# Ecological Considerations for Guangzhou-Shenzhen-Hong Kong Express Rail Link

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## Abstract

The 142 km Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) will provide the strategic linkage from Hong Kong to the comprehensive high-speed rail network in Mainland China. This will significantly increase integration of cities, and promote business and tourism towards a greener economy. An Environmental Impact Assessment (EIA) was conducted to support the sustainable planning and design of the Hong Kong Section of the XRL, approximately 26km long. This paper shares the experiences of the EIA, focusing on the ecological aspect, a major issue as the railway corridor transverses significant conservation areas such as a RAMSAR Site and Country Parks. The project is under a fast-tracked programme, and ecological surveys and impact assessments were conducted in advance of other components of the EIA, to provide earliest inputs to Value Engineering Workshops for alternative alignment options development and evaluation. Green groups were continuously engaged in the EIA process, and participated in the development of sustainable ecological protection design. The robust ecological impact assessment was successfully used to address public concerns and demonstrated the adoption of an optimized project scheme with minimal potential impacts to the environment.

## Introduction

This paper shares the experiences of an EIA for a major railway link, focusing on the ecological aspect, a key issue as the route corridor transverses significant conservation areas. The EIA was conducted to support the sustainable planning and design of the Hong Kong Section of the 142 km Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL). This strategic linkage from Hong Kong to the comprehensive high-speed rail network in Mainland China will significantly increase integration of cities, and promote business and tourism towards a greener economy.

## The XRL Project

The China State Council approved the "Medium to Long Term Railway Network Plan" in 2004, kicking off the move to construct a 16,000km long high-speed passenger rail network, with train operation speed up to 350 km/h. Upon completion of the network, high-speed rail services will cover most major cities of China.

The Hong Kong section of the XRL (the Project) is a 26 km long underground railway running from West Kowloon to boundary at Shenzhen, Mainland China (see **Figure 1**). The terminus will be located in West Kowloon where is located in the vicinity of commercial and tourist areas, next to the planned West Kowloon Cultural District in the waterfront.

The Project is of strategic importance to Hong Kong as it will connect to the Mainland's 16,000 km of high-speed railway network, thus enhancing the accessibility between Hong Kong and various major cities of the Mainland. The XRL will shorten significantly the journey time between Hong Kong and the Pearl River Delta (PRD) region, promoting Hong Kong as the southern gateway to the Mainland of China. This will 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. Overall the XRL will allow Hong Kong to have better social and economic integration with cities in the PRD and other major cities in Mainland China.

In addition, high-speed rail travel is more energy-efficient and environmentally friendly than other forms of transport. The energy consumption per seat of a high-speed train is just one-sixth that of an airplane. High-speed rails also produce far less $CO_2$ emissions than airplanes and automobiles. Its carbon emission per seat is about one-tenth of an airplane.

In other words the XRL Project would be like having a domestic airport right in the heart of town that would offer a premium railway service (running at 100m per second) to the Mainland cities, but without the hassle of air travel. This also means access to cities south of Wuhan within a five hour radius is probably more efficient by high speed rail than by air. This customer base, counting the cities alone, boasts 80 million people.

## Consideration of Alternatives & Selection of the Project Scheme

A number of alternatives for the XRL Project were identified and evaluated through the Preliminary Project Feasibility Study, Preliminary Design and Detailed Design stages, from 2006 to 2009, with continuous environmental inputs to the process such as through Value Engineering Workshops. Significant environmental resources, e.g. Country Parks, Declared Monuments and historical buildings were identified at an early stage. Other factors studied include geographical and geological considerations, land resumption, site constraints, constructability, operation flexibility and maintainability and disruption to the community.

