Highways Department - Western Harbour Link Office
路政署－西區海港連接路辦事處

Central Kowloon Route Study
中九龍幹線研究

Final Report
Environmental Assessment - Executive Summary
最終報告
環境評估　行政摘要

May 1993

Parsons Brinckerhoff Maunsell Consultants
in association with
MVA Asia · Shankland Cox · CES (Asia) · Chesterton Petty

Highways Department - Western Harbour Link Office
路政署 － 西區海港連接路辦事處

Central Kowloon Route Study
中九龍幹線研究

Final Report
最終報告

Environmental Assessment
環境評估

Executive Summary
行政摘要

May 1993
一九九三年五月

Parsons Brinckerhoff Maunsell Consultants
in association with
MVA Asia · Shankland Cox · CES (Asia) · Chesterton Petty

Cover Photograph by
Airphoto International Ltd

Central Kowloon Route Study

Final Report
Environmental Assessment - Executive Summary

CONTENTS

中九龍幹線研究

最終報告
環境評估－行政摘要

目錄

圖表

1 INTRODUCTION

1.1 Background

Improvements to increase traffic capacity on the East-West routes across Kowloon were proposed in The Second Comprehensive Transport Study (CTS-2), completed in 1989. Other studies, The Central Kowloon Traffic Study and the West Kowloon Reclamation Transport Study, concluded later that the additional East-West capacity would be required by 2001 even with the CTS-2 proposals in operation, particularly since major developments were envisaged by Metroplan in both West and East Kowloon. A new dual two lane urban trunk route, the Central Kowloon Route was proposed in the West Kowloon Reclamation Transport Study as an alternative to upgrading existing routes.

The Central Kowloon Route will connect the West Kowloon Expressway through the centre of Kowloon (in tunnel) to the planned North-South Highway in To Kwa Wan. The primary function of the Central Kowloon Route is to provide a trunk road across the centre of Kowloon and leave ground level roads to deal with the traffic within broad metro districts. The Central Kowloon Route will form a vital strategic link across Kowloon. The proposed alignment is shown in Figure 1. The construction programme is estimated to be approximately 4 years.

During the initial design stages of the project, the potential environmental impacts associated with the development of this major road scheme were considered to assist with decisions regarding selection of horizontal and vertical route alignment. Initial proposals were for an elevated road running from Kings Park to the Yau Ma Tei Interchange. However, in view of environmental and planning considerations, the decision was made to use cut-and-cover tunnel through West Kowloon. By selecting this route alignment and cut-and-cover tunnel design for the Central Kowloon Route, environmental impacts were minimised over the long term.

The option of an open road section through East Kowloon from Ma Ta Wai Road was also considered, but did not receive support from Government Departments. The eastern tunnel portal and toll plaza area will be located on the To Kwa Wan Reclamation.

1.2 Study Requirements

The Study Brief required the following objectives to be achieved:

* description of the proposed developments and related facilities for their development;

* identification and description of the elements of the community and environment likely to be affected by the proposed development;

* minimisation of pollution and nuisance arising from the development and its operation and environmental disturbance during construction and operation of the project;

* identification and evaluation of the net environmental impacts and cumulative effects expected to arise during the construction and operation of the development in relation to the existing and planned community and neighbouring land uses;

* identification of methods, measures and standards to be included in the design, which may be necessary to mitigate these impacts and reduce them to acceptable levels;

* recommendations for environmental monitoring and audit requirements necessary to ensure the effectiveness of the environmental protection measures adopted;

* identification of any additional studies which may be necessary to fulfil the objectives or requirements of this Environmental Assessment.

1.3 Environmental Legislation

The Air Pollution Control Ordinance provides powers for controlling air pollutants and defines a number of Air Quality Objectives (AQO). In relation to construction dust impacts, AQOs stipulate that the concentration of total suspended particulates (TSP) should not exceed 80 μgm^{-3} (annual average), 260 μgm^{-3} (24-hour average) and a non-statutory guideline of 500 μgm^{-3} (1-hour average) is also adopted. In relation to operational impacts, the critical pollutant is nitrogen dioxide (NO_2). AQOs stipulate that 80 μgm^{-3} (annual average), 150 μgm^{-3} (24-hour average) and 300 μgm^{-3} (1-hour average) should not be exceeded.

The Noise Control Ordinance provides the statutory framework for noise control. The Noise Control Ordinance defines statutory limits which will apply to the construction of the Central Kowloon Route

Three technical memoranda are made under the Noise Control Ordinance. These define the technical means for the assessment of noise. Together, the Noise Control Ordinance and the technical memoranda provide a mechanism for assessing noise levels and the statutory power to control noise. Under the terms of the Noise Control Ordinance, construction activity is not restricted during the period 0700-1900 hours, but is restricted for the whole day, evening and night on Public Holidays and Sundays. The Environmental Protection Department has suggested a daytime construction noise limit of 75 dB(A) [$L_{eq\ (5\text{-}min)}$].

There are no statutory controls on traffic noise, but the Hong Kong Planning Standards & Guidelines state that the traffic noise level at the facade of residential building should not exceed 70 dB(A).

2 DESCRIPTION OF THE ROUTE ALIGNMENT

The Central Kowloon Route will connect in the west with the West Kowloon Expressway and the Reclamation Primary Distributor (Road P1). The eastern end will have connections with the North South Highway, To Kwa Wan/Hung Hom and new routes serving Kowloon Bay

Reclamation with a possible connection through to a long term route from Tseung Kwan O. The selected alignment runs elevated from the Yau Ma Tei Interchange dropping to the portal of the cut-and-cover tunnel to the west of the West Kowloon Corridor. This tunnel section will run under Tung Kun Street, joining the driven tunnel at Kings Park. The tunnel advances to Ko Shan Park where the route continues in cut-and-cover tunnel to emerge onto the To Kwa Wan Reclamation to the south of Hoi Sham Park. The toll plaza will be located here. The road then joins to the interchange with the North South Highway.

