土木工程署
Civil Engineering Department

偉信 Scott Wilson

Agreement No CE 60/96

Northshore Lantau Development Feasibility Study

Environmental Impact Assessment

Executive Summary

February 2000

Scott Wilson (Hong Kong) Ltd in association with ERM Hong Kong Ltd
Brooke International • City Planning Consultants • Shankland Cox • Wilbur Smith Associates

1. INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1 In June 1998, Civil Engineering Department (CED) of the Hong Kong Special Administrative Region Government commissioned Scott Wilson (Hong Kong) Limited as the lead consultant for the Northshore Lantau Development Feasibility Study (NLDFS) (Agreement No. CE 60/96). Environmental Resources Management - Hong Kong, Limited (ERM) has been commissioned to undertake an Environmental Impact Assessment (EIA) and Shankland Cox Asia Limited has been commissioned to undertake Landscape and Visual Impact Assessment (LVIA), for the Project in accordance with the requirements of the *Environmental Impact Assessment Study Brief No. SB-044/BC.* In accordance with the EIA Study Brief Clause 10.1 (v) this Executive Summary report summarises the findings and recommendations of the EIA Report.

1.2 PROJECT DESCRIPTION

1.2.1 The Project is an integrated planning and engineering feasibility study which consists of two development packages, the Northshore Lantau Development and the preliminary design of Chok Ko Wan Link Road (CKWLR), previously named the Lantau Port Expressway. NLDFS itself is a Designated Project (DP) under Schedule 3 of the Environmental Impact Assessment Ordinance (EIAO) as an engineering feasibility study of urban development with a Study Area of more than 2600 ha.

1.2.2 A Draft Recommended Outline Development Plan (RODP) has been prepared in January 2000 (*Figure 1.2a*) based on the overall planning objective of tourism/ recreation and recommended land uses endorsed by the Committee on Planning and Land Development in December 1999. The Schedule 3 NLDFS EIA is designed to confirm the environmental acceptability of developments and infrastructures proposed in the Draft RODP through evaluation of the cumulative and residual environmental impacts. A number of Designated Projects have been identified within the Draft RODP and have been summarised in *Table 2.1a*.

1.2.3 CKWLR is an expressway, hence is classified as a Schedule 2 Designated Project under the EIAO. The CKWLR EIA has been performed to sufficient detail to demonstrate the environmental acceptability of the construction and operation of the preferred CKWLR alignment for Environmental Permit application.

Table 2.1a - Schedule 2 Designated Projects Identified within the Draft RODP

Schedule 2	Description	Schedule 2 EIAO Reference
Part I - A - Roads, Railways and Depots	• Approx. 3.5 km long Chok Ko Wan Link Road (Expressway Standard)(1) • Approx. 4 km long Road P1(3) (Primary Distributor) • Approx. 4 km long Road P2 (Primary Distributor)(2) • Approx. 3.5 km long Resort Road (District Distributor)(2)	Part I - A.1 Part I - A.1 Part I - A1 Part I - A.1
	• Penny Bay Rail Link (PBRL) and its associated stations (including 850 m of tunnel)(2)	Part I - A.2, A.4 and A.7
Part I - C - Reclamation, Hydraulic and Marine Facilities, Dredging and Dumping	• All reclamation works more than 5 ha in size including Penny's Bay Stages I and II (280 ha)(2), Yam O (10 ha)(2), Northshore Lantau (65 ha)(3), Tsing Chau Tsai East (74 ha)(3), Theme Park Extension (80 ha)(3), and Siu Ho Wan (39 ha)(3) reclamations	Part I - C.1, C.2, C.11 and C.12
Part I - I - Waterways and Drainage Works	• Artificial Lake at the Water Recreation Centre (designed as a flood storage pond)(2) • Stormwater drainage channel (discharges within 300 m of the Pa Tau Kwu(2) and Fa Peng(3) archaeological sites)	Part I - I.2 and O.8 Part I - I.1(b) (ii)
Part I - O - Tourist and Recreational Developments	• Theme Park (Phases I and II) at Penny's Bay and associated developments (about 180 ha)(2) • Theme Park Reclamation Extension to the east of Theme Park (Phase II) with an area of about 70 ha(3)	Part I - O.8 Part I - O.8
Part II - Decommissioning Projects	• Decommissioning of Cheoy Lee Shipyard with an area of about 19 ha(3)	Part II - Item 17

Note (1) : About 1.5 km section of CKWLR from Yam O Interchange to Penny's Bay roundabout is within the Project boundary of the EIA for the *Construction of an International Theme Park in Penny's Bay of North Lantau and its Essential Associated Infrastructures* (Study Brief : ESB 043/1999), hereafter referred to as the Theme Park EIA. Environmental impacts of the 1.5 km CKWLR section have been broadly assessed in the Theme Park EIA.

Note (2) : Designated Projects (DPs) covered in the Theme Park EIA.

Note (3) : To be addressed in a separate subsequent Schedule 2 EIA.

1.2.4 CED is the Project Proponent of the Theme Park EIA Study. DPs identified within the Draft RODP which may require separate studies for their Environmental Permit applications include :

1. Road P1 (Primary Distributor) of about 4 km;

2. Distributor Road for the Theme Park Reclamation Extension (about 1 km);

3. Potential Penny's Bay Rail Link extension, from Theme Park (Phase II) east roundabout to Tsing Chau Tsai East Reclamation and Hong Kong, and its associated stations;

4. Reclamations proposed at Northshore Lantau (65 ha), Tsing Chau Tsai East (74 ha), Theme Park Reclamation Extension (80 ha), and Siu Ho Wan (39 ha);

5. Proposed stormwater drainage channel at Fa Peng;

6. Construction and operation of Theme Park Reclamation Extention (about 70 ha) and

7. Decommissioning of Cheoy Lee Shipyard.

1.2.5 In addition, the proposed Technodrome, the Tourist and Convention Village, and the tourism and recreational development at Tsing Chau Tsai East may become DPs depending on their nature and environmental impacts. This has to be determined when the detailed design of the proposed developments are available.

1.3 PROJECT OBJECTIVES

1.3.1 As required by the EIA Study Brief, No. SB-044/BC, the purpose of this EIA Study is to assess the environmental acceptability and to provide information on the nature and extent of environmental impacts arising from the construction and operation of the developments proposed in the Draft RODP, taking into account the cumulative environmental impacts from other concurrent activities. A detailed assessment has been performed on the CKWLR (Yam O Interchange to R10-North Lantau to Yuen Long Highway (NLYLH) toll plaza section) to provide information for the Environmental Permit application by the Project Proponent. This EIA will provide information to contribute to decisions by the Director of Environmental Protection on:

- The overall acceptability of any adverse environmental consequences that are likely to arise as a result of the proposed Project;
- The conditions and requirements for the detailed design, construction and operation of the proposed Project to mitigate adverse environmental consequences, wherever practicable; and
- The acceptability of residual impacts after the proposed mitigation measures are implemented.