**Table 1** below shows examples of criteria adopted for the consideration of alignment options.

| **Criteria** | **Description** |
|---|---|
| *Engineering Factors* | |
| Operations Safety, Flexibility and Maintainability | • Ease of fire fighting and evacuation<br>• Flexibility for stabling requirement |
| Constructability | • Avoidance/minimisation of constructing soft ground tunnel due to safety and building settlement issues<br>• Avoidance/minimisation on construction risks due to uncertain ground condition and long tunnel |
| Land Acquisition | Minimisation of affected areas to minimise impact to local communities |
| Implementation Programme | Minimisation of construction period. Shorter construction period would be preferable as it could minimise disruption period to the 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<br>• Airborne and ground-borne noise impact associated with the trains pass-bys<br>• Landscape and visual impact associated with the above-ground structures; and impact on any significant landscape and heritage resources<br>• Indirect impact (e.g. vibration impact) on historical buildings<br>• Direct impact on graded buildings and known Archaeological Sites |
| *Other Factors* | |
| Avoidance/Minimisation of Issues/Constraints | • Minimisation of project areas encroaching into developed area<br>• Minimisation of interface issues with other projects |
| Disruption to the Community | • Minimisation of impact to local communities including residential households<br>• Minimisation of structural impact on the buildings along the alignment<br>• Minimisation of impact to business operations |

The selected XRL alignment scheme is a feasible design solution offering clear benefits in terms of operations, environment, construction and land related issues. As shown in **Figure 1**, the Project mainly comprises: 26km of underground railway, West Kowloon Terminus, tunnel ventilation buildings (VB) and emergency access point (EAP), Shek Kong Stabling Sidings (SSS) and Emergency Rescue Siding (ERS). The construction commenced in early 2010 and due for completion in 2015.


## Ecological Impact Assessment

The railway project is a Designated Project under the EIA Ordinance (EIAO) including works partly or wholly in country parks or conservation areas. An EIA study was conducted from 2008 to 2009, as an integrated part of comprehensive planning and design studies for the Project, following the EIA Ordinance Study Brief No. ESB-197/2008 and the assessment methodologies and criteria in the Technical Memorandum on Environmental Impact Assessment (EIAO-TM). The assessment evaluated potential environmental impacts of the Project during the construction and operational stages, and recommended mitigation measures to ensure compliance with statutory requirements.

Ecology was a key issue as the railway corridor transverses significant conservation areas. Comprehensive ecological surveys and detailed impact assessments were conducted in advance of other components of the EIA between 2006 and 2007, to provide earliest inputs to alternative alignment and construction options development and evaluation (see examples in **Table 2**). No-dig zones for above-ground works were identified, including in the Mai Po Inner Deep Bay Ramsar Site, Deep Bay Wetland Conservation Area (WCA) and Country Parks.

There was also public concern about potential groundwater drawdown. Proven tunnelling methods were adopted to avoid unacceptable groundwater drawdown, with monitoring and contingency measures in place.

Through underground tunnelling construction methods, above-ground works were minimized and restricted to areas with generally low ecological value. The subsequent potential ecological impacts from the Project scheme were expected to be low.

**Table 2 Examples of Ecological Considerations**

| Above-ground Works Area | Necessity of Proposed Works | Ecological Considerations in Site Selection, Engineering Design and Construction Method |
|---|---|---|
| Mai Po VB (MPV) | The ventilation buildings will serve two main purposes: (1) provide the essential fresh air and extraction of smoke in the cases of fire, (2) provide essential access for firemen to carry out fire fighting and to evacuate trapped passengers.<br><br>Ventilation building sites provide the essential construction access | *Avoid Ecologically Sensitive Areas*<br>Avoid direct impact to WCA, Mai Po Inner Deep Bay Ramsar Site, Mai Po Village Site of Special Scientific Interest (SSSI), Mai Po Village Egretry, and Conservation Area (CA) in the vicinity.<br><br>*Avoid Natural Habitats*<br>The proposed MPV is selected to be constructed in a currently highly disturbed area occupied by open car storage / garage located in the WBA zone. The |