3 CONSTRUCTION IMPACTS, MITIGATION AND MONITORING

3.1 Air Quality

The greatest potential air quality impact during the construction of the Central Kowloon Route will result from dust emissions. A number of possible dust sources were identified including demolition of existing buildings, site preparation, excavations, wind erosion of works areas, material transfer to and from trucks and vehicle/plant movements on unpaved roads and over the works areas.

Dust impacts arising from construction work were estimated using computer dispersion modelling techniques and compared with the Air Quality Objectives and guideline criteria.

In West Kowloon, the guideline 1-hour average dust concentration of 500 μgm^{-3} may be exceeded at the Six Streets Redevelopment Scheme. However, long term meteorological data from the Royal Observatory show that conditions leading to potential exceedances will be rare. Also these conditions will not necessarily coincide with maximum levels of construction activity.

In East Kowloon the guideline concentration may be exceeded around the portal area if there are no controls on dust emissions, particularly from the concrete batcher. However, if reasonable controls are adopted, nuisance should be reduced significantly.

Demolition activities, a potential source of dust, will take from 2-3 months to complete. Quantification of demolition dust impacts was not undertaken because a suitable assessment methodology is not available. However, due to the confined nature of the area and the need to demolish blocks adjacent to structures that will remain, the demolition will have to be carefully controlled. Buildings will require comprehensive shrouding for safety reasons, which will have the benefit of significantly controlling dust emissions.

The construction of cut-and-cover tunnels and the toll plaza will also potentially create high levels of dust. It is recommended that mitigation measures such as watering of exposed surfaces, tarpaulin coverings, screening and enclosures are adopted where practical. These will be in the form of contract clauses for dust reduction, monitoring and audit.

3.2 Noise Impacts

The Central Kowloon Route will be constructed through the densely populated residential areas of west and east Kowloon. No percussive piling is required for the construction of this route. The main sources of existing noise in these areas are a combination of traffic and aircraft noise.

A background noise monitoring program was undertaken to determine the existing noise levels in the West and East Kowloon urban areas. The 5 minute L_{eq} was monitored at a number of locations. Results indicate that noise levels are around 80 dB(A) close to the major roads, and around 70 dB(A) in the urban areas not directly subject to traffic noise. Noise levels of around 60 dB(A) were measured at Ko Shan Theatre and on the To Kwa Wan Reclamation.

Demolition along the cut-and-cover tunnel corridor will last 2-3 months. Typically, the method used is to break the building from the top using a hydraulic breaker placed on the roof. Waste is then hauled off site for disposal. There may be use of occasional use of cutting equipment. Nuisance essentially occurs from operation of the hydraulic breakers, which have a Sound Power level up to 122 dB(A). Other demolition techniques are available, such as using hydraulic shears and grabs. These are available in Hong Kong, but their use is not widespread. The use of such equipment is recommended.

It is likely that buildings close to the construction area will experience nuisance due to the proximity of the construction plant. However, the activities move along the corridor length so residents should not be exposed to high noise levels for long periods of time.

Although there are no statutory controls on daytime construction noise, it is desirable to minimise the noise. The main bulk of the construction activity for the cut-and-cover tunnel will be conducted underneath the roof slab, so noise impacts will be effectively mitigated. Whilst the noise impacts will be relatively short-term, efforts should be made to reduce noise levels to the minimum practicable.

Techniques available for reducing noise from construction activities include the following; employment of silenced and supersilenced equipment, employment of quieter techniques (eg. shears and grabs for demolition), acoustic screening of individual plant items to reduce noise at source, acoustic screening of receivers from direct line of sight of construction activity and operational limitations imposed on the contractor in the form of contract clauses including a noise monitoring programme.

The three schools adjacent to the construction corridor in West Kowloon require special consideration. The original proposal was to reprovision the schools to a nearby site. However, this did not meet with the requirements of the Director of Education. A number of measures were identified to minimise impacts at the schools. It is proposed to schedule work during vacations where possible, and avoid work during examination periods. The Highways Department has indicated that acoustic insulation will be provided.

3.3 Water Quality Impacts

Within the immediate vicinity of the tunnel the main sensitive receiver is the marine water in Victoria Harbour.

During the construction phase site runoff could contain suspended solids. These can cause chemical, biological, physical and aesthetic impacts on marine water. These effects subsequently could lead to ecological impacts on marine fauna. The use of bentonite for tunnel support also presents potential impacts on water bodies because of loss through accidental spillage. However, good working practices should minimise this risk.

The key environmental issue in relation to water quality is the prevention of chemicals, sewage, and solids derived from excavation and fill materials from entering the harbour water via the drainage system. Precautions will be taken so no major spillages will occur. Large volumes of fuel, oil, paint and other chemicals used on the construction sites should be stored in properly secured containers, and kept within bunded areas. Uncontrolled discharge of waste water should be avoided. Effluent should be channelled to a public sewer. To minimise volume of solids from construction sites entering receiving water prior to and during the construction of paved surfaces, all the runoff from the sites including concrete batching plants should be channelled to a series of sediment traps or basins.

3.4 Solid Waste

The main wastes arising during construction include demolition waste, excavated waste from tunnel sections, employee domestic waste and maintenance and repair waste.

Building demolition waste typically consists of concrete (20%), reinforced concrete (33%), dirt/soil/mud (12%), rock/rubble (12%), ferrous metal (3.5%) and other miscellaneous components. Currently the only recycled material is ferrous scrap, usually in the form of reinforcements bars which has a secondary market in Hong Kong. There are no existing markets for other materials, or facilities for separation. The majority of the waste is landfilled. Environmental Protection Department has stated that it is expected that most construction waste, after sorting at source, will be disposed of at public dumps after full implementation of the Construction Waste Diversion Scheme.