1.4 PROJECT ELEMENTS

1.4.1 The NLDFS Project Area covers the north-eastern part of Lantau Island which comprises generally three portions, namely Northshore Lantau which stretches along the northern shoreline of Lantau Island between Tai Ho and Kwai Shek, Tsing Chau Tsai which is an upland area at North Lantau, and Penny's Bay Reclamation which includes the broader Penny's Bay area stretching between Sze Pak Tsui and Pa Tau Kwu. The Draft RODP developments are largely to be built on reclaimed lands to be formed between 2000 to 2028.

1.4.2 The CKWLR section from Yam O Interchange to R10-NLYLH toll plaza has been designed to preliminary design level. The construction and operation of this section of the CKWLR has been assessed to Schedule 2 Designated Project level in this EIA to support its Environmental Permit application.

1.4.3 Penny Bay Reclamation and a 10 ha Yam O Reclamation comprises a total area of 290 ha. The reclamations will provide land for road (Road P2, CKWLR, and Resort Road) and rail (PBRL) infrastructures, two phases of Theme Park and its associated hotels, ferry piers, two public transport interchanges, carparks, Government, Institution or Community (G/IC) facilities, and a 32 ha Water Recreation Centre (WRC) with an artificial lake.

1.4.4 The Northshore Lantau reclamation includes a 20 ha Theme Park Gateway (completed in 2014), a Cross-Boundary Ferry Terminal (CBFT) (completed in 2018 and a second one in 2031), a 20 ha Tourist and Convention Village (completed in 2020), a 20 ha Technodrome

(completed in 2022), a 2 km waterfront promenade, a 1.8 ha service area, and a 5.4 ha bus and coach parking area. The Luk Keng headland to the west of the Northshore Lantau reclamation will be zoned as Conservation Area and a conceptual Eco Park has been proposed in the Draft RODP. The proposed Tourist and Convention Village will accommodate a large convention centre and a low-density type resort hotel. The Technodrome will provide hi tech indoor entertainment and educational facilities using state-of-the-art equipment set in a futuristic environment.

1.4.5 The Siu Ho Wan reclamation will commence in Q3 2014 for completion in Q1 2016 using public fill and marine sand fill. The reclamation will provide land for the Road P1 extension (8 ha) and a R2 residential development (planned population of about 14,000) and the schools (30 ha). An additional 1 ha reclamation at Sham Shui Kok for a possible joint Special Duties Unit (SDU) and the Small Boat Division (SBDIV) Marine Base has been planned for construction from Q1 2002 to Q4 2004. Road P1 is intended to serve all the developments alongside the North Lantau Highway (NLH). Construction of Road P1 which involves a short tunnel section is currently envisaged to commence in Q1 2015 for completion in Q4 2016. The Siu Ho Wan housing development will be built after the completion of the adjoining Comprehensive Development Area development on the existing MTR Siu Ho Wan Depot.

1.4.6 Reclamation at Tsing Chau Tsai East from Sam Chuen to Pa Tau Kwu comprises a total area of 74 ha using public fill and marine sand fill. The reclamation will be formed in three periods, namely CKWLR Phase I reclamation for CKWLR and R10-NLYLH section including the R10 toll plaza, CKWLR Phase II reclamation for the CKWLR section connected to the long term R10-Hong Kong Lantau Link (HKLL) and the Pa Tau Kwu Interchange, and the Fa Peng reclamation for proposed recreational uses. The CKWLR Phases I and II Reclamation are scheduled to be commenced in Q1 2002 and Q3 2012, respectively. Both reclamations will take 24 months to complete. The Fa Peng Reclamation is scheduled to be commenced in Q2 2022 for completion in 48 months. Construction of the tourism and recreation development at Tsing Chau Tsai East is currently assumed to be commenced in Q1 2024 with a construction period of 60 months. A village area has been planned at Tso Wan to provide 62 small house sites for the recognised villages in North East Lantau.

1.4.7 Reclamation of about 80 ha has been proposed between Pa Tau Kwu south and Phase II of the Theme Park for the possible Theme Park Extension or other recreational uses. Construction will be commenced in Q2 2026 for completion in 24 months using public fill and marine sand fill. The reclamation will also provide land for the construction of Road P2 and PBRL extensions. Construction of the proposed Theme Park Extension is currently assumed to be commenced in Q2 2028 for a period of 36 months. A 10 ha freshwater lagoon zoned as Conservation Area has been designated around the Pa Tau Kwu headland.

2. PROJECT APPROACH

2.1.1 This EIA Study has been prepared in accordance with the requirements of the Study Brief and the general principles and guidelines of the Technical Memorandum on Environmental Impact Assessment Process (EIAO TM).

2.1.2 Technical assessments were undertaken based on NLDFS developments shown on the Draft RODP and the preferred CKWLR alignment (*Figure 1.2a*).

3. SUMMARY OF EIA FINDINGS

3.1 AIR QUALITY

3.1.1 The Project Area is predominantly rural in nature and the major existing sources of air emission identified include the NLH and the Penny's Bay Gas Turbine Plant (GTP). Other potential odour sources within the Project Area include the Siu Ho Wan Sewage Treatment Works (STW) and the North Lantau Transfer Station (NLTS).

3.1.2 Air quality impacts arising from the construction of the Project primarily relate to dust nuisance and gaseous pollutant emissions from the construction plant and vehicles. Cumulative dust impacts at air sensitive receivers (ASRs) identified within the Project Area from all concurrent construction activities have been quantitatively assessed using computer dispersion modelling. With the incorporation of the recommended dust suppression measures, the maximum hourly and daily total suspended particulates levels are predicted to be within the relevant standards at the identified ASRs.

3.1.3 Vehicular emissions, industrial emissions from the GTP and the Theme Park are expected to be the major sources of air pollutant in the Penny's Bay area during the operational phase. Cumulative impacts due to all prominent sources have been assessed using computer dispersion modelling, taking into consideration the background pollutant concentrations. Results of the assessment indicate that the predicted criteria pollutant levels at all ASRs will comply with relevant Hong Kong Air Quality Objectives (AQOs). Electric passenger trains will be used for the proposed PBRL hence no air pollutant emissions of significant levels are envisaged.

3.1.4 Height restrictions have been incorporated into the Theme Park (Phases I and II) plans to avoid any potential air quality impact from the GTP and it has been assessed that the dispersion of the chimney emissions will not affect the Theme Park and its associated developments.

