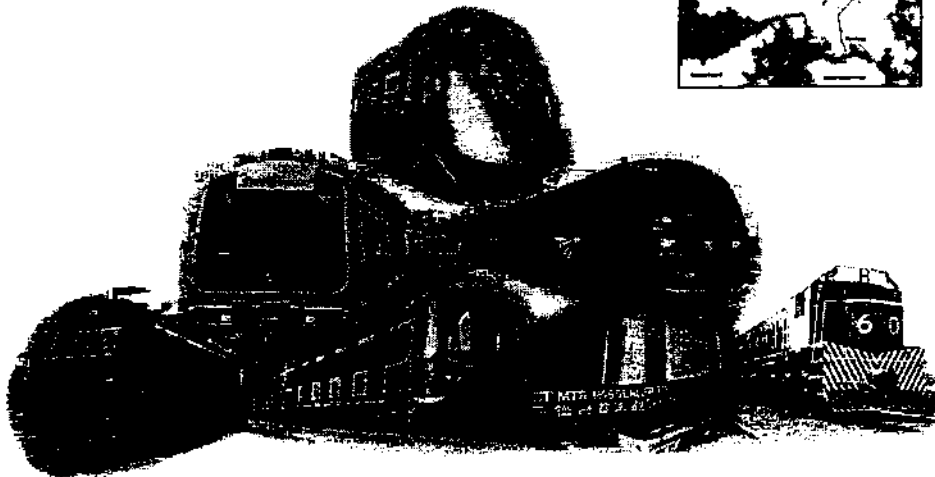
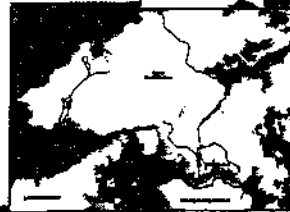
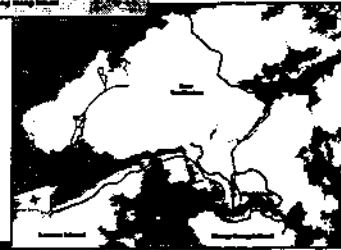
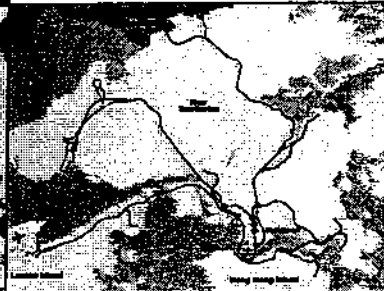
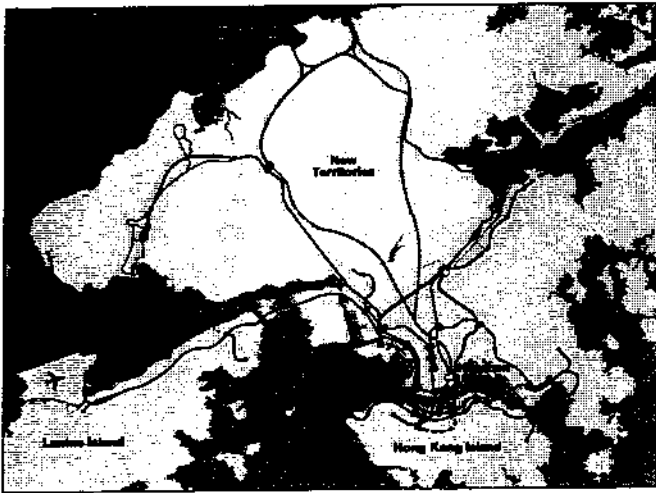


## Network Option Assessment



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## 5. NETWORK OPTION ASSESSMENT