There will also be a significant quantity of excavated fill or rock from construction of the tunnel sections. The section of driven tunnel, running from the Kings Park eastwards to Ko Shan Road Park, will give rise to approximately 300,000 m^3 of excavated rock. However, this should be considered a resource rather than a waste and may be utilised directly as land borrow material or further processed as aggregate. Recent attempts have been made to match the needs of contractors requiring fill and those seeking disposal locations, but these have proved problematic, particularly with respect to timing. It is likely that the material from the Central Kowloon Route driven tunnel will be disposed of in public dump sites.

A possible tunnel spoil disposal option is to use the material to form a small reclamation in Kowloon Bay as an advance reclamation to the Kowloon Bay Reclamation. The reclamation would be approximately 3 hectares. There are environmental benefits in terms of noise, because of the reduction in haul vehicles using local roads.

The shallower cut-and-cover tunnel sections will also give rise to a significant quantity of excavated material. This will comprise old reclamation fill of variable quality. Cut-and-cover construction technique involves excavation of the tunnel section with the area above the tunnel roof backfilled to ground level. Depending on the construction techniques, sections for the diaphragm walls may need to be excavated. The surplus fill excavated is estimated to be approximately 140,000 m^3. Depending on the quality of the excavated material, it may also be disposed of to public dump sites.

The quantities of maintenance and repair wastes generated are not likely to be significant, but may include potentially hazardous materials such as waste fuel, lubricants, or cleaning solvents. The contractor will be responsible for the disposal of hazardous materials and chemical waste and will also need to comply with the requirements of the Dangerous Goods Ordinance and the Chemical Waste Regulations (under the Waste Disposal Ordinance).

Control of littering by workforce should be promoted through better site management and adequate disposal facilities on site and this will facilitate the sorting/recycling of construction waste at source.

3.5 Visual Impact

There would be significant visual impact on the residents and users of the neighbouring buildings and streets from the loss of building, the excavation and engineering works and the reconstruction of the buildings. This impact would be limited to the construction period and no significant long term impact is anticipated once reconstruction is completed.

4 OPERATIONAL IMPACTS, MITIGATION AND MONITORING

4.1 Air Quality

The emission of pollutants from the vehicular tunnel through the tunnel portals and the tunnel vent shafts has been regarded as an environmental problem. An impact assessment was taken to identify the extent of impact to the surroundings and provide an air quality guideline for the future development of the reclamation areas at the two portals.

During the year 2011 peak hour it is predicted that approximately 60% of the vehicles using the Central Kowloon Route will be goods vehicles. The emission of nitrogen oxides, NOx, was determined to be the major issue for air pollutants when compared with carbon monoxide and particulate emissions.

Three exhaust vent shafts will be installed to discharge all the tunnel vitiated air to the ambient by vertical vent stacks. One vent stack will be located at each tunnel portal and the third one will be located at the Fat Kwong Street Temporary Housing Area near the middle of the tunnel.

Air dispersion modelling was carried out to predict the operational air quality impacts due to the vent stack emissions and the surface roads emission's at the two portal areas.

None of the identified permanent and non-permanent Air Sensitive Receptors on the existing land near the west and east portals nor near the Fat Kwong Street ventilation building will be exposed to pollutant concentrations exceeding the limit of the Hong Kong Air Quality Objectives (AQOs). Neither mitigation measures nor redevelopment restrictions are required in view of the operational air quality impacts.

The operational air quality impacts on the West Kowloon Reclamation near the west portal will be within the AQO acceptable levels. It is estimated the future development in the area will not be restricted by the air quality impact due to operation of the Central Kowloon Route.

Some areas within 20 metres of the main roads on the reclamation at the east portal will exceed the 1-hour NO_2 exposure limit. These areas will also be exposed to high noise levels from road vehicles, however, most of the areas near the east portal are within the acceptable AQO levels. The future development planning in the vicinity of the east portal, especially that in the South East Kowloon Development Statement, should take the air quality requirement into account.

The ventilation stacks should be designed higher than the surrounding structures within a 100 metre radius to avoid downwash. Downwash can cause pollutants to be concentrated on the ground from the stack vortex; this can be reduced by a higher discharge velocity. It is necessary to ensure that the height of the ventilation stack is aesthetically acceptable.

4.2 Noise

For most of its length, the Central Kowloon Route will be in tunnel and hence will have no adverse noise impacts on receivers. The use of cut-and-cover tunnels through West and East Kowloon virtually eliminates potential traffic noise nuisance in these areas. The potential problem areas are around the tunnel portals and approach roads to the west and east interchanges, where existing and planned receivers may be adversely affected by noise.

A background noise monitoring program was therefore undertaken as part of this study to measure noise levels on the To Kwa Wan reclamation. These levels were relatively low with $L_{eq\ (30\ min)}$ in the range 50-65 dB(A). In West Kowloon, however, noise levels at the future residential zoned area on the new reclamation will also be subject to noise from the major roads in the area, particularly Road D1, the Yau Ma Tei interchange and the West Kowloon Corridor. Background noise monitoring (as undertaken for the West Kowloon Corridor

Study), at the Yau Ma Tai Catholic Primary School showed that the day time $L_{eq\ (1\text{-hour})}$ was in the range 75-82 dB(A) and the $L_{(10\text{-peak hour})}$ was 87 dB(A). The West Kowloon Expressway Environmental Assessment indicated that areas of land to both the north and south of the interchange, between the West Kowloon Expressway and the West Kowloon Corridor, may be subject to facade noise levels above the Hong Kong Planning Standards & Guidelines guideline limit.

Predictions show that the Central Kowloon Route will have no noticeable impact on noise levels at the Six Streets Redevelopment Scheme in West Kowloon. The noise contribution from the Central Kowloon Route to the residential zoned area on the reclamation is, however, potentially in exceedance of the Hong Kong Planning Standards & Guidelines criterion (70 dB(A)), although only over a very small area and only at higher floor levels. This can therefore easily be mitigated through the use of non-sensitive buildings to protect future residents or through provision of a pervious road surface should this be considered necessary.