3.1.5 The impacts of fireworks display emissions from the Theme Park on air quality has been assessed in the Theme Park EIA and it is predicted that they would only contribute to marginal increases in the air pollutant levels in the atmosphere.

3.1.6 To ensure AQO will not be exceeded at the air sensitive receivers due to emissions from major roads, buffer distances recommended by Hong Kong Planning Standards and Guidelines should be followed in detailed planning of the Project developments. Results of

the computer modelling of unmitigated emission from the Yam Tsai tunnel at Road P1 have indicated exceedance of HKAQO at ASRs in the vicinity of the portal. Two ventilation buildings have been recommended at the tunnel to ensure effective dispersion of the pollutant emissions. With the incorporation of these recommended mitigation measures, air quality at Luk Keng Tsuen and the proposed Conservation Area at Luk Keng should achieve full compliance of the AQOs.

3.1.7 Odour control facilities have already been incorporated into the NLTS and the Siu Ho Wan STW to control odour level at the site boundaries to acceptable levels. Hence it is envisaged that there will be no residual odour impact for the NLDFS developments proposed in the vicinity. Potential odour impacts from the proposed sewage pumping station would not affect the adjacent ASRs with the adoption of recommended odour control measures in the detailed design such as enclosure of odour sources and provision of odour scrubbing systems.

3.1.8 Environmental monitoring and audit (EM&A) arrangement has been recommended to ensure compliance of relevant environmental standards at representative sensitive receivers.

3.2 NOISE IMPACTS

3.2.1 The Project Area comprises a predominantly rural nature. The existing NLH and the Lantau Airport Railway are the dominant noise sources along the northshore of Lantau Island. A number of industrial operations are scattered within the Project Area. Background noise of the Project Area is also affected by the aircraft noise with the Hong Kong International Airport located at approximately 4.5 km from the western Project Area boundary.

3.2.2 Noise impacts due to the use of powered mechanical equipment (PME) during construction phase of the Project have been quantitatively and cumulatively evaluated based on the worst case construction programme. Results of the assessment indicate that unmitigated construction activities associated with the Project would cause exceedances at certain Noise Sensitive Receivers (NSRs) of both daytime and evening construction noise standards stipulated in the EIAO TM. Mitigation measures such as the use of quiet plant, erection of temporary noise barriers, reduction on the number of PME usage and re-scheduling of certain construction activities to avoid evening works have been recommended to ameliorate the impacts. Night-time construction works will be limited to the dredging and sand filling activities of the first stage of Penny's Bay Reclamation. Results of the assessment indicate that compliance of the night-time 45 dB(A) criterion at NSRs identified at Peng Chau and Discovery Bay can be achieved during this worst case period.

3.2.3 Operational noise impacts from the Theme Park (Phases I and II) have been assessed in detail in the Theme Park EIA. The report indicates that noise impacts from the operations and the fireworks shows are predicted to be within relevant acceptable standards at NSRs.

3.2.4 Unmitigated road traffic noise predictions suggested that there will be approximately 1,130 residential dwellings at the proposed residential development at Siu Ho Wan and Luk Keng Tsuen, and 67 classrooms at Siu Ho Wan which exceed the relevant EIAO TM criteria. At source noise mitigation measures, including semi-enclosures and roadside barriers, have been proposed to ameliorate traffic noise impacts at the residential dwellings to achieve the EIAO TM criterion of 70 dB(A). Exceedance of the traffic noise criterion was predicted at approximately 13 classrooms at the schools in Siu Ho Wan after all possible direct

mitigation measures have been exhausted. Indirect noise mitigation measures by the provision of window insulation and air-conditioning have been recommended to achieve the EIAO TM criterion.

3.2.5 No NSRs have been planned within the Noise Exposure Forecast (NEF) 25 zone hence no adverse aircraft noise impacts are anticipated. The Government Flying Service's Penny's Bay helicopter flight path is an emergency path to be used only in adverse weather conditions. Noise levels predicted at the proposed residential development at Siu Ho Wan reveals only minor exceedance of 1 dB(A), of which the impact is envisaged to be minimal.

3.2.6 The predicted cumulative (Airport Express, Tung Chung Line, and the proposed Penny's Bay Rail Link) railway noise levels at Luk Keng Tsuen and the proposed residential and school developments at Siu Ho Wan will comply with the statutory requirements of the Noise Control Ordinance and the EIAO TM. Adverse noise impacts from train operation are not envisaged.

3.2.7 For other fixed plant noise sources, including the Penny's Bay GTP, the proposed sewage pumping station at Penny Bay, the proposed public transport interchanges at Yam O and Penny's Bay, the proposed future Container Terminal development near Kau Yi Chau and the Sewage and Water Treatment Works at Siu Ho Wan, it is predicted that their impacts on NSRs are within the relevant noise criteria.

3.2.8 Environmental monitoring and audit (EM&A) arrangement has been recommended to ensure compliance of relevant environmental standards at representative sensitive receivers.

3.3 WATER QUALITY

3.3.1 A review of EPD routine water quality monitoring data determined that the water quality in the vicinity of the NLDFS development was generally good. There were, however, exceedances of the Water Quality Objectives (WQOs) for total inorganic nitrogen to the south of Penny Bay and of dissolved oxygen to the south and east of Penny Bay and to the north of Yam O. The exceedance of the total inorganic nitrogen had been recorded for the last 10 years and was thought to be strongly influenced by the outflows from the Pearl River Estuary. The non-compliance of the dissolved oxygen WQO had not been recorded in earlier years and would be expected to recover in the future (found to have recovered based on EPD's 1999 water quality monitoring data). *E. coli* levels were in compliance with the WQOs for Secondary Contact Recreation Sub-zones to the south of Penny Bay.

3.3.2 The construction phase impacts were assessed by considering the potential impacts due to the construction of the reclamations associated with the NLDFS developments and land based construction activities, including those for the CKWLR. The assessment determined that, while there was the potential for adverse impacts to water quality, these predicted impacts could be readily controlled through the implementation of suitable mitigation measures. The mitigation measures were specified in terms of operational constraints and est practice' construction methods. The potential impacts to water quality from land based construction activities could be readily controlled through a series a est practice' methods to control wastewater discharges from the construction sites. Environmental Monitoring and Audit (EM&A) was recommended to ensure that no adverse impacts would occur during

reclamation formation, while audit of the mitigation measures for the land based construction activities would be carried out.