| Above-ground Works Area | Necessity of Proposed Works | Ecological Considerations in Site Selection, Engineering Design and Construction Method |
|---|---|---|
| | for the tunnel contractors during construction. It is thus logical to combine works areas with the ventilation building sites. Indeed this arrangement would minimize impact to the environment and nearby residents as construction traffic could be kept to the minimum.<br><br>For the safety of passengers ventilation buildings have to be located at intervals of no greater than 4.1 km along the tunnel alignment. The MPV site is virtually the only one available in that area which meets the ventilation and fire safety requirement. | proposed MPV also avoided Mai Po fishponds in the north and developed private land in the south.<br><br>*Minimize Height of Aboveground Structures*<br>The height of the MPV is determined by the functional and operational requirements of the ventilation building. To minimize impact to the bird flight path, 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. Furthermore according to Fire Services Department (FSD) regulations the ventilation louvres have to be located at least 5 m aboveground. These are the controlling factors that determine the height of the MPV. Any further reduction is not feasible. |
| ERS / SSS | Stabling sidings and a first-line maintenance facility will be located at Shek Kong Stabling Sidings (SSS) to provide stabling, maintenance and cleaning activities. An emergency rescue siding (ERS) will be located next to Shek Kong Stabling Sidings for emergency evacuation of passengers and access by emergency personnel.<br><br>With sufficient length of the alignment between the toe of Tai Mo Shan to Shek Kong, the railway 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.<br><br>In addition, the site located next to Shek Kong Barracks is large flat land with relative low terrain, this site is suitable for developing stabling sidings and emergency rescue siding. | *Avoid Ecologically Sensitive Areas*<br>Avoid direct impact to the adjacent conservation areas (CA) and Tai Lam Country Park in the vicinity. During site selection, the following recourses in alternative alignment options have been considered and avoided, such as a natural ecologically important stream (EIS) at Cheung Po, wooded areas in CAs near Tai Wo, Chuk Hang and Lam Tsuen Country Park, a bat roosting site east of Pat Heung Maintenance Centre, a Fung Shui Wood of high ecological values near Pat Heung Temple, and the Ha Che Egretry stream habitats.<br><br>*Avoid Impact to Ecologically Important Habitats*<br>Current land uses on the proposed site are mainly wasteland or developed land, eg. scrap yard, car parks and vehicle repair shops. Provision of stabling sidings at Shek Kong would minimize impact to the environment and public, as compared with other options.<br><br>*Minimize Land Take*<br>The layout has been designed to minimize the site area to 20 ha, with the ERS has combined with SSS to minimize the works areas by sharing the building maintenance resources. |
| Flood Protection Works in ERS / SSS | The SSS / ERS site falls within Drainage Basin 9 of Yuen Long, Kam Tin, Ngau Tam Mei and Tin Shui Wai Drainage Master Plan Study (DMP). A box culvert along the eastern edge of the SSS is proposed to take a 200 year storm.<br><br>With the implementation of this drainage system the current flooding problem at the existing SSS / ERS site and adjacent area would be eased. | *Bypass Channel*<br>Extensive channelization avoided by installation of a bypass channel at the eastern edge of the SSS / ERS site. Lesser storm will be carried by the widened existing channel and box culvert along the western edge.<br><br>*Maintain Existing Stream Flow*<br>Stream flow could be maintained along the drainage channel throughout the year.<br><br>*Compensatory Stream Habitat*<br>Ecological friendly stream habitats (such as natural stream bed substrate, vegetated stream bank, and gentle bank gradient) will be provided in the widened channel section for wildlife use. |

| Above-ground Works Area | Necessity of Proposed Works | Ecological Considerations in Site Selection, Engineering Design and Construction Method |
|---|---|---|
| | | |

## Continuous Public Engagement

The views and the support of the community were important to the project. Extensive public engagement process was conducted throughout the project implementation including the transparent EIAO platform for the public exhibition of the Project Profile, EIA Reports and a series of roving exhibitions, where public could provide their comments. Members of the public could view the document on the Environmental Protection Department's (EPD) website as well as through the EIA Registry. During the period, only 53 sets of written comments were received from the public. This small number for such a major strategic project crossing a number of districts reflected on the high quality of the report and these comments have been addressed satisfactorily to meet the EIAO requirements.

Non-Government Organizations (NGOs) were engaged in the EIA process, from as early as the PPFS stage in 2007, in seven rounds such as in the development and evaluation of project design options, ecological surveys and ecological protection design.

## EIA Approval

The EIA Report was reviewed by the Advisory Council on the Environment and approved by the EPD in September 2009. Based on the report, a number of conditions are set in the Environmental Permit granted to the Project, including a comprehensive environmental monitoring and audit programme.

Community liaison groups will be formed to provide a platform for affected residents and organizations for direct communication, with hotlines established for public inquiries. Monthly environmental monitoring and audit reports will also be posted on the Project website.

## Conclusion

The experiences of the EIA study for the XRL Project in Hong Kong were described in this paper, focusing on the key issue of ecological considerations. Good practices are demonstrated in the EIA process which is an integral part to support the sustainable planning and design of the high-speed railway project, towards a greener economy.

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