The assessment demonstrates that there should be no adverse noise impacts at sensitive receivers in East Kowloon, provided some mitigation is provided either in the form of a 5 metre high barrier north of the road, or pervious road surfacing. No indirect remedies such as provision of building insulation or air conditioning are anticipated.

Ventilation building noise is subject to the terms of the Noise Control Ordinance. Hence, there are noise criteria that must be met as a statutory requirement. The required criteria will form part of the specification for the design and construction of the facilities.

4.3 Water Quality

The quantity of pollutants present in Central Kowloon Route runoff will not be expected to be different from those found in any other urban runoff. The discharge of this runoff would be unlikely to produce any quantifiable adverse effects. The dangerous material generated from spillage from road traffic accidents would be anticipated to be infrequent, but is difficult to predict and assess. Its impact would depend on the quantity and composition of any spillage.

The key concern of minimising water quality impacts on marine water course in the operation phase would be the prevention of chemicals and suspended solids from escaping into the water. Sumps normally are installed as part of tunnel drainage system to collect water flowing from the tunnel.

4.4 Solid Waste

Solid waste generated during the operation of this facility is not considered significant.

4.5 Visual Impact

In the section between Yau Ma Tei at Nathan Road and Ko Shan Park, the proposed route would be in twin driven tunnels and would have no effect on the townscape or visual impact of the areas above. The only structure in this area would be the ventilation building sited at Fat Kwong Street. The design of the proposed ventilation building is largely dependant on the nature of the future residential development in the area and the future playing fields. It should be designed as an architectural feature to integrate it into the surrounding building form. At a more detailed stage, however, it would be important to consider the composition of the building elements and its appearance on the skyline.

The Ko Shan Park space should be reconstructed in its present layout of footpaths, seating areas and planting beds, with the use of some semi-mature trees to increase the immediate impact of the replacement planting, to compensate for those that would be lost. There should be no long term visual impact in the park area.

There will be views from the existing buildings to the north and west of the area of the tunnel portal and toll plaza, although the portal and plaza will be set well down below ground levels and seen against a backdrop of the reclamation development. Dense tree and shrub planting is proposed in the areas immediately around the new roads and on the embankments of the roads leading to and from the tunnel. This is required in order to screen future ground level views from the reclamation side, to break up the extent of the hard paved road space and to provide a suitable landscape setting for the road.

A temporary toll plaza sited to the north of the proposed route will cut across the corner of the existing Hoi Sham Park, requiring a small landscape strip and ornamental wall to be removed. These works will not affect the facilities within the park, but will have a significant visual impact on its users. It is proposed that the temporary plaza is bounded by a temporary decorative wall, which should effectively screen the whole of the plaza.

5 CONCLUSIONS

During the initial stages of the project, decisions concerning alignment and design considered environmental issues. The decision to use cut-and-cover tunnel through West Kowloon rather than an elevated road from Kings Park to the Yau Ma Tei interchange has facilitated environmental planning. This alignment will have greater short term impacts during the construction phase but in the long term the Central Kowloon Route will not cause environmental impacts or planning blight in West Kowloon.

The long term environmental impacts from the Central Kowloon Route can be mitigated to avoid adverse consequences. The main impacts of dust and noise levels occurring during construction will require mitigation.

In West and East Kowloon, there could be high levels of dust generated, with some residential properties subject to occasional exceedances of the recommended limit. However, these occurrences will be rare and can be minimised by the adoption of standard good working practices by the contractor. These will be enforced through contract requirements and monitoring.

The diaphragm wall technique for construction of the cut-and-cover tunnel has environmental advantages over the sheet piled method. As the main noise impacts will arise from the construction of the cut-and-cover tunnel sections, the diaphragm wall technique, as opposed to the sheet piling method, is preferred on the basis of noise impacts. Much of the excavation and concreting will take place below the top slab, thus containing dust and shielding receivers from plant noise.

Whilst high maximum noise levels may be experienced at some receivers as a result of construction of the cut-and-cover tunnel, these levels will be infrequently experienced. In addition, many of the receivers affected by construction in West Kowloon are well shielded from noise impacts because of the high building density and orientation of the facades. In West Kowloon, it has been estimated that noise levels greater than 75 dB(A) may be experienced for up to 76 days at the worst affected receivers, and for up to 70 days in East Kowloon. Efforts should be made to reduce noise to the minimum practicable level through noise control specifications in the construction contract and the use of quiet equipment and acoustic shielding of certain plant. The schools on Tung Kun Street will be provided with acoustic insulation.

Operational noise impacts from the operation of the Central Kowloon Route have been virtually eliminated by the decision to use cut-and-cover tunnels through East and West Kowloon. At the West Kowloon Reclamation, future background noise levels will be high because of the major roads in the area. The additional contribution from the Central Kowloon Route may cause a slight constraint at the area zoned for residential use, but this can be mitigated through suitable building design or the use of pervious road surfacing. At East Kowloon, the position of the administration and workshop buildings provide effective shielding to the existing sensitive receivers south of the tunnel. To the north there may be a requirement for a noise barrier or to surface the road with pervious macadam.

None of the identified permanent and non-permanent sensitive receivers on the existing land at the west and east portals or near the Fat Kwong Street Ventilation building will exceed the AQO limits. Mitigation measures will be integrated into the design of the ventilation facilities although development restrictions may be required at the east portal.