3.3.3 The assessment of the impacts of the operation of the NLDFS developments on water quality considered the potential impacts to hydrodynamic characteristics and marine water quality, as a result of sewage effluent generated by the developments and stormwater discharges, including those from the CKWLR. The assessment of the impacts of the operation of the NLDFS development on hydrodynamics and water quality was undertaken for the development alone and cumulatively with a proposed future Container Terminal developments near Kau Yi Chau. The assessment determined that the Northshore Lantau Development could cause changes in tidal current patterns but that these changes in combination with the discharge of sewage effluent and stormwater would not result in adverse impacts to water quality. It was assessed that there was the potential for poor water quality in the small embayed area at Yam O but that this potential could be mitigated and that the need for and extent of such mitigation would be determined during further, more detailed studies. The cumulative impact from the proposed future Container Terminal developments was not predicted to cause adverse impacts to water quality, except within the Container Terminal developments itself. Mitigation measures were devised to minimise the risk of such an impact. It was determined that the potential impacts from the operation of the CKWLR could be controlled through design measures for the drainage system and would not therefore pose the risk of adverse impacts.

3.4 SOLID WASTES

3.4.1 The following quantities of waste are expected to arise during the construction of the NLDFS developments and CKWLR: Dredged materials (about 55 Mm^3 and 4.2 Mm^3 respectively, maximum dredging rate is 90,600 m^3 day^{-1} and 6,000 m^3 day^{-1}, respectively), construction and demolition waste (peak generation rate of about 50 m^3 day^{-1} for NLDFS developments and minimal generation rate for CKWLR); chemical waste (a few cubic metres per month); and general refuse (3.9 tonnes day^{-1} and 227.5 kg day^{-1} respectively during peak construction period). No surplus of excavated materials is envisaged.

3.4.2 Reclamations for the NLDFS development and CKWLR require large amounts of fill materials and therefore offers a very good opportunity to utilise the public fill generated in the HK SAR. The use of public fill will not only alleviate the demand for virgin fill material but also reduce the pressure of disposing inert Construction and Demolition Material (C&DM) at the strategic landfills. The intention to maximise the use of good quality public filling material reclamations has been incorporated into the engineering design of the Project whilst ensuring that the programme is not adversely affected. Apart from Penny Bay Reclamation Stage I, over 77% of the fill requirements for other reclamations will make use of public fill. These initiatives will have indirect environmental benefit.

3.4.3 Waste arising during full operational is estimated to be approximately 335 tpd. With proper planning and management as well as waste avoidance and recycling measures, it is considered that the handling and disposal of waste arising from the Project will not cause insurmountable impacts.

3.4.4 A waste avoidance and recycling programme, which forms a major part of the Theme Park (Phases I and II) Waste Management Plan for the operation of the Theme Park and associated development, will be implemented and closely monitored. Similar plans are

recommended for the operation of other tourism and recreational developments such as Theme Park Extension, Tourist and Convention Village, Eco Park, Water Recreation Centre, Technodrome, and the recreational development at Tsing Chau Tsai East.

3.4.5 The assessment indicates that the NLTS will be able to handle the waste arising from the NLDFS developments.

3.4.6 Good waste management practices have been recommended to ensure that adverse environmental impacts from NLDFS developments and CKWLR construction and operational wastes are prevented. This EIA concludes that no unacceptable environmental impacts will result from the storage, handling, collection, transport, and disposal of wastes arising from the construction and operation of the NLDFS developments and CKWLR.

3.4.7 No biogas emission is envisaged at the Theme Park (Phase I) due to the adoption of a fully dredged reclamation option. As it is not possible to measure possible methane emission from the organic sediment within the proposed undredged areas, the gas generation rate has been estimated based on total organic carbon and sediment oxygen demand levels of the marine sediment using certain conservative assumptions. On the basis of the results of the sediment analysis and comparison with published guidance on safe levels of gas emissions, the predicted rate of gas generation is within the range which may be considered as ikely to be safe' and will not constraint the developments on top of the reclamation areas.

3.5 TERRESTRIAL ECOLOGY

3.5.1 The major habitat types within the Project Area comprise secondary woodland, tall shrubland, grassland/shrubland mosaic, brackish/freshwater wetland, village orchard, wasteland, plantation, freshwater streams, as well as backshore vegetation. The field surveys which have been undertaken indicate that the grassland/shrubland mosaic, which are typical of similar habitats elsewhere in Hong Kong, are the main habitat type. The identified secondary woodland, backshore vegetation and freshwater stream habitats are considered to have moderate to high ecological value, and all the others habitats a low value.

3.5.2 A number of plant species with ecological interest are present within the Study Area which may be affected by the proposed NLDFS developments and CKWLR including *Thespesia populnea* (Portia Tree) at Fa Peng and Pa Tau Kwu Pak Wan, *Lilium brownii* at Fa Peng Teng (Chinese lily), *Amorphophallus variabilis* (Snake Aroid) at Tso Wan, *Eriocaulon merrilli* (Pipewort) at Penny Bay and herb *Schoenus falcatus* at Penny Bay and Chok Ko Wan Tsui.

3.5.3 Two locally rare faunal species have been recorded in the Study Area: the Rice Fish (*Oryzias latipes*) in the lower Mong Tung Hang Stream and the White-bellied Sea Eagle (*Haliaeetus leucogaster*) in the Pa Tau Kwu woodland, respectively.

3.5.4 The proposed developments associated with the NSLD and CKWLR will generally lead to a loss of low ecological value terrestrial habitats with low ecological impact. Mitigation measures for the development are recommended to avoid or reduce the potential impacts on the secondary woodlands, backshore vegetation, natural streams, rare/restricted/ protected plant species, Rice Fish and the White-bellied Sea Eagle.

3.5.5 Stream habitat creation is also recommended to compensate for the loss of the permanent freshwater stream at Fa Peng and behind the GTP.

3.5.6 During project construction and operation, the potential disturbance to a pair of White-bellied Sea Eagles in the Project Area was considered moderate. Although construction disturbance effects (e.g. noise) could potentially be controlled such that disturbance to the Eagles would be minimised, and the Theme Park fireworks displays would be located about 800 m from the nesting site to reduce potential disturbance, abandonment of the nest site as a result of disturbances could not be ruled out. However, the closest point from the Theme Park to the nest site would be about 500 m and in the worst case scenario of nest abandonment, the White-bellied Sea Eagles should be able to find suitable alternative nesting sites. Hence, no significant residual impacts are expected, though construction and operation EM&A was recommended to provide feedback into construction and operation to minimise any disturbance.

3.6 MARINE ECOLOGY

3.6.1 Literature reviews of existing information supplemented with the results of Project field surveys on marine ecological resources indicate that the intertidal rocky shores within the Study Area are of medium ecological value whereas for the sandy habitats, low ecological value was assigned. Soft bottom habitats identified in the review were regarded as of low ecological value. A small area containing high ecological value assemblages of hard corals will be lost as a result of the reclamation activities. Information on baseline conditions suggests that no species of conservation importance have been recorded from the marine areas close to the reclamation site, with the exception of the Indo-Pacific Humpbacked Dolphin. However, as the waters near the proposed NLDFS reclamation sites do not appear to be highly utilised by the dolphins, it is unlikely that this area contains critical Indo-Pacific Humpbacked Dolphin (*Sousa chinensis*) habitat.

