chuk Hang and Lam Tsuen Country Parks • Ha Che Egretry stream habitats
Environmental Considerations	• Insignificant visual impact from ventilation buildings and terminus by proper architectural	• Insignificant visual impact from ventilation buildings and terminus by proper architectural	• Insignificant visual impact from ventilation buildings and terminus by proper architectural	• Insignificant visual impact from ventilation buildings and Stabling Sidings by proper architectural design • Potential impact on	• Insignificant visual impact from ventilation buildings and Stabling Sidings by proper architectural design • No known direct	• Insignificant visual impact from ventilation buildings and Stabling Sidings by proper architectural design • Landscape impact	• Insignificant visual impact from ventilation buildings by proper architectural design • No known direct impact on cultural

Criteria	Alignment Option						
	Southern Section			Northern Section			
	S1 (Base Scheme)	S2(1)	S3	N1 (Alternative Scheme)	N2(1)	N3 (Base Scheme)	N4
	design	design	design	Ho Pui Archaeological Site • Cumulative impact from sharing with existing West Rail Infrastructures	impact on cultural heritage	on Fung Shui Wood of high values near Pat Heung Temple • Potential impact on Pat Heung Sheung Tsuen Archaeological Site	heritage • Landscape and visual impact from stabling sidings due to substantial alteration of natural landform
Other Factor							
Avoidance of issues/constraints	-	• Tunnelling in congested Sham Shui Po avoided	-	• Reduction of land take by using existing West Rail land but affecting densely populated area	• Avoidance of locating ERS and SSS in densely populated area	•	• Tunnelling impact on above ground structures minimised • Soft ground tunnelling minimised
Disruption to the Community	• Higher structural impacts	• Lower structural impacts	• Higher structural impacts	• Approximately 370 number of households affected • Few businesses affected	• Approximately 150 number of households affected • Some businesses affected	• Approximately 340 number of households affected • Higher number of businesses affected	• Approximately 230 numbers of households affected • Higher number of businesses affected

Note:
(1) The preferred alignment options are highlighted for easy reference.
(2) KT12 is classified as an Ecological Important Stream (EIS) under *Environment, Transport and Works Bureau Technical Circular (Works) No. 5/2005 "Protection of natural streams/rivers from adverse impacts arising from construction works*.

Southern Section

2.34 Alignment option S1 (base scheme in PPFS) would require the tunnel to pass below densely populated areas in Sham Shui Po, which is built on soft ground. To ensure the safety of the tunnel and the integrity of the buildings above it, it would be necessary to maintain the tunnel within competent rock. Based on the available site investigation information in the PPFS stage, this option required a deep alignment within rock below the structures. During the PPFS, project specific site investigation was undertaken and the data indicated that the rock head was subject to deep weathering, posing a significant risk. An initial assessment also indicated that settlement from the tunnelling works could impact on over 200 buildings. The dense urban nature of the area restricted access from the surface to undertake underground mitigation works and the deep tunnel alignment posed a significant technical challenge due to the high ground water pressures within the soft ground portion. Construction of this alignment option would require very extensive mitigation measures for ground improvement work in urban Kowloon in order to limit impact to the existing buildings and would have significant impact to construction programme. As such, alignment option S1 is considered inappropriate.

2.35 For alignment option S3, this alignment runs along Lin Cheung Road. Stack tunnels configuration will be required to pass through the narrow corridor constrained by existing highways and building foundation on either sides of the road. Deep tunnel of more than 40m below ground will be required. For constructing a deep underground tunnel, intervention of for maintenance of TBM cutter heads at high air pressure of above 3.4 Bar would be required to avoid ingress of groundwater into tunnel. This method would induce higher construction risk and much slower tunnel construction progress rates. In addition, the construction period should be confined after non-operation hours of KSL to avoid potential risk to the passengers of KSL, as such the construction period would be longer and also potential disturbance to the operation of KSL is anticipated on the following day if there is any construction delay. As the extensive infrastructure development and the associated piled foundations along this route would pose a significant constraint on tunnel alignment, alignment option S3 was considered impractical.

2.36 Alignment option S2, which runs along the Hoi Wang Road and Sham Mong Road, was preferred over alignment options S1 and S3 as S2 would not be at risk from poor ground conditions, considering that the difficulties of bored tunnelling works deep underground. Furthermore, the possible impact on existing developments in Sham Shui Po could be minimised.

Northern Section

2.37 Alignment option N1 (PPFS Alternative Scheme) utilizing the West Rail Depot was not supported from a sustainable development view point. From a social impact perspective, the vacant land adjacent to the existing West Rail Pat Heung Depot is not sufficient to cater for stabling requirements, hence, additional land resumption will be required. Affected areas within the vicinity of the proposed stabling sidings include Tin Sum (Kau Tsuen), Strong Sing Garden, and the estimated number of households affected is approximately 370. From an environmental perspective, the approach tunnels would impose considerable environmental issues adjacent to the portal area in Kam Tin. The associated facilities for this alignment option would also have potential ecological impacts on natural ecologically important stream KT12 and a woodland in Conservation Area (CA) near Tai Wo (portal). In addition, this route would require a longer construction time due to the longer alignment particular for the extended soft ground tunnels.

2.38 Alignment option N3 (PPFS Base Case) was not preferred from a sustainable development perspective. This proposal would affect Sheung Tsuen, Cheung Uk Tsuen; and the number of households to be affected was estimated to be approximately 340. Furthermore, the proposed site for stabling sidings would be located within an area of archaeological importance and adjacent to the Pat Heung Temple (a graded building). This alignment would also locate the ERS within an area zoned as “Open Storage, Other Uses”. Clearance of the land could have social impact due to the large number of affected households as well as a variety of business and employment opportunities affected within this area. The associated facilities for this alignment option would also have potential

ecological impact on a woodland of high ecological value near Pat Heung. Given these environmental and social constraints, alignment option N3 was not preferred.

2.39 Again, for alignment option N4, the location within the head of the valley where the open storage sites are situated was initially considered to be desirable from a land perspective. However, a more thorough investigation revealed that about 230 households would be affected. In addition, the clearance of the area zoned as "Open Storage" may inflict other social issues such as impact to businesses and loss of employment opportunities. This eastern alignment will reduce the length of soft ground tunnelling and numbers of TBMs required, however the associated works areas may encroach into the buffer zones of the adjacent Chuk Hang and Lam Tsuen Country Parks. The substantial alteration to natural landform would impact on landscape resources, and also the structures for the above ground stabling sidings would be visually incongruous with surrounding landscape. Given these environmental and social constraints, this option was also not preferred.

2.40 Alignment option N2 addressed many of the shortfalls identified in the other alignment options. In addition, the land for stabling sidings has the least number of households (approximately 150) affected within the area. When compared to other schemes, it is considered that this scheme would bring the least impact to local communities. Moreover, the site spans between Kam Tin Road and Kam Sheung Road, providing dual access to facilitate evacuation and rescue operations. Considering the traffic conditions within Pat Heung area, this dual access would have good advantage over the other schemes.

Preferred Alignment

2.41 Based on the evaluation results, the preferred alignment options comprising a combination of alignment options S2 and N2 were selected for the Project, taking account of engineering, operational and environmental constraints. The cost estimation for the different alignment options was considered to be an insignificant factor and therefore was not considered in the selection process. For the northern section, alignment option N2 offered clear benefits in terms of operations, environment, construction and land related impacts. For the southern section, alignment option S2 presented a number of benefits and a feasible design solution could be developed to address the constraints.

West Kowloon Terminus

Principle Functions

2.42 The terminus will be a principal gateway between Hong Kong and the Mainland, and will also form a regional transport hub which will maximise rail travel, both cross-boundary and within the HKSAR, in order to promote the mobility of residents and visitors.

Preferable Location

2.43 The WKT will be located immediately to the north of the proposed WKCD, with the following benefits envisaged:

- The terminus location will form an integrated railway/transport/development hub with Kowloon Station (Airport Express Line and Tung Chung Line) and Austin Station (Kowloon Southern Link) and the associated airspace developments, providing point-to-point connection via the existing MTR network.
- The terminus will be integrated into the West Kowloon Reclamation Areas and Tsim Sha Tsui / Jordan Areas. It is anticipated that the provision of a terminus in this area will create a continuous people-dominated living space interlinking buildings, and activity areas, extending to the harbour front and adjacent districts.
- The terminus will partly extend into the underground area of the WKCD to provide better terminal operations. Integration into the WKCD will greatly enhance not only the prominence of the rail terminus as a gateway to the Mainland, but also the WKCD as a regional cultural

hub. It is also anticipated that the WKT site will generate more visits to the proposed art, culture and tourism facilities in the WKCD thereby promoting cultural tourism.