1 導言

1.1 背景

有關增加九龍區東西幹線交通量的改善措施，在一九八九年完成的「第二次整體運輸研究 (CTS-2)」內被提出。其他研究，「中九龍交通研究」與「西九龍填海運輸研究」其後亦推斷，到2001年，即使 CTS-2內之建議落實，東西幹線的交通量仍然需要額外增加，特別是因為大都會計劃已構思出西及東九龍的主要發展。一條新的分隔雙線市區幹線道路－－「中九龍幹線」－－便在「西九龍填海運輸研究」內被提出，以作為改良現有幹線道路的一項選擇。

「中九龍幹線」將會通過九龍中央（經隧道）把西九龍快速公路與計劃在土瓜灣興建的南北幹線連接。「中九龍幹線」的基本作用是提供一條通過九龍中央的幹線道路，而讓地面的道路去應付整個市區內的交通。「中九龍幹線」將會成為九龍區交通一個重要的關鍵性連繫。建議的定位請參閱圖一。建造工程預計需時約四年。

工程的最初設計階段，已顧及與這個主要道路計劃發展相關的潛在環境影響，以作為決定選擇水平或垂直式幹線定位時的參考。最初的建議是興建一條高架道路，由京士柏至油麻地交匯處。但顧及環境及設計的因素，最後決定利用隨挖隨填隧道通過西九龍。長遠地看，「中九龍幹線」的幹線定位及隧道設計將對環境的影響減至最少。

另外一個方案是由馬頭圍道建造一段地面道路越過東九龍，但這方案得不到政府部門的支持。隧道在東九龍的出入口與收費廣場區將位於土瓜灣填海區。

1.2 研究之要求

研究簡報要求達致下列目標：

* 說明建議內之發展及與該等發展有關之設施；
* 鑒定及說明可能受建議內發展影響之社區及環境成份；
* 減少該發展及其運作引起之污染與損害及該計劃之建築與運作期對環境之滋擾；
* 據現存及計劃中之社區與鄰近土地使用，鑒定及評估建築與運作期內預期之基本環境影響及累積影響；
* 鑒定減低該等影響及令其達致可接受水平之方法、措施及標準；
* 建議為保證環境保護措施能有效執行之環境監測及審查要求；
* 鑒定任何為達致本環境評估之目標或要求所需之額外研究。

1.3 環境法規

「空氣污染管制條例」為控制空氣中污染物質而立法，及介定一套「空氣質量指標(AQO)」。在建築工程塵埃影響方面，AQO 規定空氣中總懸浮粒子不能超過 80微克／立方米（年平均量），260微克／立方米(24小時平均量)，以及無法律效力的 500微克／立方米(1小時平均量）。在運作影響方面，主要的污染物質為二氧化氮(NO)，AQO規定不能超過 80微克／立方米（年平均量），150微克／立方米（24小時平均量）及300微克／立方米（1小時平均量）。

「噪音管制條例」為管制噪音而立法。「噪音管制條例」介定之法定限制對「中九龍幹線」之興建工程亦將適用。

「噪音管制條例」內有三項技術性備忘錄。這些備忘錄介定評估噪音的技術性細節。「噪音管制條例」與其備忘錄為評估噪音聲量提供機制，同時為管制噪音而賦與法定權力。據「噪音管制條例」內之規定，每日上午七時至下午七時內，建築工程可以不受限制地進行，但在公眾假期及星期日，全日、黃昏及晚上都禁止建築工程進行。環境保護署建議，日間建築工程噪音上限為75分貝(A)[等效連續聲(5分鐘)]。

對交通噪音，香港並無立法管制。不過，「香港規劃標準與準則」指出，住宅樓宇正面的交通噪音聲量不應超過70分貝(A)。

2. 幹線定位說明

「中九龍幹線」的西端將與「西九龍快速公路」及「填海主要幹路（P1幹線）」連接。東端則分別連接南北幹線，土瓜灣／紅磡區，以及通往九龍灣填海區的新幹線道路；亦可與一條往將軍澳的現有幹線道路連接。幹線的定位由最初的在油麻地交匯處興建高架道路改為現在入口位於西九龍走廊西面的隨挖隨填隧道。這段隧道將在東莞街下穿過，與直往高山公園的京士柏行車隧道連接，然後再由隨挖隨填隧道前往海心公園南面的土瓜灣填海區，隧道的收費廣場將設在這裡，幹線然後接上南北幹線交匯處。

3. 工程引起之影響，影響之減輕及監測

3.1 空氣質量

「中九龍幹線」建造工程期內，泥塵的散發預計會對空氣質量做成最大的影響。泥塵散發的來源有多個：現存建築物的拆卸；地盤預備工程；挖泥；風對工地的侵蝕；貨車運送材料；以及車輛或器材出入工地泥路等。

建築工程引起的泥塵影響是利用電腦技術模擬散發模式估計出來，並與空氣質量指標及指引標準比較。

西九龍「六街重建計劃」所產生的泥塵，可能超過 500微克／立方米這個1 小時平均泥塵含量的指引。不過，據天文台的長期氣象資料顯示，導致泥塵可能超過指引的情況將不會很多。而且這些情況不一定與建築工程施工高峰同時出現。

隧道在東九龍的出入口處，要是對泥塵散發沒有管制，尤其是由混凝土機做成的情況，泥塵含量可能超過指引內的界限。不過，只要有合理的管制，損害應可大為減少。

將需時二至三個月才完成的拆卸工程是一個泥塵的潛在來源。因為久缺一套適當的評估方法，拆卸工程的泥塵所帶來的影響沒有被測定。不過，因為環境狹窄，而且待拆樓宇的毗鄰建築物將被保留下來，拆卸工程將會被小心監管。為了安全理由，建築物有需要以護幕遮蓋，以便有效地控制泥塵的散發。

隨挖隨填隧道與收費廣場的建造工程亦可能會製造大量泥塵。建議於可行時採用例如灑水在露天地方；以油布覆蓋；利用屏風和圍板等減輕措施。這些措施將列入合約條文內，以減低、監測及視察泥塵的散發。

3.2 噪音影響

「中九龍幹線」的建造工程，將會在東及西九龍人煙稠密的住宅區內進行。工程無須使用撞擊式打樁。這些地區的現有噪音主要來自車輛與飛機。

東及西九龍市區的現有噪音聲量是經由一個背景噪音監測程序測定的。該計劃在多個地點進行 5分鐘等效連續聲測試。結果顯示接近主要道路的噪音聲量大約為80分貝(A)，市內非直接受交通噪音影響的區域則為大約70分貝(A)。高山劇場與土瓜灣填海區量度到大約60分貝(A) 的噪音聲量。