3.6.2 Potential impacts to marine ecological resources from the proposed construction works may arise either indirectly, e.g. through perturbations of the surrounding water quality, or directly as a result of habitat loss. The natural intertidal and subtidal assemblages within the various reclamation footprints will be lost permanently. However, it is anticipated that given adequate seawall design, assemblages typical of those lost will recolonise after reclamation. Indirect impacts during the reclamation process, such as an increase in suspended solids levels and decrease in dissolved oxygen in the water column may impact intertidal and subtidal filter feeders and other marine organisms. However, the effects are not expected to be severe and no unacceptable impacts are predicted to occur from NLDFS developments or CKWLR Project construction.

3.6.3 Operational impacts to marine ecological resources may occur through disturbances to water quality due to changes in the hydrodynamic regime of the area or due to polluted discharges into the marine environment. It is expected that all NLDFS developments discharges will comply with the *Water Pollution Control Ordinance* discharge standards and consequently marine ecological resources will be protected from impacts. Minor changes in the local hydrodynamic regime are predicted although these are not expected to alter water quality to an extent that marine ecological resources are affected. An increase in the number of vessels travelling to and from the Pearl River Delta and the NLDFS is predicted to occur. Many of these vessels on the northshore of Lantau are expected to be high speed ferries to and from the cross boundary ferry terminal (CBFT) which could potentially impact dolphin

populations. Mitigation measures have been recommended to minimise disturbances to dolphins.

3.6.4 Mitigation measures specific to marine ecology include the provision of either rubble mound, armour rock or concrete armour seawalls on the edges of the reclamations to facilitate colonisation by intertidal organisms and corals which will be lost as a result of the construction of the reclamation. Mitigation measures designed to minimise impacts to the seasonal population of marine mammals that use the area include restrictions on vessel speed and the use of bubble curtains during underwater percussive piling work for construction of the CBFT and Road P1. Other mitigation measures designed to mitigate impacts to water quality to acceptable levels (compliance with WQOs) are also expected to mitigate impacts to marine ecological resources.

3.6.5 The impacts occurring as a result of construction and operation of the NLDFS are the direct loss of 258 ha of the low ecological value soft benthic assemblages, 4.6 km of medium and low ecological value intertidal shores and 0.16 ha of high ecological value coral habitat. The loss of the habitat within the areas to be reclaimed can be mitigated through the provision of 11.3 km of rubble mound, armour rock or concrete armour sloping seawalls which are suitable for the colonisation and growth of intertidal organisms. These seawalls will provide 3.1 ha which are suitable for the colonisation and growth of corals. This mitigation measure reduces the magnitude of the residual impact to acceptable levels.

3.6.6 The cumulative losses of habitats as a result of NLDFS developments, Theme Park and its associated developments and Route 10 are the direct loss of 558 ha of soft bottom benthic habitat, the severity of which is anticipated to be acceptable as the areas to be reclaimed are of low ecological value. The residual impact is considered to be acceptable as the habitat is of low ecological value and the rubble mound, armour rock or concrete armour sloping seawalls and Artificial Reefs to be deployed will assist in enhancing the marine ecology of the area surrounding the completed reclamations. The direct loss of 0.458 ha of subtidal hard surface habitats of high ecological value is unlikely to be acceptable without mitigation. The provision of rubble mound, armour rock or concrete armour sloping seawalls is expected to provide greater than 7.4 ha of habitat suitable for colonisation by corals. With these mitigation measures in place the residual cumulative loss of subtidal habitat is considered to be acceptable. The direct loss of 4.68 km of natural and 4.27 km of artificial intertidal habitats, the severity of which is anticipated to be acceptable in the light of the provisioning of greater than 15.2 km of sloping artificial seawalls that are ecologically enhancing.

3.6.7 An ecological monitoring and audit programme involving the use of dive surveys will be conducted to report on the progress of colonisation of the rubble mound, armour rock or concrete armour sloping seawalls once construction works have ceased. As an additional habitat enhancement measure the Project Proponent of the Theme Park EIA, CED, has undertaken to deploy Artificial Reefs (AR) in Hong Kong waters at a site (or sites) to be decided upon consultation with AFCD and others. The location and feasibility of the AR within the Project Area is subject to detailed study. Construction phase dolphin monitoring should be conducted to evaluate whether there have been any effects on the animals. Operation phase dolphin monitoring should be conducted for a period of two years on commencement of operations of the CBFT by a qualified research team, to evaluate whether there have been any effects on the animals. Further monitoring and audit activities specifically designed to assess the effects of the reclamation activities on marine ecological

resources are not deemed necessary as those conducted to detect and mitigate any unacceptable impacts to water quality will serve to protect against unacceptable impacts to marine ecological resources.

3.7 FISHERIES

3.7.1 A review of existing information on capture fisheries indicates that the value and productivity of the adult fisheries resources in the marine areas close to the proposed reclamation sites are in general low. Adult capture fisheries resources are unlikely to be adversely impacted by the NLDFS and CKWLR Projects as they will likely avoid the works areas. Ichthyopankton survey had been undertaken for wet and dry seasons. Although impacts to fish fry may occur through the permanent loss of habitat and/or elevated suspended sediment levels as a result of the proposed reclamation works, these impacts have been deemed acceptable as these waters are not an important nursery or spawning area for commercial fisheries species. Any impacts which are predicted can be mitigated through Project design. Any measures which are required to reduce impacts to water quality will also serve to protect against unacceptable impacts to capture fisheries resources.

3.7.2 In terms of residual impacts to capture fisheries, the combination of the small loss of fishing grounds and the low value to the Hong Kong fishery are expected to be compensated for by the potential environmental benefits of the proposed rubble mound, armour rock or concrete armour sloping seawalls. Artificial Reefs have been recommended for deployment as an additional marine ecology and fisheries habitat enhancement measure. As a result, the residual impacts to capture fisheries through the construction and operation of the NLDFS and CKWLR Projects has been deemed acceptable.

3.7.3 In terms of impacts to the culture fisheries, the Ma Wan Fish Culture Zone (FCZ) is not predicted to be impacted by either suspended solids elevations, dissolved oxygen depletions or nutrient elevations as a result of the either the construction or operation. Discharges comply with WPCO standards and any potential impacts to water quality and, therefore, culture fisheries resources at the FCZ, will be avoided. Project changes to the hydrodynamic regime are not expected to impact the water quality of the FCZ as current speeds are expected to be only minimally affected.