Scheme Design

2.44 During the PPFS, the formulation of the terminus configuration was based on the following generic planning items:

- Architecture to promote the WKT as the gateway to China;
- Segregation of arrival and departure passengers;
- Convenient station access and interchange with other transport modes for passengers as well as those travelling with luggage;
- Establishment of focal points for meeting places and greeting at terminus entrances and exits;
- Departure lounges and waiting areas;
- Simple and clear circulation patterns for passenger access to the terminus and to/from the platforms; and
- Provision of commercial opportunities.

2.45 The operation planning of the WKT also does not require maintenance of rolling stock, and emptying of sewage tanks in the terminus. In addition to the above planning consideration, operation requirements of 6 and 9 platform tracks for short haul and long haul trains respectively would also be considered in the scheme design of WKT. The track layout design for WKT was therefore carefully considered such that the effect of a small delay of a long haul train would not amplify progressively to one or more 'knock on' effects to following trains.

2.46 Following the PPFS, a Preliminary Design Study was conducted to develop scheme options for the WKT. With regard to the above considerations, there are two main new schemes were developed and presented in **Table 2.5** and **Figure No. NOL/ERL/300/C/XRL/ENS/M50/034.**

Table 2.5 WKT Design Scheme Options

Scheme	Approx. Required Area (ha)	Appro. Track Level (mPD)	No. of Platform	Remark
PPFS Alternative Scheme	12	-20 mPD for both shuttle and long haul	4 shuttle and 10 long haul platform tracks	A refuge siding located on the west side of the long haul facility will be provided. This scheme could not provide the required operation capacity to match with the overall line capacity.
Option 1	12	-21.5 mPD for both shuttle and long haul	6 shuttle and 9 long haul platform tracks	No conflicts with adjacent road networks.
Option 2	12	-19 mPD and -26 mPD for long haul and shuttle respectively	6 shuttle and 9 long haul platform tracks	This scheme, a 'grade separated' junction between the shuttle and long haul services, is developed from Option 1 to further improve the junction capacity and the number of train conflicts. The provision of grade separated junction minimises any conflict between incoming shuttle and outgoing long haul and vice versa and maximises throughput of the junction.

Scheme	Approx. Required Area (ha)	Appro. Track Level (mPD)	No. of Platform	Remark
				However, the length of the overunns at the long-haul and shuttle tracks is limited to just 55 meters which is too short and will impact on operational safety. Similar to Option 1, there would be no conflict with adjacent road networks.

Preferred WKT Scheme

2.47 Engineering constraints and operational requirements were predominant factors in the selection of the preferred scheme. Factors including headway and platform capacity, train movement conflict, extension to WKCD, and feasibility of future expansion to Hong Kong Island and accommodating the adjacent road networks were also considered.

2.48 During the Preliminary Design, a review was conducted on the PPFS track layout with respect to the latest planning, operational, and engineering design requirements. Improvement for the PPFS scheme was identified and the PPFS scheme was revised, with the objective to:

- Minimise major conflict movements between shuttle and long haul trains (i.e. short haul arrival and long haul Departure);
- Improve the junction arrangement to eliminate the conflict movement encountered in grade separated junction;
- Straighten the platforms as much as possible;
- Increase the shuttle platform capacity with additional platforms; and
- Maximise the flexibility for a future extension to Hong Kong Island (i.e. by platform orientation and adjusting, alignment & rail level, etc).

2.49 Option 2, which made use of a grade separated junction for long haul and shuttle trains, were also not selected because neither could provide the flexibility of extending the overruns for both long haul and short haul trains, which could be a risk to operational safety. Option 1 was therefore selected, as it allows the roadworks to be integrated with the station structure.

Ventilation Buildings/Emergency Access Points (EAP)

Principle Functions

2.50 Ventilation buildings will serve several purposes. In normal operation, they will be the air exchange route for the railway system. In emergency mode, they will be essential components of the tunnel smoke control system.

2.51 In addition, the ventilation buildings will serve as a EAP. EAPs will be activated in the event of train fire or incident inside tunnel and the EAPs will serve as the access points for firemen and police into the rail tunnels. Parking areas are provided next to the ventilation buildings for parking of emergency vehicles. A permanent Emergency vehicle access (EVA) connecting the existing road networks and the ventilation building will be provided for access by Fire Services Department and police vehicles in case of incident inside the rail tunnels. All these provisions are intended for the safety measures of the XRL passengers.

Types of Ventilation Building

2.52 The height of the building is determined by the functional and operational requirements of the ventilation building. Plant rooms that can be located below ground have all been designed to be

provided below ground to keep the height of the building to the minimum. However there are plants that cannot be installed below ground because of the access problem during installation and the subsequent maintenance. In addition, the ventilation louvres shall be located at least 5 m above ground in accordance with FSD regulations.

2.53 With regard to the above constrains, three generic types of ventilation buildings, as presented in **Table 2.6**, have been developed for the Project and modified to suit the tunnel setting at each particular situation.

Table 2.6 Generic Type of Ventilation Buildings

Type	Max. Height	Description	Remark
Type 1 – Underground ventilation fans with shaft	Approx. 14m	● Ventilation fans will be located directly above the shaft ● Equipment plant rooms will be located below ground within the shaft	● This type of ventilation building has a sufficiently large underground shaft that could accommodate some of the plant rooms underground.
Type 2 – Above ground ventilation fans with shaft	Approx. 19m	● Ventilation fans will be located either directly above or immediately to the side of the tunnel shaft. ● The vertical ventilation ducts will connect vertically to the surface.	● This type of ventilation building, due to site constraint, has a smaller shaft that is sufficiently large for accommodating the tunnel ventilation duct but cannot accommodate equipment and plant rooms underground.
Type 3 – Above ground ventilation fans with tunnel adit	Approx. 21m	● Ventilation building will consist of a long sloping adit linking ventilation building to the rail tunnels.	● Due to geographic constraints, this type of ventilation building cannot be located directly above the tunnel alignment and is away from the tunnel alignment. As a result, a long inclined ventilation adit is required to link to the ventilation building at ground level to the rail tunnels underground. ● This type of ventilation building is normally located adjacent to a steep slope.

Design Criteria for Ventilation Building

2.54 Design criteria developed for ventilation building are presented in **Table 2.7**.

Table 2.7 Design Criteria for Ventilation Building

Criteria	Description
Functional requirements	• Location and orientation within the site of the tunnel ventilation fan (TVF) will be determined by the connection to the tunnels below the TVF shafts. • Allow vehicular access by relevant authorities, such as Fire Service Department (FSD), police in case of emergency; and MTRCL for maintenance of the railway related facilities to the building. • Allow access from the building into the rail tunnel underground.
Accessibility	Suitable EVA for fire appliances with water supply and street fire hydrant. Access road should also be capable to allow vehicular access and parking for relevant parties, such as FSD, ambulance, MTRCL.
Constructability	• Avoidance/minimisation of constructing soft ground tunnel due to safety and building settlement issues. • Avoidance/minimisation on construction risks due to uncertain ground condition and long tunnel.
Land Acquisition	Minimisation of affected areas to avoid disruption to local community.
Site Formation Levels	Adequate site formation level to protect the building and rail tunnels underneath from flooding.
Environmental	Avoidance/Minimisation of impact on wetlands, sites of conservation importance (including Country Parks, Conservation Areas, Mai Po Inner Deep Bay Ramsar Site, and species of conservation interest).

Criteria	Description
Operational requirements	• Functional requirements include ventilation provision for the tunnel, power provision for tunnels, telecom provision and fire service provision. • Adequate size of E&M and building services plantrooms to avoid overheating of mechanical equipment. • Provision of emergency access point. • Minimal impact to adjacent buildings during operation of tunnel ventilation system. • Easy maintenance with heavy plantrooms located on G/F. • Ventilation louvers at the top-most portions of the vent building.

Selection of VB/EAP locations

2.55 The risk to passengers during emergency situations would be reduced by the lowering the separation between ventilation buildings. However, due to the very rugged terrain between Kowloon and the boundary, suitable locations for the ventilation buildings/EAPs are few. It is also very difficult to find room for ventilation within urban Kowloon due to heavy development in the city areas. However, the tunnel ventilation buildings/EAPs could not be kept too far apart due to safety and service requirements. Seven ventilation buildings with EAPs and a separate EAP will therefore be required for tunnel sections to allow proper and safe railway operation and safety protection to passengers in case of incident inside the tunnels. A ventilation building will also be required to serve the track fan and northern end of WKT and act as an EAP for the northern side of the track fan.

2.56 Land selection for VB/EAP has avoided important wetlands and wildlife habitats, existing graves and Fung Shui sight lines. Furthermore, use of land within village area, conservation area, or private lands has been minimized. In order to keep land requirement for VB/EAP to an absolute minimum, the total footprint and height of the ventilation buildings have also been minimized as far as practicable.

2.57 Generally, the sites of ventilation buildings/EAPs will be used as work sites and/or construction/ventilation shafts during construction phase to minimise the works areas as well as disturbance to the public and environment. Sufficient space will be available for parking of emergency vehicles during the operation phase. Sites suitable for ventilation buildings are therefore restricted by engineering constraints, land availability, accessibility and environmental factors.