### 5.1 Background

- 5.1.1 During Stage 1 of the RDS-2 Study, the NDS Team determined the initial comprehensive network, essentially the identification of all possible railway route configurations across the HKSAR. This network was reviewed over a range of issues including engineering feasibility, transport planning, financial viability, planning and environment, leading to the selection of a 'preferred' network development option.
- 5.1.2 As detailed in Chapter 3, the environmental input to the review process comprised the preparation of the Initial Evaluation Report (IER). The IER compared the initial comprehensive network against the environmental resources protected by statute which were considered as "absolute constraints" for the proposed new railway developments. The execution of this 'sieving' exercise at the early stages of the SEA ensured that none of the remaining corridors would result in any direct conflict with key (statutorily protected) strategic environmental resources.
- 5.1.3 In order to bring the Top Down and Bottom Up approaches together, the Consultants together with RDO devised a series of "Network Strategies" which identified the "common component" schemes from the original initial comprehensive network. These component schemes were designed with the key aims of providing relief to the congested parts of the network, promoting development areas and serving future demands within the HKSAR and across the Boundary with the Mainland.
- 5.1.4 The role of the SEA within the second stage of the NDS was to examine the environmental implications of the proposed Network Strategies in terms of the mapped environmental constraints and key issues arising from previous SEA deliverables and discussions, and to provide a review of their environmental performance in order to determine an environmentally-preferred network development option. The findings of the network assessment were presented in *Discussion Paper E11: Interim Assessment - Network Options Evaluation (NOEP)*. The NOEP drew upon information presented in the IER as well as the additional baseline information (see Section 5.4), in forming a view on the environmental acceptability of the proposed rail development options.

### 5.2 Network Strategies

- 5.2.1 As indicated above, the focus of the NDS during Stage 2 was upon those schemes which were likely to be priority schemes for either network relief or were required as infrastructure in strategic development plans. In broad terms the NIL, FHC and TDL were considered as priority schemes for network relief, with the EKL and Kowloon Southern Loop (KSL) required in conjunction with strategic development.
- 5.2.2 Stage 2 focussed upon the timing of implementing the priority schemes and the ways in which they could be built up from the existing/committed network. This phasing was initially built around three options for the FHC, however, a fourth alternative was included for network testing purposes during the later stages of Stage 2. This fourth alternative was not evaluated from an environmental perspective, however, it comprised basically the same component schemes and as such, the findings from the evaluation of the three main options remained valid.

- 5.2.3 The four FHC configurations that were considered by the main study were:
- East Rail as FHC to EXH/ADM
  - EKL as FHC to EXH/ADM
  - East Rail as FHC to VIP/Central
  - EKL as FHC to VIP/Central
- 5.2.4 The initial work on the phasing studies was carried out using the latest available CTS-3 assumptions including:
- a revised economic forecast, incorporating the effects of the economic downturn;
  - the latest available CTS-3 highway networks (February 1999), including one for 2016;
  - non-integrated fares for railways; and
  - revision to bus route assumptions to reflect the latest round of tendered services.
- 5.2.5 The original planning datasets were retained with full reclamation still assumed and full port development on Lantau.
- 5.2.6 The key conclusions from the main RDS-2 Study in relation to this work were that the most urgent schemes were the FHC and the NIL, and that these would be needed around 2011. The need for the EKL and TDL was seen as being development-dependent, whilst the patronage forecasts indicated that the KSL would be needed in the longer term, and that the WIL and OWC were only likely to be viable if supported by significant development.
- 5.2.7 In terms of overall network performance, the tests showed there was little to choose between the rail development options with each providing effective relief to the most congested parts of the existing/committed rail network. The VIP options generally had a slightly poorer network performance but this was offset by the potential offered by opening up of a new corridor (between VIP and Central) on Hong Kong Island.
- 5.2.8 Subsequent work was undertaken by the main NDS study during Stage 2 in order to define the networks which would be used to assess the financial and economic aspects of the schemes. Prior to this final round of patronage forecasts, the input assumptions were once again updated to take into account the latest CTS-3 findings and assumptions on land use data. The main changes of assumptions which set the context for the forecast were as follows:
- Planning data was revised with the consequence that development on harbour reclamations was dramatically reduced, with increases, particularly of population, in the New Territories and Outlying Islands; the planning data also included the theme park development on North Lantau.
  - The car fleet growth assumptions were revised in line with lower growth projections from CTS-3.
  - The latest Cross Boundary forecasts were adopted based on recent trends of increased demands.