3.8 RISK ASSESSMENT

3.8.1 A number of potential sources of hazard have been identified within the Project Area. These include the Siu Ho Wan Water Treatment Works, which is classified as a Potentially Hazardous Installation, the proposed Tang Lung Dangerous Goods Anchorage, the Towngas high pressure gas pipeline which has a landfall at the Luk Keng headland and runs along the North Lantau coast to Tai Ho, and the handling and storage of fireworks and sodium hypochlorite at the Theme Park (Phases I and II).

3.8.2 Based on the identification of hazard sources within the NLDFS Study Area, the proximity of the proposed NLDFS developments to these hazard sources and the additional population due to the proposed NLDFS developments, it is found that the proposed developments considered in the Draft RODP do not contribute to any significant increase in overall risks from the hazard sources.

3.8.3 It is concluded that the Draft RODP is compatible with Hong Kong Risk Guidelines and are feasible from hazard to life considerations.

3.9 LANDSCAPE AND VISUAL IMPACT

3.9.1 The Northshore Lantau area is rural in nature with significant intrusions along the north coast in the form of the NLH. Elements consist of natural and man-made coastlines, bay and coastal waters, undulating hills and upland area, associated with Fa Peng Teng, Tai Yam Teng and Tai Shan, and some small streams and associated valleys. Upland areas are dominated by grassland, and denser shrubland and woodland exist in scattered groups along sheltered stream courses and the lower slopes. Many of the streamcourses in the north of the study areas have already been altered due to construction of the NLH corridor. Much of the coastline has already been disturbed or reclaimed.

3.9.2 Development is proposed predominantly on reclamation and the local natural landscape will remain relatively undisturbed. Impacts will be concentrated on the south and east on Tsing Chau Tsai headland due to cut slopes for the construction of the CKWLR and the service reservoir. Additional smaller impacts will occur on the south and east Fa Peng Teng hillsides due to construction of the Road P1 extension, tunnel portals and at Ngong Shuen Au due to loss of woodland for CKWLR.

3.9.3 Landscape character on Fa Peng Teng will change from primarily natural hillsides to a zone containing a road and the reservoir with associated slope cuttings, although much of the hillsides will retain their overall character. The change of Penny Bay from a bay to a reclaimed area will represent a major change in character. The proposed development will cause a change of the overall character of this eastern end of Lantau, from being distinctly rural to a more sub-urban tourism and recreation oriented landscape, with a mix of build up and natural areas.

3.9.4 Visual impacts will arise from the extension of the coastline along the northern side of Lantau. However, much of its coastal areas are already reclaimed and is dominated by the NLH and Airport Railway. The predominantly low rise development complimented by comprehensive urban design and landscaping will provide the opportunity to create a new character to the coastal zone to screen and buffer the transport corridor. The recent policy decision for enhancing the existing NLH corridor and the landscape treatment of the

additional transport infrastructure will provide an opportunity to achieve such objectives and will have a beneficial impact visually on the Northshore Lantau area.

3.9.5 On the southern side of Lantau the impacts are likely to be greater overall as the change in character will be from the current bay with limited disturbance to a large reclamation. The change of character will be great, but will also provide opportunity to create positive visual features and high quality landscaping of the area.

3.9.6 The main landscape impacts after mitigation are the loss of good quality woodland, shrubland and natural coastline. A range of mitigation measures have been proposed in the form of compensatory planting and provision of naturalistic contours. Rough blasting for cut slopes will reduce impacts to the greatest extent. Visual impacts will be substantially alleviated by mitigation measures. Impacts that persist are associated chiefly with the slope cutting for CKWLR at Pa Tau Kwu.

3.9.7 The primary residual impact that have been identified are the loss of the bay at Penny Bay and coastal water on the Northshore Lantau and the adverse impact of the CKWLR on local landscape and visual quality of the area. However, the development will introduce a high quality tourism and recreational area which is a new landscape character. In accordance with the EIAO TM, the landscape and visual impacts are considered acceptable with mitigation.

3.10 HISTORICAL, ARCHAEOLOGICAL AND CULTURAL HERITAGE

3.10.1 Desk-top literature review and field surveys were conducted to assess the cultural heritage impacts. The NLDFS developments and the CKWLR have been designed with due consideration to avoid and minimise the potential impacts to the known archaeological sites as far as practicable.

3.10.2 Mitigation measures to heritage resources such as temporary coverage of the archaeological site before construction have been recommended to ameliorate the potential impacts. In order to ensure the preservation of the heritage sites within the Project Area, a number of archaeological sites, heritage building structures, and grave sites located in the vicinity to construction sites have been recommended to be shown on construction plans as emporary protection area". The sites will be fenced off during the construction period.

3.10.3 Preservation by record prior to the reclamation of Chok Ko Wan archaeological site has been recommended to mitigate the impact through implementation of a full rescue programme. Field evaluations conducted at the proposed Tso Wan Village Expansion Area site have identified three grave sites and two boundary stones. No significant archaeological remains have been identified during the field evaluations.

3.10.4 The preferred alignments of CKWLR and Road P2 may have impact on potential archaeological deposit at the original coastal area currently covered by Cheoy Lee Shipyard. Field evaluation at the Cheoy Lee Shipyard site has been recommended to provide data for the design of the structural support locations of the roads. Rescue excavation may be considered if avoidance of impacts is considered impractical.

3.10.5 Detailed design of certain developments and infrastructures including the Road P1, drainage channel at Fa Peng, looking out area at Fa Peng Teng and services reservoirs at Yam O Tuk should avoid direct impact to the archaeological sites in the vicinity as far as practicable.

3.11 LAND CONTAMINATION

3.11.1 Contaminated land issues have not been identified as a major concern for the Study Area, with the exception of the Cheoy Lee Shipyard (CLS) site. However, the NLDFS EIA comprises Schedule 3 level coverage of the environmental impacts arising from shipyard decommissioning, although access to the shipyard site was not available as part of the Schedule 3 NLDFS EIA, due to its present operation and private ownership. A separate and subsequent EIA Study will be commissioned by CED before the decommissioning of the CLS. This subsequent decommissioning EIA, which, due to access requirements can only commence after the shipyard property has become available, will include detailed site investigation and formulation of appropriate remedial methods and procedures, if required, to decontaminate the shipyard site. CED presently expect this decommissioning EIA to be completed and submitted under the EIAO to DEP for approval in 2002. More importantly, this decommissioning EIA will need to be approved under the EIAO, and an Environmental Permit issued by the DEP before any construction work can commence in the shipyard area.