2.58 Since the traffic connectivity for the ventilation buildings in the northern section is generally poor, the temporary construction access roads provided for northern side would be generally used as a permanent EVA during the operation phase.

2.59 With regard to the above considerations, nine viable sites have been proposed at Mai Po, Ngau Tam Mei, Tai Kong Po, Pat Heung, Shing Mun, Kwai Chung, Nam Cheong, Mong Kok West and West Kowloon. With consideration of suitable types of ventilation building (**Table 2.6**) at each particular site and design criteria (**Table 2.7**), the details of the proposed ventilation buildings/EAP are presented in **Table 2.8**.

Table 2.8 Summary of Proposed Ventilation Buildings/EAPs

Ventilation Building/EAP	Site Location	Current Usage	Land Status (OZP)	Approx. size of VB/EAP (m)	Building Type	Approx. Building Height	Major Usages during construction and operation phases	Requirement of Tunnel Adit
Mai Po Ventilation Building (MPV)	Mai Po	Open car park	Other specified uses annotated "Comprehensive Development to Include Wetland Restoration Area"	25 x 33	Type 1 - Underground ventilation fans within launch shaft	14m	Ventilation, TBM launching and emergency access	No
Ngau Tam Mei Ventilation Building (NTV)	Ngau Tam Mei	Unused Land	Green Belt,	19 x 54	Type 2 - Above ground ventilation fans with shaft	21m	Ventilation, TBM reception and emergency access	No
Tai Kong Po Emergency Access Point (TPP)	Tai Kong Po	Abandoned pig farm	Agriculture	13 x 16	N/A	8m	EAP, TBM reception or drill and blast tunnelling works and emergency access	Not Applicable
Pat Heung Ventilation Building (PHV)	Tai Ling	Unused Land	Agriculture	32 x 42	Type 3 - Above ground ventilation fans with tunnel adit	13m	Ventilation, drill and blast tunnelling works and emergency access	Yes (Approx. 330m long)
Shing Mun Ventilation Building (SMV)	Shing Mun Bus Stop	Bus Stop	Residential (A)	22 x 34	Type 1 - underground ventilation fans with shaft	21m	Ventilation, drill and blast tunnelling works and emergency access	Yes (Approx. 60 m long)
Kwai Chung Ventilation Building (KCV)	Site next to Wing Yip Street	Open car park	Industrial	30 x 35	Type 3 - Above ground ventilation fans with tunnel adit	20m	Ventilation, drill and blast tunnelling works and emergency access	Yes (Approx. 650m long)

Ventilation Building/EAP	Site Location	Current Usage	Land Status (OZP)	Approx. size of VB/EAP (m)	Building Type	Approx. Building Height	Major Usages during construction and operation phases	Requirement of Tunnel Adit
Nam Cheong Ventilation Building (NCV)	Site in the north of Nam Cheong Station PTI	Open car park	Comprehensive Development Area (CDA)	20 x 42	Type 1 - Underground ventilation fans within launch shaft	14m	Ventilation, crossover and emergency access	No
Mong Kok Ventilation West Building (MKV)	Site next to Hoi Ting Road	Open car park	Road	21 x 36	Type 1 - Underground ventilation fans with shaft	13m	Ventilation and TBM retrieval	No
West Kowloon Ventilation Building (WKV)	Site next to Jordon Road	Open area	Open Space	15 x 74	Type 1 - Underground ventilation fans with shafts, and an Emergency Assembly Area	19m	Ventilation and emergency access	No

Mai Po Ventilation Building (MPV)

2.60 Apart from the use of a ventilation point and emergency access point during operation phase, the site will also be used as a TBM launching shaft towards Ngau Tam Mei and possibly towards Mainland during construction stage.

2.61 The selected location of MPV is a formed land, which is currently an open car park for trucks and coaches, to avoid any direct impact to ecological habitats. The location of MPV site is constrained by the geological constraints as it cannot be moved either northwards to Mai Po wetland or southwards to developed private lands. The currently proposed location is therefore considered to be the most suitable location which meets the ventilation and fire safety requirement. The environment in this area will be enhanced by the architecture and landscape design of the ventilation building.

2.62 As the site sits on an area of low lying flat land, flood protection has been considered and thus the site formation level of ventilation building will be raised about 2m high to allow for a flood protection level of 1 in 200 years, according Drainage Services Department (DSD) *Stormwater Drainage Manual*. Since MPV is located close to Wetland Conservation Area (WCA), Type 1 ventilation building will be adopted to minimise the visual and ecological impact.

Ngau Tam Mei Ventilation Building (NTV)

2.63 Apart from being a permanent ventilation point, the proposed site of NTV will also be used as a TBM retrieval shaft and a construction shaft for drill and blast tunnelling works during the construction phase. It is located near the foot of the northern slopes to Kai Kung Leng and immediately adjacent to the public access road to Ngau Tam Mei Water Treatment Works.

2.64 The selection of this site would eliminate the need for soft ground mined tunnel thereby reducing the construction safety risk. Apart from minimizing direct impact on village houses to the practicable extent, formation of a new construction access road would not be required as the existing WSD access road can be utilised. In this way, environmental impacts pertinent to the construction of this ventilation building could be minimized.

Tai Kong Po Emergency Access Point (TPP)

2.65 Given the distance between NTV and the ventilation building to the north of ERS is about 4km, as such only an EAP is required to be provided at Tai Kong Po for satisfying fire safety strategy and no ventilation fan will be provided at the TPP.

2.66 The proposed location of TPP is located in an agriculture zone, currently an abandoned pig farm. This site will be used for TBM retrieval and for drill and blast tunnelling works during the construction phase. As the condition of the existing access road is poor, road improvement works will be required for future permanent EVA and temporary construction access.

Pat Heung Ventilation Building (PHV)

2.67 The PHV will be located in Tai Ling, away from Tse Uk Tsuen Works Area, which will be used as a temporary TBM retrieval shaft. The PHV site will be used for the construction of ventilation adit, which support for drill and blast tunnelling works of the main tunnels, to minimise the ecological impacts on agricultural habitats. The PHV is located away from the existing nearby occupied houses as far as practicable. An ventilation adit will link the ventilation building with the tunnel. Similar to other sites, the temporary construction access road will be converted to a permanent EVA during the operational phase.

Shing Mun Ventilation Building (SMV)

2.68 A ventilation building will be required immediately to the south of Tai Mo Shan in order to achieve the tunnel ventilation and emergency safety access requirements.

2.69 The SMV was initially located at the northern end of Shing Mun Valley Park, and an inclined adit was required to be constructed to the tunnel for both construction access and permanent ventilation building. This site provided a constrained construction platform with problematic access due to the steep slopes and adjacent road configuration. The significant level difference between the site and the tunnel of over 100m resulted in a very long adit.

2.70 With the proposed works area at Shek Yam, a shorter adit together with a shaft could be constructed to provide access to the tunnel. As such, the need for a long adit at Shing Mun could be removed but the tunnel ventilation requirement still remains. Given the site constraints identified at the site next to Shing Mun Valley Park, the SMV site was finally selected at the adjacent PTI to minimise impact on the Park.

Kwai Chung Ventilation Building (KCV)

2.71 The site of KCV will be used as a ventilation point and emergency access point for the tunnel section during operation, and an adit for drill and blast tunnelling works will be provided during construction.

2.72 The site was avoided to be located at Mei Lai Road to minimise potential noise and visual impacts to nearby sensitive receivers such as Mei Foo Sun Tsuen and Po Leung Kuk Tong Nai Kan College. The preferred location of KCV is located next to Kwai Chung industrial area and currently occupied by a temporary recycling plant and a car park. With the preferred location located next to industrial area, it is expected that there would not be any significant impact to the environment.

Nam Cheong Ventilation Building (NCV)

2.73 A TBM launching shaft for two directions (south towards WKT and north towards Mei Lai Road) will be required during construction. Thus the site adjacent to Nam Cheong Station Public Transport Interchange (PTI) is selected as the preferred location of NCV, in order to accommodate a combined construction shaft and ventilation building. The NCV will be located and constructed to integrate with the construction shaft. It will also be sunken to reduce the footprint of the ventilation building site to minimise potential visual and planning impacts to the surrounding developments.

2.74 As NCV will be located in a site of Hong Kong Housing Authority (HKHA), which will be developed to a residential development. The site area therefore has been reduced to absolute minimum, without EVA parking and space for landscaping. Vehicles attending to an emergency incident will be parked in future adjacent areas under the planning by Hong Kong Housing Authority.

Mong Kok West Ventilation Building (MKV)

2.75 Given the limited available area in Mong Kok West, the location of MKV will be the vacant site adjacent to Hoi Wang Road, which is also the proposed site for the proposed future Central Kowloon Route (CKR) Flyovers.