沿隨挖隨填隧道走廊的拆卸工程將需時二至三個月。典型的方法是用一台放置在天台上的水壓式軋碎機將建築物從上而下拆毀。然後將廢物運離地盤棄置。間或可能用上切割器材。噪音損害基本上來自水壓式軋碎機操作時發出的聲浪，可高達 122分貝(A)。 其他拆卸技術，例如使用液壓式剪切機及抓爪，亦適用於香港，但應用並不廣泛。應考慮使用這些器材。

接近工程區域的樓宇，因與建築地盤為鄰，將會很可能受到噪音損害。不過，因工程沿著走廊進行，居民不應會太長時間受到高度噪音的影響。

目前雖然並無法例管制日間的工程噪音，噪音亦有需要減低。隨挖隨填隧道的建造工程，大部份將會在路面下進行，噪音影響將會被有效地減少。噪音影響將會比較上屬短期性質，但仍須致力於將可發出的噪音的聲量減至最低。

減低工程噪音的可行技術包括下列各種：使用有減聲或超級減聲裝置的器材；採用發出較少聲浪的技術（如利用剪切機及抓爪拆卸）；個別工程器械使用隔音板以即場減低噪音；為直接面對工程的噪音承受者提供隔音板；以及與承建商以合約形式要求遵守操作限制包括對噪音的監測。

與西九龍工程走廊毗鄰的三所學校需要受到特別考慮。原來的建議是安排學生到附近的地方上課。但未能符合教育署署長的要求。多項減少對學生的影響的措施亦被考慮。現建議盡可能將工程編在學校假期內，而考試時間則避免有工程進行。路政署已表示將會提供隔聲設備。

3.3 對水質之影響

在隧道周圍，最易受影響的是維多利亞港的海水。

在建築期內，地盤排放的污水內含有懸浮固體物質。這些物質可對海水做成化學、生物、實質及外觀的影響。後果是對海洋動物群做成生態上的影響。隧道內作支撐用的皂土因意外而溢出，亦對水質做成潛在的影響。不過，良好的工作習慣應可減低這個危險。

就水質來說，主要的環境問題是防止化學物品、污水，以及由挖填產生的固體物質經由排水系統流入海港。為避免發生上述物質的大量溢出，將會採取預防措施。地盤內使用的大量燃料、燃油、油漆及其他化學物品應以安全的容器妥為裝載，貯存地方應築堤圍欄。污水不應隨意傾倒。流水應該從公共污水管排放。路面鋪設工程的前後，為了減少地盤的固體物質流進水裡，所有從地盤，包括混凝土處理器材排出的水，必須先經過濾程序。

3.4 固體廢物

建築工程期內產生的廢物主要為拆卸的廢料，挖掘隧道的廢料，工作人員的廢物，以及保養及修理所製造的廢物。

典型的建築物拆卸廢料包括混凝土(20%)，強化混凝土(33%)，塵／土／泥 (12%)，石塊／碎石(12%)，黑色金屬 (3.5%)及其他各種成分。目前唯一作為循環再造材料的只有黑色廢金屬，通常是製成加固條，在香港是有一個二手市場的。其他材料現時沒有市場，也沒有設備去分類。大部份的廢物都作堆填用。環境保護署已表示，「建築工程廢物轉運計劃」實施之後，預期所有建築工程廢物將會在現場分類後，再運送往指定地點棄置。

隧道建造工程亦會帶來非常數量的泥土和石塊。由京士柏東向至高山公園的一段行車隧道將會挖出大約30萬立方米的石塊。但這些石塊可直接用作取土原料或加工製成碎石，故不應被視為廢物。近年有嘗試將兩類承建商的需求配合，一類是需要泥土作填料，另一類則在找合適的地點傾卸泥土，但已證明有問題，特別是時間的配合最為困難。「中九龍幹線」工程產生的泥土很可能要運往公眾卸泥區棄置。另一個棄置隧道泥土的選擇是將這些泥土在九龍灣小規模填海，作為九龍灣填海區的前期工程。這個填海區大概會有三公頃的面積。這選擇對環境有好處，因為運泥車往來少了，噪音也可以減少。

較淺的隧挖隧填隧道路段亦會帶來相當份量的挖出物，這些挖出物包含各種不同質量的舊填海用料。隧挖隧填的建築技術是首先挖出隧道路段，然後將隧道上蓋部份回填至路面。按工程技術所需，可能要挖出地方來建造連續地下牆。剩餘的挖出物估計大約有14萬立方米。這些挖出物會視乎其質量而可能被運往公眾卸泥區棄置。

保養及維修工作所製造的廢物的數量不應該會太多，但可能包含有潛在性害處的物質，例如燃料渣、潤滑劑，或者清潔溶劑。承建商要負責處理這些有害物質和化學廢物，亦須遵守「危險品條例」及「廢物處理條例」內的「化學廢物規則」。

3.5 外觀影響

對附近的居民和路人來說，樓宇拆掉、挖泥及工程，還有樓宇重建等，在外觀會做成相當大的影響。這影響只限於建築工程期內，工程完成後預料不會有深遠的長期影響。

採用較好的現場管理制度和提供充足的處置廢物設備，除了能管制工人隨便掉棄廢物垃圾外，也方便了建築工程廢物的現場分類和處理。

4 運作引起之影響，影響之減輕及監測

4.1 空氣質量

汽車隧道經隧道出入口及通風口的污染物排放一向被視為一個環境問題。這些污染物對環境的影響已被評估，以找出有關影響的程度，並為隧道兩端出入口填海地區的未來發展提供一個空氣質量指引。