3.11.2 As a result of the CLS site Schedule 2 EIA described above, appropriate remediation will be performed in accordance with EPD guidelines for the decommissioning of the shipyard site, future potential negative impacts are not expected. The concerns for potential impacts of land contamination are reduced further as there have been no documented spillages or confirmed leakages from this shipyard site, or any other facilities within the Study Area according to Government sources. Where shipyard facility operations are noted to be a concern for causing potential contamination, it is noted that standard mitigation measures will be employed, thereby reducing the need for contact with any potentially contaminated soils during construction works. In order to provide quantitative information to the limited extent possible, a preliminary sampling programme was conducted along a stream bed discharging from the southeastern boundary of the CLS site. The results of five soil samples indicated that, whilst low concentrations of total petroleum hydrocarbons (as gasoline) and 11 heavy metal compounds were detected in some samples, the concentrations were not a major concern. Almost all of the detected metal compounds were noted to be below the respective Dutch ” Value concentrations, which would imply clean, uncontaminated soil. Likewise, there was also no sign of elevated levels of contamination in the marine sediment samples taken from outside the seaward boundary of the shipyard. Therefore, assuming that remedial measures prescribed by the CLS site Schedule 2 EIA are conducted in accordance with appropriate protocols and the *Guidance Notes* (this will be verified in the CLS site Schedule 2 EIA), there will be no potential residual negative impacts, and no insurmountable conditions for the future use of the former CLS site for road and railway access to the Theme Park (Phases I and II) and associated developments.

3.12 ENVIRONMENTAL MONITORING AND AUDIT (EM&A)

3.12.1 An EM&A Manual has been prepared for the Project which contains detailed EM&A arrangement for the construction of CKWLR. It is envisaged that there may be multiple contracts underway in the area during the construction of CKWLR for which an Environmental Projects Office (ENPO) will be set up to integrate the reclamation and construction works in the North-East Lantau area. The Project EM&A Manual which has recommended a comprehensive EM&A programme comprising monitoring before construction and monitoring and audit during both construction and operation of the Project for air (baseline, construction and operation), noise (baseline, construction and operation), water (baseline and construction), waste management (construction and operation), terrestrial (baseline, construction and operation), and marine ecological (baseline, construction and operation) resources.

3.13 BENEFITS AND ENVIRONMENTAL ENHANCEMENTS ARISING FROM THE PROJECT

3.13.1 The perceived benefits associated with the tourism and recreational developments are expected to be primarily of an economic nature. The Theme Park development and hotels, and other proposed recreational developments would be expected to strengthen HK SAR role as major tourist destinations in Asia and the world and generate substantial employment opportunities during both construction and operation. The proposed housing in Siu Ho Wan would help increase housing supply to meet the demand.

3.13.2 The reclamation for the Theme Park and associated developments will require a large amount of fill material and therefore offers a very good opportunity to utilise the public fill generated in the SAR. The use of public fill will not only alleviate the demand for virgin fill material but also reduce the pressure of disposing inert Construction and Demolition Material (C&DM) at the strategic landfills. The entire NLDFS has assumed an overall 40% of the total filling material to be public fill. The reclamation design intention is to maximise the use of good quality public filling material for the proposed reclamations. Except for the Penny Bay (Stage I) Reclamation which the use of public fill is constrained by the construction programme, over 77% of public fill will be used as fill materials at other proposed NLDFS reclamations.

3.13.3 The proposed NLDFS developments will transform the area from a predominantly rural to a suburban area with tourism and recreation oriented landscape. It will provide an opportunity to create positive visual features and a high quality landscape setting.

3.13.4 The Cheung Sok Island has been zoned Conservation Area in the OZP. A preliminary planning concept of an Eco Park has been proposed at Luk Keng under the Draft RODP, subject to further investigation, and it is expected that recreation of habitats or introduction of new habitats/ species would be required to upgrade the interest of the site and enhance visitor appeal.

3.13.5 The deletion of two reclamation areas (about 16 ha) to the south-west and east of Cheung Sok from the previous North-East Lantau Port OZP has preserved approximately 1 km of natural coastline.

3.13.6 As an additional habitat enhancement measure the Project Proponent of the EIA for Construction of an International Theme Park in Penny's Bay of North Lantau and Its Essential Associated Infrastructures has recommended to deploy 4,350 m^3 Artificial Reefs (ARs) in Hong Kong waters at a site (or sites) to be decided upon consultation with the AFCD. ARs act as fish aggregation devices and provide hard bottom, high profile habitat in areas without natural cover. The AR subsequently will provide food, shelter and a nursery ground for commercial fish and, over the long term enhance fishery stocks. Enhanced fish stocks in the area will not only benefit local fishermen but will also increase the availability of prey items for the seasonal population of marine mammals that use the area. One potential location for the deployment of the ARs includes the area north of the Luk Keng headland. The location and feasibility of AR within the Project Area is subject to detailed study.

3.13.7 The rubble mound, armour rock or concrete armour sloping seawalls proposed for the reclamation have been demonstrated to become colonised by subtidal hard surface assemblages, such as soft corals, gorgonians and hard corals. Thus the potential habitat provided by the total surface area of the such sloping seawalls of the NLDFS reclamations is expected to mitigate for the loss of natural shorelines whilst providing additional habitats and benefit to Hong Kong marine ecology and fisheries after construction.

3.13.8 Secondary woodland planting will compensate for the approximate loss of 1.8 ha of the woodland at Ngong Shuen Au which cannot be avoided by the PBRL, Road P2 and CKWLR alignment has been recommended. As considerable areas, not less than 7 ha, of woodland planting are proposed as landscape and visual impact mitigation on the adjacent hill side to the east of Ngong Shuen Au, sufficient compensatory woodland will be provided. Species used for planting should take reference from the species identified in the Tree Survey and be native to Hong Kong or South China region.

3.13.9 The use of fabric (plastic) fenders instead of tropical hardwood fenders has been recommended in the proposed Theme Park Ferry Pier and service quay, as well as the Cross Boundary Ferry Terminal construction.

3.13.10 The use of wooden hoardings in the Project construction will not be allowed and metal (aluminium, alloy, etc.) has been recommended to help reducing the construction and demolition (C&D) wastes.

3.13.11 The Theme Park operator, HKITP, will additionally benefit the environment by implementation of waste reduction initiatives. The quantity of recyclable materials potentially recovered by local recyclers under market driven conditions is estimated to be about 23 to 26% of the total waste generated. These estimates are based on the market conditions in Hong Kong. The analysis on the markets show that the market for the major recyclables exists, especially when source separation programmes are in place to enhance the market value of the materials. It has been recommended in the Theme Park EIA that the operator should institute a source separation programme to recover recyclables from the remaining waste stream with a recycling target of an additional 10% for remaining recyclable materials and an extra 10% for food waste if a composting facility is available in HK SAR. A waste avoidance and recycling programme, which forms a major part of the HKITP Waste Management Plan for the operation of the Theme Park, should be implemented and annually monitored. It is recommended similar waste reduction and

recycling arrangement could be considered by other NLDFS tourism and recreation developments.