West Kowloon Ventilation Building (WKV)

2.76 The proposed ventilation building complex will serve as a ventilation point, emergency evacuation, emergency assembly area, accommodation for railway plant facilities, and other supporting facilities. The WKV will be located in an open area bounded on the west by Lin Cheung Road and on the east by Hoi Wang Road and the future road D1A north, as constrained by land availability in West Kowloon.

Stabling Sidings

Principle Functions

2.77 In order to accommodate with increased long haul train services to Hong Kong without affecting the overall line capacity to Hong Kong, stabling sidings within the Project are required to meet the operational requirements. Operational requirements are listed below:

- Stabling requirements for long haul trains to support the operation of the West Kowloon Terminus;
- Overnight stabling for long haul trains, for return journey back to the Mainland on the following day;
- Routine maintenance checks and inspections for long haul trains and shuttle trains during stopping over in Hong Kong before the return journey;
- Stabling for short haul trains both at night and daytime off-peak;
- Central infrastructure structural maintenance for the XRL and trackside maintenance; and
- Cleaning and inspection services for short haul and long haul trains.

2.78 Given the limited stabling capacity at the WKT, an alternative location must be assigned. In addition, a small scale engineering depot for necessary maintenance facilities (e.g. maintenance of permanent-way, overhead line, signalling and control, etc) and engineering trains will be required for maintenance of infrastructures and buildings, as well as handling of emergency situation such as derailment or emergency servicing.

Preferable Location

2.79 The Mainland Section of the XRL would be busy with networks linking to other cities in China. If all the XRL trains to be stabled in Mainland, empty trains report to service would consume the valuable XRL line capacity and adversely impact the operation efficiency. Therefore, it is not recommendable to stable all trains serving the XRL in Mainland.

2.80 As discussed in **Section 2.41**, alignment option N2 is the preferred alignment with the at-grade stabling sidings provided at an area in Shek Kong. With sufficient length of the alignment between the toe of Tai Mo Shan and Shek Kong, the alignment could be gradually rise up to a more shallow alignment in Shek Kong, such that the stabling tracks could be developed within the proposed site. In addition, the site is large and flat with relative low terrain and the least social impact, this site is suitable for developing stabling sidings and emergency rescue station. As discussed in **Section 2.41**, provision of stabling sidings at Shek Kong would minimise impact to the environment and public, as compared with other options. The proposed site will have the least impact to local community in the Shek Kong area.

Layout and Size of Stabling Siding

2.81 In order to achieve the operational requirements described in **Section 2.77**, the SSS will comprise:

- Eight stabling sidings (approx. length 520m each);
- Four covered running maintenance sidings (approx. length 480m each);
- Three permanent-way sidings (approx. length 300m each);
- Workshops and plant rooms;
- Stores (including dangerous good stores);
- One office building with control centre for the compound, gatehouse and canteen;
- Stabling siding for emergency rescue bus;
- Shunting tracks; and
- Train Wash.

2.82 In addition, a total of six locomotives will be stabled at the SSS. The associated facilities will comprise:

- Two 40m locomotive sidings;
- Refuelling tank; and
- Locomotive maintenance shed and workshops.

2.83 Only minor maintenance activities and inspection will be carried out in stabling sidings. The proposed layout of SSS has been designed to minimise the site area to approximately 20 hectares to accommodate the above-mentioned facilities. Given that the layout is limited by site area as well as the existence of ERS, the proposed layout is an optimum scheme to accommodate all the operation requirements of XRL. Schematic layout and sections are presented in **Figure Nos. NOL/ERL/300/C/XRL/ENS/M50/017** to **020**.

2.84 As the estimated flood levels are higher than the existing ground levels at the SSS / ERS and cut and cover approach tunnel to the SSS / ERS, river training and culverting of the existing river on the west side of the SSS and provision of box culvert along the eastern edge of the ERS will be required for flood protection. The SSS site falls within Drainage Basin 9 of Yuen Long, Kam Tin, Ngau Tam Mei and Tin Shui Wai Drainage Master Plan Study (DMP), in line with the design principle of the DMP, a flood protection level of 1 in 200 years has been adopted for drainage design in SSS.

2.85 The peripheral drains - a box culvert along the eastern edge of the SSS will be provided to take a 200 year storm. Lesser storm will be carried by the widened existing channel and box culvert along the western edge of the SSS. Such flood protection measure would ease the potential flooding problem at the future SSS, ERS and adjacent area.

Emergency Rescue Station

Principle Function

2.86 An open air emergency rescue station (ERS) is required for fire fighting and evacuation of passengers in case of emergency at approximately the mid-point of the alignment.

2.87 The ERS is designated as a place for trains to stop and to discharge passengers either to another train in the event of mechanical problems or evacuation to an open air platform in the event of a train fire. The ERS will be a depressed box with an open top for safety reason. Firemen's lifts and staircases will be provided to allow ease of access for firemen.

Preferable Location

2.88 To provide an efficient and immediate response and rescue for any incident occurring inside the long tunnel between WKT and Futian Station, the ERS should be located near the mid-point of the alignment as far as practical. The ERS will be combined with SSS to minimise the land take by staggering the approach and the main tunnels, sharing the building maintenance resources, and to facilitate a prompt response to any incidents/accidents with the site links to convenient public access (i.e. Kam Tin Road and Kam Sheung Road). As mentioned in **Section 2.80**, the provision of ERS at Shek Kong would minimise impact to the environment and public.

Layout and size of ERS

2.89 The length of the ERS with open roof is about 500m long to accommodate a full length of a long haul train which consists of 16 coaches with a total of about 430m together with a buffer distance. It will comprise of three tracks and two island platforms, with the two outer tracks being the mainline running tracks and the centre track being a pocket track for emergency refuge. Island platforms will be provided between the tracks for detraining passengers in case of emergency. Staircases along the platform would lead passengers directly to ground level. The ERS has been sized to suit a long haul train. The ERS being below ground will minimise the noise impact. The location and schematic section of ERS are presented in **Figure Nos. NOL/ERL/300/C/XRL/ENS/M50/017** to **018, and NOL/ERL/300/C/XRL/ENS/M50/021** to **022**.

Train System

2.90 High-speed rail system is generally defined as having a maximum speed of over 200 km/h or higher. All types of high-speed trains are electrically powered via overhead lines.

2.91 The 140-km XRL will run from the WKT in Hong Kong to Shibi in Guangzhou. There will be three intermediate stations, Futian and Longhua in Shenzhen, Humen in Dongguan, which provide connections to other high speed rail networks in the Mainland. The section between Guangzhou and Longhua has commenced in December 2005, while the section between Longhua and Futian is in good progress.

2.92 Two types of train services will be provided by XRL:

- Short haul services between WKT and Longhua (LOH) in Shenzhen, Humen (HUM) in Dongguan and Shibi (SHB) in Guangzhou; and
- Long haul services between WKT and various major cities in the Mainland.

2.93 A maximum operating speed of 200km/h will be adopted for the Project. This is in line with the current design of the Mainland Section of the XRL between LOH and the boundary.

2.94 China Railway High-Speed (CRH) trains will be used in XRL and will be provided by the relevant operation entities in the Mainland, and the details of the CRH trains were not available during the preparation of EIA Report.

2.95 The selection of trackform types will be based on environmental, operational and maintenance considerations. Discussion with Mainland counterparts is being conducted to ensure compatibility along the entire line. The preliminary design of the trackform type is a trackform of embedded concrete sleepers with slightly resilient fixings on top. Appropriate vibrating mitigation trackform for a high-speed railway are being further studied for areas where ground-borne noise would exceed at sensitive receivers. A 600mm deep provision will be provided for the tunnel to allow for further enhancement of mitigation measures, if later studies confirm such requirement.

Construction Methodologies

Tunnelling Methods

2.96 The primary tunnel construction forms to be adopted for the Project are:

- cut-and-cover construction;
- drill-and-blast construction; and
- bored tunnelling construction, in which the tunnel would be excavated mechanically with a tunnel boring machine (TBM).

Cut-and-Cover Construction Method

2.97 Cut-and-cover construction is a proven and common method of excavation and construction for station, shafts and ventilation building. This construction method can accommodate different shapes of works areas. It typically requires several overlapping stages of work to be conducted in sequence, including removal of obstruction and diversion of existing utilities, installation of pipe pile wall/diaphragm wall, grouting, installation of decking, soil excavation, construction, backfilling and reinstatement.

2.98 In urban areas, the trench can be covered with a temporary deck following excavation to maintain traffic management, if required.

Drill-and-Blast Construction Method

2.99 Drill and blast methods are the conventional method of excavation for large face area hard rock tunnels within Hong Kong. It involves using a specialized rock drilling rig to drill holes in the rock which will then be charged with explosives, and detonated.

2.100 The use of explosive for the bulk excavation of hard rock is the most efficient method available in the market. As compared with cut-and-cover method, drill and blast construction will involve less construction plant items and reduce the duration of overall long term noise from the works, thus reduce impacts on residents living near construction shafts or above the tunnel route.