到2011年，在高峰時間內使用「中九龍幹線」的車輛估計大約60%是貨車。除了一氧化碳，氧化氮NO_x就是主要的空氣污染物。

隧道內污濁的空氣將由垂直排氣管經三個廢氣通風口排出外面。隧道兩端出入口各有一個通風口，第三個則位於隧道中段附近的佛光街臨時房屋區。

為預計隧道運作時通風口與兩端出入口路面車輛排放的廢氣對空氣質量的影響，已進行了空氣擴散模擬測驗。

在隧道東西出入口及佛光街通風口附近的現有地區，所有已鑒定的永久及非永久受影響者，其承受的空氣污染物含量將不會超過香港空氣質量指標(AQO)內的規定。考慮到隧道運作時空氣質量的影響，減輕措施或再發展的限制並不需要。

在隧道西端出入口的西九龍填海區，運作性空氣質量影響將在空氣質量指標的可接受水平之內。估計該區的未來發展將不受「中九龍幹線」運作時對空氣質量的影響所限制。

在東端出入口填海區主要道路20米範圍內的部份地區，二氧化氮NO的一小時平均含量將超過指標內的規定。這些地區亦會嚴重受路面車輛發出的噪音影響；但大部份接近東端出入口的地方所受的影響都不超過空氣質量指標內的規定。隧道東端出入口範圍的未來發展計劃，特別是列入「東南九龍發展報告」的，應對空氣質量要求予以充份考慮。

通風口的設計，應高過周圍範圍100 米內的建築物，以避免污染物下沉。下沉現象使通風口的渦流在地面令污染物集中。這現像可利用較高的排放速度減少出現。通風口的高度必須在外觀上為人接受。

4.2 噪音

「中九龍幹線」大部份都是隧道，因此不會有噪音影響。幹線以隨挖隨填隧道東西穿過九龍，事實上消除了這些地區的潛在交通噪音。可能有問題的地方是隧道出入口附近，以及東與西交匯處的連接道路，這些地方的現有及將來的受影響者可能要承受噪音的害處。

本研究工作之一是進行背景監測程序以量度土瓜灣填海區的噪音聲量。這地區的噪音聲量比較低，只有等效連續聲(30分鐘)50至 65分貝(A)。西九龍新填海地帶的未來住宅區的噪音聲量，亦受該區主要道路，特別是D1幹線、油麻地交匯處及西九龍走廊的交通噪音影響。背景噪音監測（與「西九龍走廊研究」進行的相同）在油麻地天主教小學量度到日間噪音等效連續聲(1小時)是75 至82分貝(A)，而10 小時高峰聲量是 87分貝(A)。「西九龍快速公路環境評估」指出，西九龍快速公路與西九龍走廊間交匯處的南北兩面地區，所承受的正面噪音聲量可能超過「香港規劃標準與準則」的規定。

據預測，「中九龍幹線」對西九龍的「六街重建計劃」地區將不會有明顯的噪音影響。但幹線對填海區民居的噪音影響，可能超過「香港規劃標準與準則」內所規定的 70分貝(A)規定，雖然受影響的地方有限及只限於樓宇的高層。要減低影響不難，可採用非敏感式樓宇設計，或在有需要時鋪設減音路面。

環境評估顯示東九龍受影響區域只要在道路北面築一道5 米高的屏障，或鋪設減聲路面，應可消除噪音的不良影響。除此外，其他更直接的解決方法，例如供應大廈隔音設備或冷氣機等，皆是不可預期的。

通風設備發出的噪音受「噪音管制條例」的條文規限。因此，法律規定必須遵守噪音管制標準。這些標準亦成為設計及建造通風設備的規格之一部份。

4.3 水質

「中九龍幹線」所產生的排放物，內含的污染物份量，預計將與其他市區排放物的相若。這些排放物應該不含做成可定量的不良影響。交通意外溢出的有害物質預期不會很多，但很難作推測及估計。其影響視乎溢出物的份量及成份。在運作階段，減少對海水水質影響的關鍵之處是防止化學物品及懸浮粒子流進水裡。通常是在隧道排水系統內裝設引流管收集隧道流出的水。

4.4 固體廢物

幹線運作時產生的固體廢物，影響並不重要。

4.5 外觀影響

油麻地彌敦道與高山公園間的一段幹線，建議是雙管行車隧道，對該區的城市景色及外觀不會有影響。區內唯一的有關建築是位於佛光街的通風口。這個計劃中的通風口的設計，極之受該處未來住宅區發展的性質，以及未來遊樂場的影響。通風口的建築風格，應與鄰近的建築物融和。稍後較詳細的設計階段，最重要是考慮通風口的組成結構及其景觀。

高山公園的場地應按現時的行人徑、座椅區及種植區佈局而重建，並利用一些半成長的樹木來加強植物重植時的直接效果，亦可補充那些可能損失的植物，對公園區來說，應該沒有長遠的外觀影響。

隧道的出入口與收費廣場低於地面，背景是填海的發展區，但出入口與收費廣場北及西面的現存樓宇將會看到景物。建議在緊貼新路的周圍及連接隧道的道路的基堤上密種樹木。有此需要是為了使填海區看不到未來的地面情景，亦可將呆板的道路路面點綴美化，並為該處提供可觀的景緻。

位於建議中幹線南面的臨時收費廣場將會佔了現時的高山公園的一角，故此需要拆除一小片園景及一道裝飾用牆。上述工程不會影響園內設施，但對公園遊人將會有明顯的觀感上的影響。建議該臨時收費廣場應以美化的臨時圍牆圍上，應可有效地起遮掩作用。

5 結論

計劃的初期，有關定位與設計的決定均把環境問題考慮在內。採用隨挖隨填隧道而放棄京士柏至油麻地交匯處高架道路的決定方便了環境計劃的制定。這個定位在建築工程進行時將會產生較大的短期影響，但長遠來看，「中九龍幹線」對西九龍不會做成環境影響或計劃上的困難。