- The latest CTS-3 highway assumptions were incorporated.
- 5.2.9 The four rail development options were re-run under the new assumptions. This work confirmed that the NIL and FHC should be the first schemes implemented, and that they should be in place around 2011. However, with the revised planning data reflecting intensified development in the NENT, increased pressure on the East Rail Beacon Hill tunnel link brought forward the need for the TDL. The EKL was still regarded as development-dependent, whilst the KSL would not be required until the TCL started to reach capacity, in around 2016.
- 5.2.10 Of the longer term schemes, the uncertainty over the Green Island development underlined the need for the WIL only once such plans were fixed. For the SIL, there was little change from the original planning data, and so the scheme still required significant additional development to make it viable.
- 5.2.11 The NOL scheme benefited from the changes to the planning data and increased Cross Boundary flows. The preferred scheme linked KSR to the committed Lok Ma Chau Spur Line and the East Rail, and passed through the proposed SGA's at Au Tau and Nau Tam Mei. A possible future SGA at San Tin is also served by the alignment.
- 5.2.12 All four rail development options identified above were carried forward into Stage 3.

### 5.3 Network Development Options

- 5.3.1 The role of the SEA during Stage 2 was to examine the environmental implications of the proposed railway network development options and to review their environmental performance such that information on any environmentally preferred rail development option could be used by the main RDS-2 team members.
- 5.3.2 Information resulting from the SEA was used by the main study team to assist in the development of the domestic network options. At the time of undertaking the Stage 2 component of the SEA, three domestic network options had been identified by the NDS, each of which included component schemes which had been 'screened' to ensure the avoidance of all environmental resources identified as constituting absolute environmental constraints. Consequently, environmental factors had already played a role in the development of these options. Details of the three options that were assessed are given below.
- 5.3.3 It was determined in the NDS that the key components of the initial comprehensive network remaining after Stage 1 could be configured in a number of different ways resulting in three network options (two centred around an East Rail extension to form the Fourth Harbour Crossing and one around an East Kowloon Line crossing the harbour). Whilst the three options assessed by the SEA essentially comprised the same common components, the timing of the implementation of the individual schemes varied between each of the options. For the purposes of Stage 2 of the study, the implementation of the component schemes within the three rail development options was divided into the following four periods:
- 2001-2006;
  - 2006-2011;
  - 2011-2016; and
  - post-2016.

5.3.4 By 2016, each of the Strategies was assumed to contain the same common components, though they may have been served by different railway operators and linked together in different ways. The component schemes comprised:

- Fourth Harbour Crossing (FHC) for which there were a number of options as discussed below;
- North Island Line (NIL) which linked Hong Kong Station (HOK) to North Point (NOP) and was intended to relieve the TWL and ISL and serve the Central and Wanchai reclamation areas;
- East Kowloon Line (EKL) which linked Hung Hom (HUH) to Diamond Hill (DIH) via Ho Man Tin (HMT), Ma Tau Wai (MTW), To Kwa Wan (TKW) and Kai Tak (KTA). This scheme was intended to serve the South East Kowloon Development area and relieve the EHC section of TKOL;
- Kowloon Southern Loop (KSL) which linked West rail to HUH. This scheme was intended to provide a direct link from the NWNT to the existing and new development areas in Kowloon, and improve rail access between the eastern and western parts of Kowloon;
- Tai Wai Diamond Hill Link (TDL) which was intended to provide relief for East Rail and the interchange at TAW, reduce congestion at Kowloon Tong, and improve access from NENT to eastern areas of Kowloon;
- West Hong Kong Island Line which was an extension of the Island Line (ISL) from Sheung Wan (SHW) to serve areas of Western and Kennedy Town and the new development areas on the Green Island Reclamation (should it proceed); and
- Outer Western Corridor (OWC) which was designed as both a relief scheme for West Rail and the TCL, and to permit further development in Lantau and the NWNT.