2.101 The adoption of mechanical or chemical breaking systems however requires additional rock drilling and the slow process will extend the construction period and the noise impact. Rock tunnel boring machines may be a practical alternative method but the tunnelling machine size is significantly larger than any utilised in Hong Kong, the ground conditions are particularly difficult for the technology and the varying cross sections do not lend themselves easily to a TBM solution.

2.102 With careful control of the quantity of explosives, the generated vibration levels on existing structures (buildings, roads, utilities etc) can be well controlled. In addition, the duration of a blast is very short (less than 6 seconds) and infrequent (every 12 to 16 hours), and therefore both airborne and ground-borne noise impact induced by blasting would not be a concern compared with the use of power mechanical plant. Drill and blast is well proven technology for tunnel construction in hard rock.

Bored Tunneling Construction Method

2.103 Tunnel boring machines (TBM) will be utilised for the soft and mixed ground tunnels. The construction methodology eliminates the need for surface access except at launching and retrieval shafts thus minimising surface disruption. The machine can be utilised for short lengths of rock sections of the tunnels but is not as efficient or flexible as tradition drill and blast techniques.

2.104 The selection of the appropriate tunnelling machine will depend on many issues, including the ground conditions, contractor's experience, tunnel size and tunnel alignment. Given the ground conditions anticipated, a shielded TBM erecting an un-drained (i.e sealed) segmental lining will be specified to ensure the stability of the tunnel face, safety of the workers, minimize the impact to the groundwater regime and limit surface settlement.

Considerations of Preferred Construction Method

2.105 The preferred construction method would be predominantly determined by engineering factors including safety, geological conditions, site conditions/constraints, accessibility, programme and cost-effectiveness.

2.106 Environmental considerations have also been considered to minimise the potential ecological, noise, air and water quality impacts as well as waste generation.

General Geography

2.107 The Hong Kong section of XRL tunnels will be constructed predominantly in the competent, generally grade III and better, volcanic and granitic rocks, which form the peaks of Kai Kung Leng and Tai Mo Shan, intersected by dykes and fault zones of varying significance. The other significant sections where the tunnels will be constructed through soft or mixed ground are located in Mai Po, Kam Tin and West Kowloon.

General Description of Site Conditions

2.108 With the exception of the natural terrain of Kai Kung Leng, within the Lam Tsuen Country Park, and Tai Mo Shan Country Park, the area to the north of Tai Mo Shan is a mixture of wet and dry

agricultural land, including the Mai Po wetlands, interspersed with areas of low density low-rise residential and light industrial / commercial development.

2.109 The Shek Kong area, located to the north of Tai Lam Country Park, is intersected by public roads and numerous open nullahs, generally flowing east to west, which drain the western slopes of Kai Kung Leng and the north-western slopes of Tai Mo Shan. Another prominent feature of the area is the Shek Kong airfield and barracks.

2.110 With the exception of Lai King Hill, the area to the south of Tai Mo Shan and Shing Mun Country Park is highly urbanized and includes well-developed districts of Kwai Chung, Lai Chi Kok, Tai Kok Tsui and Mong Kok. These areas contain numerous multi-storey residential / commercial / industrial buildings, public roads, mass transit infrastructure, educational institutions, public buildings, and nullahs and drainage culverts.

Environmental Considerations

2.111 Potential environmental issues associated with each tunnelling methods have been reviewed and a summary of the benefits and dis-benefits of construction methods is presented in **Table 2.9**.

Table 2.9 Benefits and Dis-benefits of Construction methods

Construction Method	Benefits	Dis-benefits
Cut-and-cover construction method	• Accommodation of different sizes of works areas	• More construction plants will be involved such that this would generate relatively more noise and dust impacts • Sensitive receivers will be affected over a longer construction period • Require recycling of bentonite for diaphragm wall construction • Larger amount of spoil required to be disposed of
Drill and blast construction method	• All works underground to minimize the disturbance to land, wildlife and public activities at ground level throughout the period of construction • Lesser spoil to be disposed of, as compared with C&C method • Above-ground works only required for portal construction • Noise impact could be minimized with the provision of temporary doors and barriers at the portals and shafts	• Higher vibration to adjacent sensitive receivers, but could be mitigated through blast design and careful monitoring • Duration of blasting would be short (less than 6 seconds) and infrequent • Require provision of site explosives magazines for storage of explosives • Transportation of explosives on public roads
Bored tunnelling construction method	• All works underground to minimize the disturbance to land, wildlife and public activities at ground level throughout the period of construction • Lesser spoil to be disposed of, as compared with C&C method • Noise impact could be minimized by provision of temporary decks over the portal • Above-ground works only required for construction of retrieval and launching shafts • Comparatively lower vibration impact • Lesser impact on groundwater level with the installation of water	• Preferable for 24hr operation to ensure stability of ground • Requires additional land for the handling of slurry that require processing before disposal • Potential adverse ground-borne noise impact when excavating in rock below existing buildings

Construction Method	Benefits	Dis-benefits
	tight concrete tunnel lining in pre-cast segments	

Preferred Tunnel Construction Methods

2.112 The anticipated geological conditions along the alignment are critical in the selection of the construction methods. The type of soil, rock and the presence of water have a fundamental impact on the selection.

2.113 TBMs are commonly used for the excavation of long tunnels in soft and hard rock. The advantages of excavation by TBM in rock tunnelling are relatively high daily production rates as compared with drill and blast methods, a controlled excavation profile, and low vibration and noise generation. However, the TBM tunnelling would generally involve continuous operation, which often would be a main source of ground-borne construction noise impact. In addition, procurement of TBM is expected to be about 18 months, due to limited number of suppliers, shortage of manufacturing capability and overall global demand within the buoyant tunnelling market. As such, the daily production rate of TBM will be relatively higher than that for blasting but the overall production rate will be lower for short tunnel sections.

2.114 Excavation by drill and blast method is not a continuous operation and in general has lower daily production rates than TBM tunnelling. Drill and blast operation will have less lead time required and there are programme advantages. Drill and blast tunnelling in rock is however better to manage ground risk issues but magazines and ventilation adits will be required for supporting the blasting.

2.115 With consideration of the above-mentioned engineering constraints, environmental benefits and dis-benefits, and programme risks, drill and blast construction method will be adopted for rock tunnels while bored tunnelling method will be adopted for mixed and soft ground tunnels. Cut-and-cover construction method will be adopted for the areas which require this conventional method, such as ERS, ventilation building/vent shaft/ EAP.

2.116 The construction method for each tunnel section has therefore been selected, based on engineering and site constraints. The proposed use of TBM and drill and blast tunnelling has been maximised to reduce impacts from above-ground works. The majority of soft ground and mixed ground tunnel sections will be constructed by bored tunnelling method. The remainder of the soft and mixed ground tunnel segments; principally the ERS, the southern approach to the ERS, the SSS approach, and the tunnels to the south of Hoi Ting Road will be constructed by cut and cover method. The rest of the alignment through Hong Kong will be constructed using drill and blast.

2.117 The preferred construction methods of different tunnel sections is summarised in **Table 2.10** and presented in **Figure No. NOL/ERL/300/C/XRL/ENS/M50/035**.

Table 2.10 Preferred Construction methods

Construction Method	Tunnel Sections	Selection Reasons
Cut-and-cover construction method	• ERS and SSS approach tunnels • Nam Cheong TBM launching shaft • WKT approach tunnels	• Engineering constraints
Drill and blast construction method	• Ngau Tam Mei to Tai Kong Po Tunnels • Tse Uk Tsuen to Mei Lei Road Tunnels	• Geological and engineering constraints • Minimisation of works areas • Avoiding works areas located in ecological sensitive areas, such as Lam Tsuen Country Park • Minimisation of potential disturbance to the public
Bored tunnelling construction method	• From Boundary to Ngau Tam Mei Tunnels • Tai Kong Po to north of ERS Tunnels	• Geological and engineering constraints • Comparatively shorter construction period • Minimisation of works areas

Construction Method	Tunnel Sections	Selection Reasons
	• South of ERS to Pat Heung Tunnels • Mei Lai Road to Mong Kok West Tunnel	• Avoiding works areas located in ecological sensitive areas, including Mai Po wetlands, agricultural land and grasslands at Wo Shang Wai, Mai Po Inner Deep Bay Ramsar Site, Tai Mo Shan Country Park, Lam Tsuen Country Park, Shing Mun Country Park • Minimisation of potential disturbance to the public

2.118 The sequences of works associated with the proposed tunnelling works are constrained by the engineering requirements. A shaft is required for launching and retrieval of TBM, and a portal for drill and blast construction. Conventional mechanical sequential excavation & support will be used for the construction shafts until rock is reached. The drill and blast construction is likely to be a combination of mechanical, pneumatic or hydraulic splitting or expanding grout techniques. For cut-and-cover construction, the construction sequence is discussed in **Section 2.97**.