「中九龍幹線」的長遠環境影響可以減輕以免做成不良後果。工程期內泥塵與噪音的主要影響需要減輕。

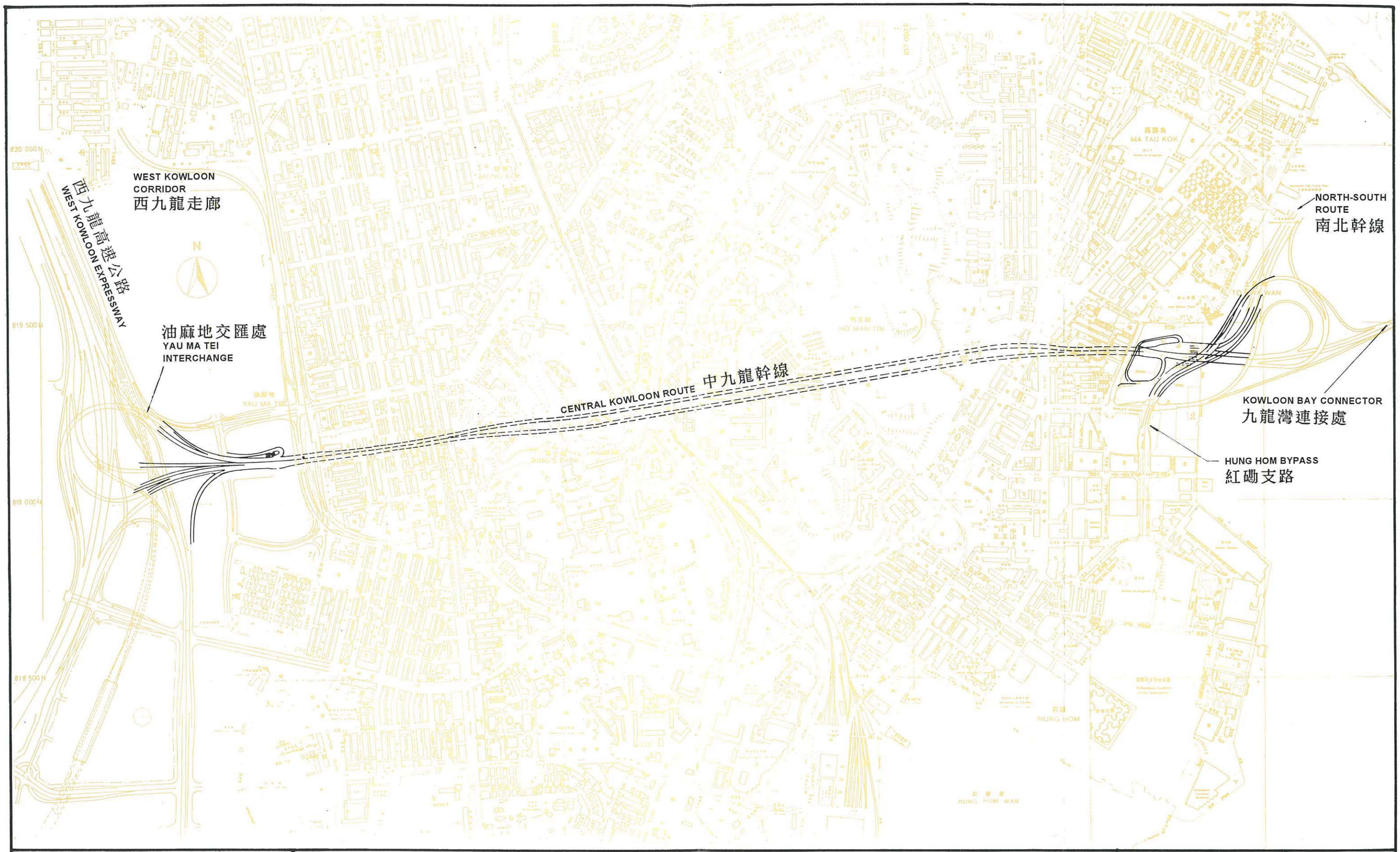
在西及東九龍，可能會產生大量泥塵，部份住宅樓宇所承受的塵量偶然會超過建議的規限。不過這情況將會很少出現，而承建商採用標準的良好工作習慣亦可減少這種現像。這可透過將要求訂約及監測來執行。

隨挖隨填隧道工程的地下連續牆技術比板樁法對環境有利。因為主要的噪音影響來自隨挖隨填隧道的建築工程，故此選擇地下連續牆技術而非板樁法，原因就是考慮到噪音的影響。大部份的挖掘混凝土澆築工程都在路面下進行，泥塵和噪音都不會擴散。

部份受噪音影響者會因隨挖隨填隧道的建築工程而需忍受聲量極高的噪音，但這種高聲量的情況不常出現。此外，很多受西九龍建築工程影響的地方會因樓宇的高密度及面向而免受噪音之苦。在西九龍，估計最受影響的地方最多有76天噪音聲量超過75分貝(A)， 而在東九龍則為70天。故應在建築工程合約中強調噪音管制和儘量採用聲浪少的設備及將某些器材附以隔聲裝置盡力把可發出的噪音的聲量減至最低，東莞街的學校將得到隔聲設備的供應。

「中九龍幹線」運作時的噪音影響，因採用隨挖隨填的隧道設計東西穿越九龍而有效地消除。在西九龍填海區，因該區的主要道路幹線而令未來的背景噪音聲量不低。「中九龍幹線」的額外影響對歸作住宅用途的地區構成輕微壓力，適當的建築物設計或鋪設減聲路面當可舒緩這些壓力。在東九龍，行政及工場大樓的所在成為隧道南面受影響地方的有效屏障。在北面則有需要建造一道噪音屏或鋪設減聲路面。

在隧道東西出入口的現有地區及接近佛光街通風口的地區，所有已鑒定的永久或非永久敏感承受者所受的影響都不會超過「香港規劃標準與準則」內的規限。雖然在東端出入口需要有發展規限，但減輕措施將會包含在通風設施的設計裡。



Parsons Brinckerhoff Maunsell Consultants	**Central Kowloon Route Study - Key Plan** 中九龍幹線研究：初步設計 - 索引圖	FIGURE NO 圖號 **1**	SCALE 比例 0 50 100 200m DATE 日期 **April 1993**