5.3.5 The main difference between the rail development options was the variation in the chosen alignment and operator of the proposed Fourth Harbour Crossing (FHC). The variants were as follows:

- Option 1 was built around the assumed extension of East Rail via the FHC, linking HUH to EXH and ADM. This was intended to provide a direct link for NENT passengers to Hong Kong Island, and relieve the congestion at Kowloon Tong station and along the Nathan Road corridor;
- Option 2 was built around the early implementation of the EKL, and involved extending it from HUH via the FHC to EXH and ADM. This option was intended to provide relief to the TWL and direct access to NENT commuters to the Kowloon Peninsula and Hong Kong Island; and
- Option 3 was built around East Rail as the FHC, but differed from Option 1 in respect of the alignment on Hong Kong Island; instead of EXH/ADM the FHC linked HUH to VIP and then continued to Central via stations at Leighton Hill and Wan Chai South. This alignment provides a direct harbour rail crossing to Causeway Bay and extends the railway network to a new corridor serving parts of Happy Valley and Wanchai South.

*Results of the Environmental Assessment of the Three Domestic Strategies*

- 5.3.6 The three proposed Network Strategies were assumed to be constructed and operated predominantly underground. For the purposes of the environmental assessment undertaken in the NOEP, it was also assumed that the rail components of each of the rail development options were to be developed within corridors which were gauged, on advice from the engineering Consultants, to be about 1 km in width.
- 5.3.7 The purpose of the NOEP was to review the environmental implications of the proposed three rail development options with the aim of identifying the scope of environmental disparity between them, if any, in order that a preferred rail development option could be concluded on environmental grounds. However, this did not prove possible to the extent envisaged in the Inception Report as the three rail development options alternatives comprised "common component" schemes and by definition therefore, were extremely similar both in terms of their components and, therefore, their environmental performance.
- 5.3.8 The vast majority of the options making up the three network Strategies were proposed to be operated within tunnels. This very greatly reduced the potential operational phase environmental impacts of the three Strategies since the potentially affected environmental resources were largely located on the surface.
- 5.3.9 The issues associated with the air quality benefits that may be accrued from the implementation of the rail development options in comparison to the equivalent provision of road-based alternatives were also evaluated and presented in the NOEP. A summary of the key findings is given below.
- 5.3.10 The NOEP reviewed the potential strategic environmental impacts expected to result from the implementation of the Network Strategies under the disciplines of operational noise, water quality, ecology, cultural and heritage and hazards. Due to the great similarity between the three Network Strategies, the review found that there were no significant differences between their comparative environmental performance. As such, the assessment related to the aforementioned disciplines could not provide recommendations in relation to a preferred strategy. Instead, due to the effective 'sieving' work that had been undertaken earlier in the study to avoid all resources identified as constituting absolute environmental constraints, the fact that the component schemes were predominantly underground providing effective operational phase mitigation, and combined with the level of assessment that was possible at this stage of the study given the assumptions related to corridor width etc., each of the domestic rail development options was considered as being equally environmentally preferred.
- 5.3.11 A comparison of the air quality "pollutant-effectiveness" of road and rail transport modes was undertaken based on historical (1997) data. It concluded that the average air quality and GHG emissions from road transport far outweighed those from rail, even when the indirect emissions from fossil fuel power stations are included in the latter case.
- 5.3.12 Closer scrutiny of the individual components of the average emissions revealed, in some cases, less disparity between the pollutant potential of the two modes. Overall, however, in strategic environmental terms, rail was shown unequivocally to be a less environmentally damaging form of mass transport.

- 5.3.13 As air quality benefits were determined as a being a key issue which distinguished the development of rail over other transport means, further consideration was given to this area of study, and an assessment was undertaken to ascertain the differing level of benefit that could be accrued from each of the proposed rail development options in comparison to road based alternatives.
- 5.3.14 The assessment and comparison of the air quality and GHG "benefits" which might be accrued from the individual rail development options was based upon the patronage captured by each of the rail development options. To determine the difference between road and rail, the patronage captured by the rail networks was assumed to be transported instead by road vehicles. Using Traffic Census data to determine appropriate vehicle types and occupancies, the numbers and thus emissions from those vehicles were calculated. These were then compared with the predictions of emissions for the Network Strategies and by subtraction, the "benefit" in emissions from transporting the numbers of passengers by rail instead of road was determined.
- 5.3.15 As expected, the results identified that road based emissions were greater than those of rail and that all three rail development options produced similar air quality savings. Earlier implementation of the East Kowloon Line increased the emissions savings and served to highlight the notion that for new railway proposals, demand-led network development may also result in an environmentally preferred rail development option.
- 5.3.16 It should be noted that the emission savings were calculated from a simply derived model which assumed that, where rail was assumed to be implemented subsequent to existing road infrastructure, the rail passenger projections resulted from an equivalent diversion from road based forms of transport. However, the results of the wider transport planning modelling exercise conducted for RDS-2, and incidentally supported by modelling in CTS-3, indicates that the existence of a more comprehensive rail network would not, on its own, facilitate such a 'like for like' diversion of road users to rail.
- 5.3.17 It is therefore concluded that much greater emissions savings could be achieved if measures complementary to the use of rail were adopted. These might include greater restraint on the use of private transport and the development of an integrated public transport system in which bus and minibus services were restructured to complement, rather than parallel and compete with rail services. This would have the dual effect of increasing further the patronage of rail services and also reducing the emissions being generated from road-based sources which have been shown to be more environmentally degrading. It is considered that these elements would form an important contribution to the achievement of better air quality conditions in Hong Kong.