3.13.12 The current dredged and drained design of Penny's Bay Reclamation will have a 30% decrease in total dredging volume, a 34% decrease in fill volume, and a 97% reduction in the volume of contaminated sediments requiring disposal compared to the previously proposed combined Container Terminals No. 10 & 11 Ancillary Works (Design) and the Design of Reclamation and Edge Structures for Container Terminals 10 and 11 and Back-up Areas (fully dredged option) of the Lantau Port Development - Stage 1 Study.

3.13.13 Environmental benefits will also arise from the conversion of land uses from port developments to tourism and recreation purposes, in particular for visual and landscape aspects.

3.13.14 The public modes of transport to the proposed NLDFS developments are expected to dominate. Of the public modes, the rail mode will be dominant mode of access to the Theme Park through the proposed Penny's Bay Rail Link, which is connected with the Tung Chung Line, and its possible future extensions and will be complemented by other transport modes and the provision of integrated transport facilities (PTIs at Yam O and the Theme Park) to improve accessibility by rail.

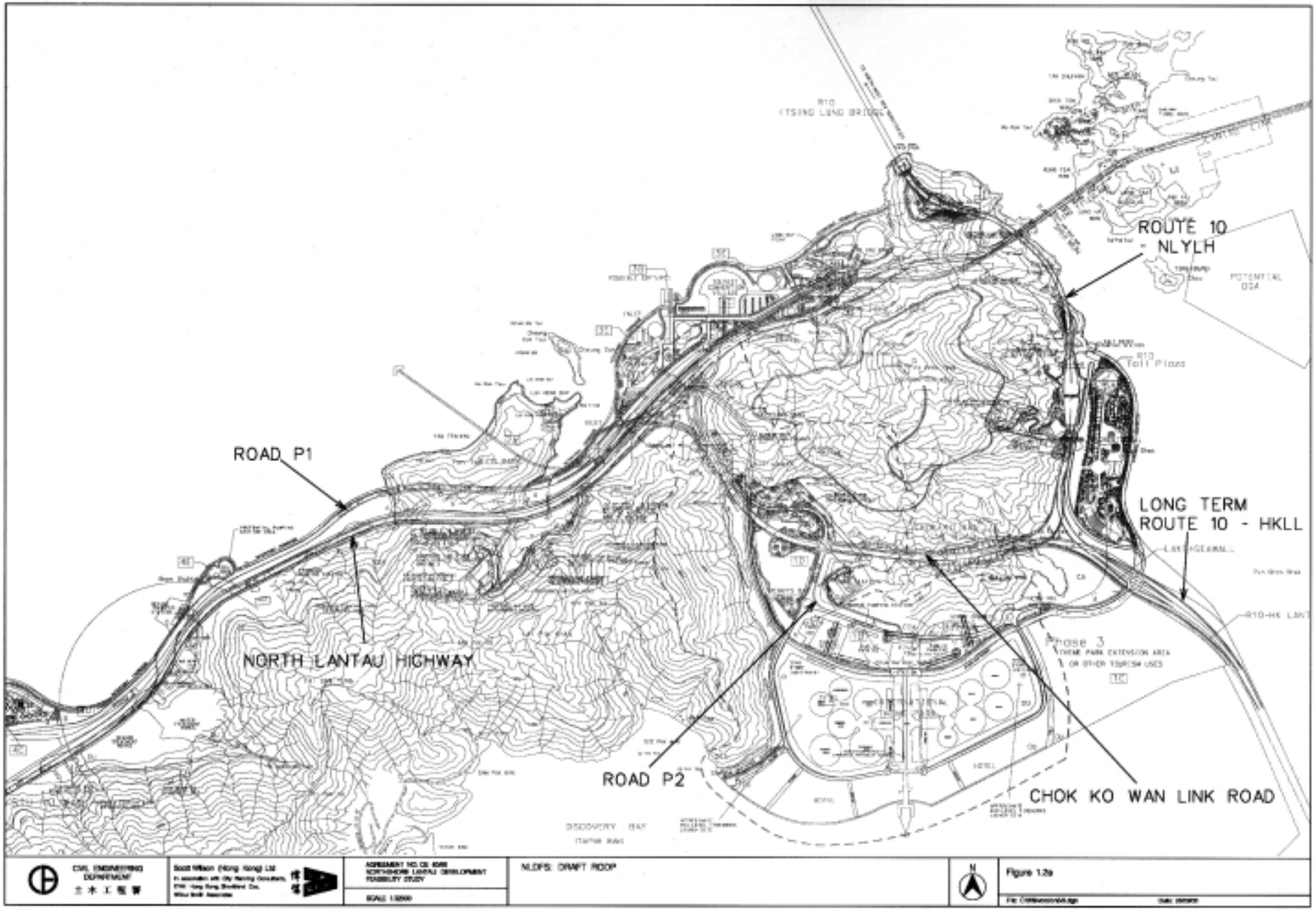
4. OVERALL CONCLUSIONS

4.1.1 The EIA has, based on the latest information available, critically assessed the overall acceptability of the adverse environmental consequences that are likely to arise as a result of the Project and, where necessary, has specified the conditions and requirements for the detailed design, construction and operation of the Project to mitigate against adverse environmental consequences, wherever practicable.

4.1.2 The EIA for NLDFS and CKWLR has predicted that the Projects will comply with all environmental standards and legislation after the proposed construction and operational stage mitigation measures are implemented and has thus demonstrated the acceptability of residual impacts. EM&A mechanisms have been recommended before, during construction and operation to verify the accuracy of EIA predictions and effectiveness of recommended mitigation measures.

4.1.3 In conclusion, the EIA has determined that the preferred CKWLR alignment and its associated 17 ha reclamation at Tsing Chau Tsai East are considered to be environmentally acceptable. It also provides a suitable basis for the Director of Environmental Protection to consider granting an Environmental Permit to allow the construction and operation of CKWLR (Yam O Interchange to R10-NLYLH toll plaza section).

4.1.4 The EIA has also demonstrated the environmental feasibility of the NLDFS developments and infrastructures proposed in the Draft RODP and there should be no insurmountable environmental impacts during the construction and operational stages. Further studies are likely to be required for DPs within NLDFS where sufficient details are not presently available in this EIA, as listed in Section 1.2.4.


ROUTE 10
- NLYLH
ROAD P1
NORTH LANTAU HIGHWAY
LONG TERM
ROUTE 10 - HKLL
ROAD P2
CHOK KO WAN LINK ROAD
NLDFS: DRAFT RODP
Figure 1.2a