Works Areas Requirements and Locations

2.119 To minimise the potential disturbance and impact to the public and environment, the works areas are typically located at the site of the permanent ventilation buildings, though in the case of works areas in Tse Uk Tsuen and Mei Lai Road, these works areas will be required for the retrieval of TBM. Mei Lai Road Works Area also provides early access to the area of recognised poor ground conditions to the north.

2.120 Shek Yam Works Area is used as a main production site for the Tai Mo Shan tunnel due to the limitation of available space and the problems of deep shaft construction associated with Shing Mun Works Area.

2.121 Given the large scale of the Project, additional works areas would be required for supporting the construction and have been identified for site office, storage of materials, nurseries and site explosives magazines.

2.122 A summary of works areas currently envisioned for supporting the construction of the Project is presented in **Appendix 2.2**. The locations of works areas have been selected with consideration of their accessibility and suitability for construction works and future permanent facilities. The above-ground works areas have been minimised to reduce and avoid the potential environmental sensitive areas including Mai Po Inner Deep Bay Ramsar Site, Deep Bay Wetland Conservation Area and Country Parks. Majority of the construction works areas have been located in Government land in the southern section and in fallow agricultural farm land to minimise the disturbance of on going business and dwellings in the northern section. Locations of the works areas are presented in **Figure Nos. NOL/ERL/300/C/XRL/ENS/M50/004 to 015**.

2.123 The construction sequence has been designed to minimise concurrent activities so as to reduce cumulative impacts as far as practicable. The following sections present the construction methods and sequences of works proposed for the Project facilities and other supporting facilities required for the construction of the Project.

West Kowloon Terminus (WKT) and associated facilities

2.124 The WKT is approximately 700m in length and 250m in width. The proposed track level for the preferred track scheme will be at about -21.5mPD. There are four floor levels in the terminus (namely, B3, B2, B1 & ground level) to accommodate various facilities. Part of the terminus shall encroach into the WKCD works area at underground levels.

2.125 The formation level for the bulk excavation of the terminus will be at approx. -24mPD, which is approx. 28m in depth. The excavation works is adjacent to the harbour side, high ground water

level regimes owing to both tidal effects and rainwater infiltration is anticipated. A permanent diaphragm wall will be constructed to provide lateral support to the ground and limit groundwater inflow into the construction site. In view of deep excavations, a stiff lateral support system must be provided to control the lateral movement of the cofferdam wall, as well as the settlement of adjacent ground.

2.126 The WKT site will be broadly split into five different zones as presented in **Figure No. NOL/ERL/300/C/XRL/ENS/M50/030.** Given the considerations of large site area, depth of excavation, highly varied site conditions and geology for the construction of the terminus, different construction methods and lateral support systems will be adopted for different zones.

2.127 In Zones 1 (WKCD area), the excavation lateral support is anticipated to be bottom up open cut method with ground anchors. The typical construction sequence is:

- Install diaphragm wall at the boundary of station, and construct piled foundation and socket H-piles column at region of open cut;
- Excavate and install layers of ground anchors stage by stage until the final excavation level is reached; and
- Construct station structure using bottom up method.

2.128 In Zones 2 & 3, (Site A area), the excavation lateral support is anticipated to be pseudo top-down open cut method. The typical construction sequence is:

- Install diaphragm wall at the boundary of station and construct piled foundation and socket H-piles at region of open cut;
- Form temporary cut slope with angle varying from 26 to 40 degrees depending on different soil types;
- Excavate the central portal of the station and construct central portal of the station structure by bottom-up method;
- Cast ground floor slab at the perimeter of the site;
- Excavate soil below ground floor at perimeter of the site until B1 formation level is reached;
- Cast B1 floor slab at the perimeter of the site;
- Repeat the excavation sequence at the perimeter of the site downward until the final formation level is reached; and
- Cast the final floor level at perimeter of site (i.e. B3).

2.129 In Zones 4 (Track Fan Area), the excavation lateral support is anticipated to be a combination of bottom up and top down method. The typical construction sequence for top down is:

- Install diaphragm wall and construct piled foundation and socket H-piles at ground level;
- Cast ground floor slab as lateral support to the wall with some openings for mucking out;
- Install temporary traffic deck;
- Excavate soil from below the ground floor slab until B1 formation level is reached;
- Cast B1 slab and repeat the excavation sequence for subsequent levels until the final formation level is reached; and
- Cast the floor slab of track level.

2.130 In Zones 5 (Approach Tunnel Area), the excavation lateral support is anticipated to be bottom up method. The typical construction sequence is:

- Install diaphragm wall at the boundary of approach tunnel;

- Excavate and install layers of struts stage by stage until the final excavation level is reached. Preloading of steel shoring may be required to control wall deflection; and
- Construct tunnel box structure by bottom up method, and remove steel struts stage by stage.

2.131 Rock will be encountered in two areas (Zones 1 and 3). The use of explosives is being reviewed and might be adopted. This will be confirmed in further investigation. In event that explosives are not adopted, drill and splitting of rock by hydraulic machine will be used for breaking and removing rock.

2.132 The disposal of large volume of excavated material shall be disposed by means of barges through the barging point situated at the seafront of West Kowloon. Trucks will be used for transporting the excavated material from the excavation area to the barging point. This will reduce the disturbance to the public roads.

2.133 The anticipated construction sequence for the intake and outfall units of the seawater cooling system is summarised below:

- Install a floating silt curtain at the locations of the proposed intake and outfall units to avoid soil from the landside going into Victoria Harbour;
- Excavate on the land side of the existing pre-cast wall units and install protective measures (e.g. grouting, sheetpiles, etc) to avoid fill materials entering the harbour;
- Remove the existing vertical wave absorbing seawall units by cranes and excavate the fill materials down to the required level for installation of the new culvert precast units;
- Place the precast units (the opening of two outermost precast units sealed off);
- Rebuild the seawall with concrete blocks above the precast units and re-construct the concrete backing and coping;
- Backfill the precast units;
- Complete the construction of the land side section of the culvert;
- Remove the seal off walls in the outermost precast units; and
- Backfill to the required level and remove the protective measures.

Shafts, adits and Ventilation Buildings/EAPs

2.134 Shafts and adits to be provided along the alignment, will be used for tunnel ventilation during the construction and operational phases. These structures will also provide access for tunnelling equipment, permanent material and spoil removal.

2.135 Shafts and adits will be typically located at permanent ventilation buildings to minimise the potential disturbance and impact to the public and environment. Typically the shaft will be sized for envisaged construction methods that will require sizable openings and clear access space for the delivery and removal of equipment (e.g. TBMs), spoil handling, material delivery and plant maintenance. Based on requirement of the construction methods and access needs, the sizes of these works sites have been minimised as far as practicable.

2.136 Construction shafts at Tse Uk Tsuen and Mei Lai Road will be required for retrieval of TBM. These shafts are located near the transition from soft ground to rock which allows for machine removal without impact on the adjacent tunnelling works. The Shek Yam Works Area is used as a main production site for the Tai Mo Shan tunnel due to the limitation of available space and the problems of deep shaft construction associated with Shing Mun Works Area. **Table 2.11** summarises the locations of shafts and adits.

Table 2.11 Locations of Construction Shafts and Adits

Shaft/Adits	Principle Activity	Occupation	Future Usage
Mai Po Shaft	Launching of TBM	Permanent	Mai Po Ventilation Building and emergency access point
Ngau Tam Mei Shaft	Retrieval of TBM and drive drill and blast tunnel	Permanent	Ngau Tam Mei Ventilation Building and emergency access point
Tai Kong Po Shaft	Retrieval of TBM and drive drill and blast tunnel	Permanent	Tai Kong Po Emergency Access Point
Tse Uk Tsuen Shaft	Retrieval of TBM	Temporary	The site will be reinstated and returned to the Government
Pat Heung Adit	Drive drill and blast tunnel south	Permanent	Pat Heung Ventilation Building and emergency access point
Shing Mun Shaft	Shaft construction	Permanent	Shing Mun Ventilation Building and emergency access point
Shek Yam Shaft and Adit	Drive drill and blast tunnel north and south	Temporary	Site will be reinstated and returned to the Government
Kwai Chung Adit	Drive drill and blast tunnel north and south	Permanent	Kwai Chung Ventilation Building and emergency access point
Mei Lai Road Shaft	Retrieval of TBM	Temporary	The site will be reinstated and returned to the Government
Nam Cheong Shaft	Launching of TBM	Permanent	Nam Cheong Ventilation Building and emergency access point
Hoi Ting Road Shaft	Retrieval of TBM	Temporary	Part of the shaft will form permanent cut-and-cover tunnel
Mong Kok West Shaft	Construction of ventilation shaft	Permanent	Mong Kok West Ventilation Building and emergency access point

2.137 Shafts and ventilation buildings/EAPs will be typically constructed by cut-and-cover method, and the adits by drilling method. Diaphragm wall, sand drains, and struts as the temporary excavation and lateral support system will be involved during the construction of shaft. Casting of diaphragm wall, which is a continuous underground concrete wall, will be conducted before excavation works. This wall would largely limit groundwater entering into the excavation area, and therefore minimise the groundwater drawdown outside works boundary. Subsequent to the completion of diaphragm wall and sand drain installation, if necessary, a series of observation wells, pump wells and recharge wells will be installed prior to the commencement of excavation work for mitigating groundwater drawdown.