#### **5.4 Collation of Baseline Information**

- 5.4.1 As part of the SEA, a Baseline Information Paper was prepared. The information was collected predominantly during Stages 1 and 2 of the Study. The data collected during Stage 1 was comprehensively mapped and used in the initial screening of the initial comprehensive network against the identified absolute environmental constraints; comprising those environmental resources that had been extended statutorily designated by the Administration and were therefore perceived to be of greatest environmental importance.

- 5.4.2 The baseline data collection and mapping exercises involved the identification of those environmental resources located within a baseline "envelope" of approximately 1 km width centred around the proposed new rail corridors (i.e. 500 m on either side of the proposed railway alignment). This approach was adopted because, at the time of undertaking the baseline assessment, the proposed rail routes were at a very provisional stage of development and subject to change. A width of 500 m was considered sufficient by the project engineers to ensure that, if the route was selected for further development, a final alignment would be development within this envelope and therefore any potential environmental conflicts should have been identified and , where practicable, avoided.
- 5.4.3 Discussion regarding the identification of the absolute environmental constraints and the 'sieving' of the initial comprehensive network against these resources is presented in Sections 4.7 and 4.8.
- 5.4.4 During Stage 2 of the Study, work was undertaken to build upon the earlier baseline information collection exercises. The following paragraphs provide information regarding this work and on the resources that were subsequently mapped.

#### *Air Quality*

- 5.4.5 A review of the principal legislation for the management of air quality was undertaken, providing an overview of the current statutory requirements and baseline conditions in the HKSAR.
- 5.4.6 The focus of the air quality baseline review concentrated on two of the seven main criteria pollutants - nitrogen oxides (NO<sub>x</sub>) and Respirable Suspended Particulates (RSP). NO<sub>x</sub> is widely acknowledged to be strongly influenced by emissions from the combustion of fuel; with both power stations and motor vehicles considered as dominant sources. Motor vehicles, in particular those using diesel, have been identified as a significant contributor to the total quantity of RSP emitted in urban areas.
- 5.4.7 An indication of Hong Kong's baseline air quality was obtained by reviewing data from the EPD's nine Air Quality Monitoring Stations, however, no physical mapping was undertaken.

#### *Operational Noise*

- 5.4.8 For operational railway noise, a review was undertake of the legislative controls, principals and assessment procedures that exist in Hong Kong. Whilst reference was made to the noise criteria that railways must achieve, no physical mapping was undertaken in relation to this subject area.

#### *Ecology*

- 5.4.9 As reported previously, a number of ecological resources were considered as absolute environmental constraints, and these resources were mapped to ensure that the railway developments did not impact upon them. The mapped resources comprised existing and proposed Marine Parks and Reserves, Ramsar site, fish culture zones, Site of Special Scientific Interest (SSSI), and existing and proposed Country Parks.