2.138 The Ventilation buildings for tunnel ventilation will be built on top of a shaft or adjacent to an adit which will be in use to support the tunnel construction. The buildings will be simple reinforced concrete structures with rooms to house the ventilation fans and support systems. The construction works will include the civil structure and all the Mechanical, Electrical & Plumbing (MEP) provisions. On completion of the structure and initial MEP provisions, the tunnel ventilation fans, communications systems, security and any other specialist systems required for the railway will be installed.

SSS and ERS

2.139 The SSS is an at-grade facility to the west of the ERS box. Preparation of the site will require a cut-and-fill exercise to level the site to around +14mPD. The northern part of the site will require some filling. The future buildings within SSS will be founded on piles or spread footings subject to the loadings and ground condition to be confirmed in detailed design stage.

2.140 The construction of the ERS together with the associated approach tunnels will adopt a conventional bottom up construction within permanent and temporary cofferdams. The ERS cofferdam will be formed by permanent diaphragm walls with lateral supports.

2.141 River training and culverting of the existing river on the west and east side of the facility will be required to prevent flooding. A new box culvert will also be established to the east of the ERS. Temporary river diversions will be conducted in sections and phases in order to complete the drainage system for the whole facility, for minimising water quality impact at the downstream.

2.142 The construction of roads and buildings are assumed to commence once the excavation of the ERS box has been completed, along with drainage and traction power facilities. A suitable formation will be prepared to allow the construction of the ballasted stabling tracks. The works will include drainage, ducting and the foundations for the overhead line masts.

Cross Passages Ground Treatment Works

2.143 As a safety requirement, cross passages (CP) between running tunnels would be provided. In the event of a fire in one of the tunnels, the non-incident tunnel will provide evacuation route and refuge for rail passengers.

2.144 Construction method of the CP will depend on the tunnel type and ground condition. CPs in rock tunnels are mostly in the form of a cross passage door across the dividing wall between the main tracks. For the CPs in soft or mixed ground conditions, stabilization works will be required to ensure the ground stability, the integrity of the tunnel and the safety of the workforce. An appropriate construction method would be selected for each CP in respect of particular ground conditions to avoid any potential impacts on environmental sensitive areas such as Mai Po Inner Deep Bay Ramsar Site, Country Parks, etc.

2.145 The CPs are at a nominal distance of 250m apart along the route length, there are about 100 cross passages will be formed along the 26km alignment.

Barging Points

2.146 It is anticipated that the excavation of the tunnels and associated structures will generate approximate 9.1 Mm^3 of spoil from all works areas. Six barging points have been proposed to transport the spoil generated from the Project to the Mainland or other locations for reuse/disposal, and an existing barging point at Pillar Point will be used for transport spoil to Mainland/public fill reception facilities. A summary of the proposed new barging points is presented in **Table 2.12**.

Table 2.12 Proposed New Barging Points

Barging Point	Location	No. of Ramp	Serving Area	Current Usage
BP1	West Kowloon	2 (new, same locations as adopted for KSL construction) 3 (new)	WKT	Nil
BP2	Nam Cheong	3 (new)	WKT, Nam Cheong and Mong Kok West	Public cargo handling
BP3	Rambler Channel	2 (new)	Kwai Chung, Mei Lai Road, Shek Yam and Shing Mun	Nil
BP4	Siu Lam	2 (new)	SSS and ERS	Nil
BP5	Lung Kwu Sheung Tan	2 (new)	Ngau Tam Mei, Tai Kong Po and Mai Po	Loading and unloading of construction materials

Barging Point	Location	No. of Ramp	Serving Area	Current Usage
BP6	Tsing Chau Tsai	2	Pak Heung and Shek Yam	Loading and unloading of construction materials

2.147 Cable stayed structure with a jig or similar method will be adopted for the construction of barging ramps where located close to sloping seawall at West Kowloon (BP1). A heavy spanning steel truss hung by cables will be used for the access of trucks to dump excavated material onto the barge. Since this area prevents barges from mooring against the sea wall, a pontoon will be kept such that barges can berth against it instead of against a guide pile allowing discharge of materials from the barging ramp. This construction method will be adopted to avoid disturbance of seabed and minimise potential impact on water quality induced by marine works.

2.148 Loading ramps will be constructed at other barging points. Enclosed tipping hall and wheel washing facility will be provided at each barging point to minimise the construction dust impact.

2.149 Minor dredging works will be required to form a berthing area in Lung Kwu Sheung Tan. The dredging depth would be 2m deep from the existing seabed level and a maximum dredging rate of about 2,000m^3/day is anticipated.

Nursery Area

2.150 Temporary nursery areas at Siu Lang Shui and So Kwun Wat will be provided for the transplanted trees at an early stage of construction to allow trees to grow during the construction period. Only minor works including erection of fencing and installation of irrigation pipes and surface drainage will be carried out in these areas.

Temporary Site Explosives Magazines

2.151 The construction of the Project will involve substantial amounts of bored tunnel excavation of which about 14km of tunnel section will be carried out by the drill and blast method.

2.152 It is estimated that blasting cycle times are either 12 or 16 hours and therefore over a two-day period there will be three or four blast cycles per face. Drill and blast tunnel excavation will be carried out from six work sites, three in the northern New Territories and the other three in urban Kowloon areas.

2.153 It is estimated that the required explosives storage are 800 kg and 1,200 kg for northern and southern areas respectively. The required minimum internal and external separation distances from the magazines should follow the requirements stated in UK “Manufacture and Storage of Explosives Regulations, 2005” published by the UK Health & Safety Executive, a document as specified by the Hong Kong Commissioner of Mines (CoM). In addition, it is preferable to limit the transportation distances as far as practicable when considering the possible location of magazine. This is also particularly pertinent given explosives are not permitted within road tunnels, and there would be a considerable distance of about 40 to 50km for explosives transported from northern New Territories to Kowloon via above ground or at grade roads, and vice versa.

2.154 With consideration of above factors, together with the limited daily delivery arrangement available from Mines Division of Civil Engineering and Development Department (CEDD), a list of potential locations for explosives magazine sites have been identified, reviewed and short-listed for further detailed study and discussion with Mines Division. The magazine site selection process is documented in Working Paper No. 13A – Explosives Magazine Site Selection.

2.155 Two project-specific site explosives magazines at Tai Shu Ha Road West and So Kwun Wat are selected as necessary to store the explosives (refer to **Appendix 13.1** – Quantitative Risk Assessment for details of explosive storage and delivery arrangement). A Quantitative Risk

Assessment (QRA) has been carried out to assess potential risks associated with the preferred site explosives magazines with details given in **Section 13** of this EIA study.

2.156 The magazines will be designed in compliance with the general requirements of Mines Division, as defined in their document "How to apply for a Mode A Explosives Store Licence".

2.157 The site formation works will include clearance of vegetation and slope works for both sites, and a stepped site formation profile will be constructed at So Kwun Wat. Both sites will be surfaced with hard standing and enclosed with security fences. Utility connections will be made to the local networks. The magazine structures will comprise brick built / reinforced concrete buildings on shallow foundations. Mounding around the buildings will be constructed, using sandbags or earth bank.

Construction Programme

2.158 The proposed construction dates are tentatively scheduled as shown in **Table 2.13**. The construction works would commence in December 2009 and the overall project completion is anticipated to be in 2015. A preliminary construction programme is presented in **Appendix 2.1**. The assessments in this report have been based on this construction programme.

Table 2.13 Tentative Civil Construction Works Schedule of Key Elements

Location	Tentative Commencement Date	Tentative Completion Date
Tunnel		
Mai Po to Boundary	August 2010	June 2015
Mai Po to Ngau Tam Mei	August 2010	December 2014
Ngau Tam Mei to Tai Kong Po	August 2010	December 2014
Tai Kong Po to Kam Tin	July 2010	December 2014
Kam Tin to Shek Yam	December 2009	December 2014
Shek Yam to Mei Lai Road	March 2010	July 2014
Mei Lai Road to Mong Kok West	December 2009	December 2014
Mong Kok West to WKT	December 2010	December 2014
Ventilation Building/Emergency Access Point		
Mai Po Ventilation Building	August 2010	December 2014
Ngau Tam Mei Ventilation Building	August 2010	December 2014
Tai Kong Po Emergency Access Point	December 2009	December 2014
Pat Heung Ventilation Building	June 2010	November 2014
Shing Mun Ventilation Building	May 2010	June 2014
Kwai Chung Ventilation Building	May 2010	July 2014
Nam Cheong Ventilation Building	May 2013	December 2014
Mong Kok West Ventilation Building	May 2010	June 2014
Other Facilities		
Shek Kong Stabling Sidings and	July 2010	December 2014

Location	Tentative Commencement Date	Tentative Completion Date
Emergency Rescue Station		
West Kowloon Terminus	December 2009	December 2014

Concurrent Projects

2.159 There are several major concurrent designated projects in the vicinity of the Project's works areas, as summarised in **Table 2.14**. At this stage, consideration of concurrent projects for cumulative environmental impacts will only take into account those with available implementation programmes. Cumulative impacts from the planned and existing major concurrent projects, if any, have been assessed in the individual sections of this EIA study.