- 5.4.10 During Stage 2, reviews of a number of ecological studies were undertaken to obtain information on important (though not statutorily protected) ecological resources. Those resources that were found to be located within the assumed rail corridors were mapped (comprising fung shui woodlands and mangrove stands). The locations of the resources identified within the assumed rail corridors are shown in Annex D (Figures D1, D2, D3 and D4). Whilst not constituting absolute constraints to the development of the railways, these resources were considered to be ecologically important and therefore, where practicable, they should be avoided.
- 5.4.11 In addition, to the data collected from the review of ecological studies, the SEA Team used information on the categorisation of Hong Kong's ecological habitats (after WWF 1992). The categories of ecological habitat through which the proposed rail development corridors pass are shown in Annex D (Figure D8).

#### *Cultural and Heritage*

- 5.4.12 A review was undertaken of the relevant legislation, guidelines and conventions which form the basis of the conservation of the heritage and cultural resources in the HKSAR. As a result of this review, Declared Monuments were identified as absolute constraints and consequently those monuments that were within the baseline envelopes were identified and mapped at Stage 1.
- 5.4.13 During Stage 2, a further review was undertaken to verify and build upon the earlier collected data. As of the 1 January 2000, there were 67 sites which had been designated as declared monuments and 8 sites which had been designated as deemed monuments by the Antiques and Monuments Office (AMO). Those resources that were found to be within the assumed rail envelopes are shown in Annex D (Figures D1, D2, D3 and D4).

#### *Hazard*

- 5.4.14 Potentially Hazardous Installations (PHIs) were not considered to represent absolute environmental constraints and they were not therefore mapped during Stage 1. However, during stage 2, an exercise was conducted to identify and map those PHIs which were located within the assumed baseline envelopes.
- 5.4.15 The review found that the PHI register (1997) specified a total of 38 PHIs in Hong Kong. Each of these PHIs has an associated Consultation Zone, within which designated developments (i.e. railways) will need to be accompanied by a formal Hazard Assessment report which will be "vetted" by relevant Government departments before development may proceed.
- 5.4.16 In addition to the PHIs, a number of hazardous facilities or activities (including operating and closed landfills, Towngas HP pipeline routes and DG transport routes) were also considered to be of relevance to a strategic study and so were identified and mapped. The locations and consultation zones of these resources are shown in Annex D (Figures D1, D2, D3 and D4).

- 5.4.17 Whilst other sources of potential hazard exist (including chemical plants, aviation fuel pipelines, gas-fired power stations, explosives magazines, petrol filling stations etc.) these were considered to be of lesser importance and therefore they were not mapped. However, it is recommended that these resources are investigated and precisely located at a later stage of the rail development process (e.g. the EIA).
- 5.4.18 As railway developments are 'designated' under the EIAO the EPD may require a Hazard Assessment to be undertaken for any external hazardous facility or activity, where it is considered that loss of, or risk to human life is a key issue with respect to the Hong Kong Risk Guidelines.

#### *Landscape and Visual*

- 5.4.19 Landscape and visual resources were not considered to represent absolute environmental constraints, and they were not therefore mapped during Stage 1. However, during stage 2, a review of the relevant legislation and available baseline information relating to areas considered to be of high landscape and visual value was undertaken.
- 5.4.20 To date, no Territory-wide evaluation or classification of landscape resources has been undertaken and, as a consequence, the compilation of information initially drew upon landscape characteristic information that was presented in other studies (such as EIAs or other strategic planning and development studies. To supplement this data, information on areas of high landscape value was also obtained from a variety of other sources including the Planning Department, ongoing strategic planning studies and the Consultants own in-house EIA database.
- 5.4.21 Following consultation with the Planning Department, it was agreed that the a number of landuse zonings defined within the Town Planning Ordinance and under Outline Zoning Plans could be considered as having 'landscape value'. Hence, the following resources were mapped to assist the consideration and evaluation of landscape impacts:
- Country Parks;
  - SSSIs
  - Conservation Areas;
  - Green Belts and
  - Coastal Protection Areas.
- 5.4.22 Annex D (Figures D5, D6 and D7) presents the mapped information on the landscape sensitive resources.
- 5.4.23 From the mapping exercise it became clear that there was considerable overlap between these "landscape elements" and other elements identified during the baseline collection exercise. For example, the mapping of ecological resources (including woodlands, country parks and SSSIs) and cultural and heritage resources (including archaeological features and historic buildings and structures) has ensured that many areas of landscape value have already been identified and avoided by new railway proposals.