Table 2.14 Major Concurrent Projects

Project	Planned Construction Period
Proposed Comprehensive Development at Wo Shang Wai, Yuen Long	2008 to 2012 (1)
Central Kowloon Route (CKR)	2012 to 2016 (2)
West Kowloon Cultural District (WKCD)	2013 to 2016 (3)
Road Works at West Kowloon	2012 to 2014
Construction of Cycle Tracks and the associated Supporting Facilities from Sha Po Tsuen to Shek Sheung River	Mid 2009 to Early 2012
Upgrading of Remaining Sections of Kam Tin Road and Lam Kam Road	2011 to 2016
Yuen Long & Kam Tin Sewerage and Sewage Disposal	2009 to 2013

(1) Section 16 Planning application was submitted in 2008 and approved by TPB on 19 September 2008. Details of the latest construction programme are not available yet during the preparation of the EIA study. As advised by the Developer, the earliest construction works for Wetland Restoration Area would commence in 2010 wet season, and therefore the construction of the comprehensive development is assumed to commence in early 2010.
(2) Details of construction programme and design of CKR are not available during the course of EIA study. Cumulative impact from the construction and operation of CKR could not be evaluated during the course of EIA study.
(3) Details of construction programme and design of WKCD are not available during the course of EIA study. Cumulative impact from the construction and operation of WKCD could not be evaluated during the course of EIA study.

Continuous Public Involvement

2.160 Considering the importance of views and support of the community in the development of railways, a public consultation programme was launched by the Project Proponent in conjunction with the preliminary design which commenced in May 2008 to consult public on the railway scheme to design the railway scheme will best suit the needs of the community. The public consultation programme consists of two rounds which commenced in May and September 2008 respectively with respective district councils and rural committees, also the gazette of the railway scheme on 28 November and 5 December 2008, and a series of roving exhibitions and briefings to the residents along the alignment.

2.161 First round of public consultation was conducted from May to July 2008 with the relevant District Councils (DCs) / Rural Committees (RCs) as listed below:

- Sham Shui Po District Council
- Yuen Long District Council
- Yau Tsim Mong District Council
- Sha Tin District Council - Traffic and Transport Committee
- Tsuen Wan District Council - Traffic and Transport Committee
- Kwai Tsing District Council
- Kam Tin Rural Committee

- Pat Heung Rural Committee
- San Tin Rural Committee

2.162 After the commencement of Preliminary Design Study, further information such as alignment, ventilation buildings and works areas were provided in the second round of public consultation from September to November 2008 with the relevant District Councils/Rural Committees as listed below:

- Kwai Tsing District Council
- Sham Shui Po District Council
- Tsuen Wan District Council
- Yau Tsim Mong District Council - Traffic and Transport Committee
- Yuen Long District Council
- Sha Tin District Council - Traffic and Transport Committee
- San Tin Rural Committee
- Kam Tin Rural Committee
- Pat Heung Rural Committee

2.163 A total of 33 and 29 meetings/consultations were conducted with DCs/RCs and local residents respectively, since the planning stage of the Project. The public was generally supported the development of the Project and their views/concerns were also considered in the preliminary design stage and will also be considered/addressed in detailed design stage.

2.164 In addition to the above-mentioned meetings/consultation, the gazette conducted in end 2008 also gathered the views from the public on the Project as well as the views from the residents along the alignment from the resident briefings.

2.165 Non-Government Organizations (NGOs) have also been engaged in the EIA process, as early as the PPFS stage. In February 2007 a meeting was held with NGOs to solicit their views and identify potential key environmental issues of the Project, for consideration in the development and evaluation of alignment options.

2.166 After selection of the preferred alignment, a further meeting with NGOs was conducted in October 2008, to introduce the alignment and latest progress of the Project. A follow-up site visit was conducted in December 2008 to the key works areas in the northern area, particularly the SSS site with potential ecological issues. Based on the completed ecological surveys, a workshop was conducted in early February 2009 to brief NGOs on the key findings, focusing on ecological mitigation measures for the SSS site. A number of their recommendations have been beneficial to the development of the current design.

2.167 A summary of major environmental concerns from the community and responses from Project Proponent is presented in **Table 2.15**.

Table 2.15 Major Environmental Concerns/Views

Concerned Parties	Major Environmental Concerns/Views	Responses and EIA Findings
Public/Resident along the alignment	Concern on noise impact due to above-ground construction works	During the course of developing the construction plants and programme, key features, including minimization of construction plants, works in phases and avoidance of simultaneous operation of construction plants, have been considered as far as practicable to alleviate the construction noise impacts. Noise sensitive receivers (NSRs) that would be affected by the construction noise were identified. The construction noise levels at the representative sensitive receivers have

Concerned Parties	Major Environmental Concerns/Views	Responses and EIA Findings
		been predicted. Without implementation of mitigation measures, noise exceedances at some NSRs are envisaged. As such, practicable and feasible mitigation measures have been explored to minimize the construction noise impact. Mitigation measures are recommended though several NSRs would be subject to noise levels exceeding the noise criteria as a result of mitigation measures exhausted. Community liaison and an Environmental Monitoring and Audit (EM&A) will be conducted to monitor and minimize the noise impact to the NSRs during the construction phase.
	Concern on dust impact due to the construction works	Major dust impact would arise from surface ground works, concrete batching plant, temporary stockpiles on site and barging activities. With the recommended mitigation measures, the dust levels at the air sensitive receivers (ASRs) would comply with the criteria of EIAO-TM and Air Quality Objective (AQO). An Environmental Monitoring and Audit (EM&A) will be conducted to monitor and minimize the dust impact to the ASRs during the construction phase.
	Concern on ground-borne noise impact due to tunneling works	The potential source of ground-borne noise impact is the operation of tunnel boring machine (TBM). Assessment has been conducted to evaluate the ground-borne noise impact at the NSRs and the results, with the inclusion of safety factor, indicated that there would be noise exceedances for about 2-3 days at only four representative NSRs. Monitoring at the time of TBM operation will be conducted to confirm the assessment findings and monitor the ground-borne noise impact at the NSRs. In addition, An EM&A programme, together with careful scheduling of the works and close liaison with the affected parties will be conducted to minimize the noise impact.
	Concern on ground water drawdown during construction	The tunnel sections will be constructed with either “drained” lining (i.e. water pressure relieve system is provided), or “undrained” lining (i.e. with fully tanked linings). Both linings would prevent the groundwater leakage into the tunnel, and therefore there would be insignificant ground water drawdown during the tunneling works. Past experience also indicated that impact on ground water drawdown was not encountered during the tunneling works. A well designed and managed groundwater monitoring programme will be developed to monitor the groundwater levels. Sufficient pre-construction monitoring will also be undertaken such that baseline groundwater levels can be established and any seasonal (or other) variations in groundwater level identified.
	Concern on ground-borne noise impact during operation	The railway tunnel will be located at levels of at least 20m below local ground, except a small section to the north of ERS. Assessment has been conducted to predict the ground-borne noise levels at the NSRs on top of/close to the tunnels. Results indicated that the ground-borne noise levels would comply with the stipulated noise criteria. Low noise trackform will however be installed at the selected

Concerned Parties	Major Environmental Concerns/Views	Responses and EIA Findings
		alignment sections to further minimise the impact. A commissioning test will be conducted to monitor the ground-borne noise levels at the selected NSRs.
	Concern on air and noise pollutions from ventilation buildings	As XRL trains are electrically powered, and so there would not be any emission from fossil fuel generated from the trains. As such, there would be no air pollutants exhausted from vent shafts and no air quality impact is envisaged. Prevailing background noise measurements have been conducted to establish the fixed plant noise criteria. Maximum sound power levels have been assigned for each vent shaft to control the potential noise impact from the ventilation buildings.
Green Groups	Concern on the potential hydrogeological impact during construction	As discussed above, past experience indicated that impact on ground water drawdown was not encountered during the tunneling works. There would be insignificant ground water drawdown during the tunneling works and thus hydrological disruption is not anticipated. In fact, changes in the water table will be insignificant as compared with natural fluctuations due to the rainfall patterns. Ground water monitoring during construction phase will be conducted to monitor the ground water level.
	Concern on the potential ecological impact associated with building structures in Mai Po	The size of each ventilation building has been minimised during the detailed design stage to avoid and minimise any visual and ecological impact.