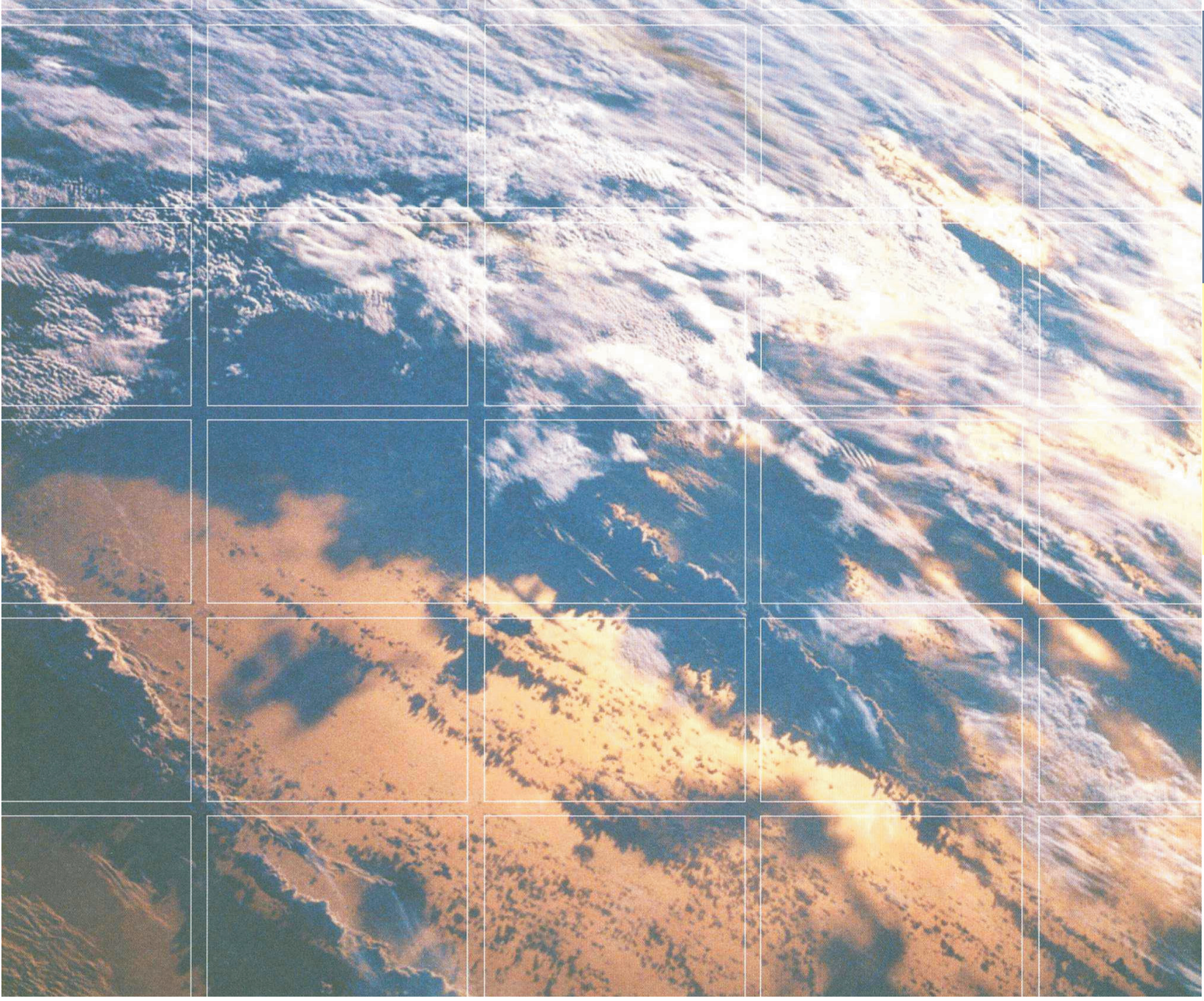

Part 1 - Introduction

Sections 1 - 4

中華電力
CLP Power

ExxonMobil

Capco 青山發電有限公司 Castle Peak Power Co. Ltd.

Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities

EIA Study (EIA Study Brief ESB-126/2005)

EIA Report
Part 1 - Introduction
Sections 1 - 4

22nd December 2006

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ERM

Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities

22nd December 2006

For and on behalf of
ERM-Hong Kong, Limited

Approved by: Robin Kennish

Dr Robin Kennish

Position: Director

Date: 22nd December 2006

ERM

CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

Castle Peak Power Company Limited (CAPCO), a joint venture between CLP Power Hong Kong Limited (CLP) and ExxonMobil Energy Limited (EMEL), is proposing the development of a Liquefied Natural Gas (LNG) Receiving Terminal in the Hong Kong SAR. CLP is the operator of CAPCO's power generating facilities. The facility will provide the infrastructure for a sustainable supply of natural gas (NG) for Hong Kong, primarily to fuel CAPCO's power plant at Black Point but other energy users in Hong Kong, could be considered for terminal access.

The Government's environmental policy includes the control of emissions from the existing power stations in Hong Kong. Central to this effort is the use of natural gas. As a consequence, natural gas is positioned to play an increasingly important role in the generation of electricity. Development of a LNG terminal in Hong Kong will play a key role in the continued use of gas at Black Point Power Station facilitating CAPCO's ability to meet the Government's emission reduction objectives.

1.2 PURPOSE AND NATURE OF THE PROJECT

The Project will provide a replacement for the gas currently supplied to CAPCO from the Yacheng gas field, which is expected to be depleted by early in the next decade. The project involves the construction and operation of a LNG receiving terminal and associated facilities at either South Soko Island or Black Point. The receiving terminal will provide a facility for receiving and unloading of LNG carriers, onshore LNG storage, LNG regasification, and a pipeline for transporting natural gas (regasified LNG) to the existing Black Point Power Station (BPPS). For the South Soko option, the natural gas will be sent via a submarine gas pipeline to a Gas Receiving Station (GRS) at BPPS. For the Black Point option the connection to BPPS will be via a short onshore pipeline within the boundaries of the proposed terminal and the power station. For both site locations, the principal natural gas user will be CAPCO.

The following elements of the Project addressed in this EIA Report are classified as Designated Projects under the *Environmental Impact Assessment Ordinance* (*Cap. 499*) (*EIAO*).

For both the South Soko Island and Black Point options:

- Construction of a storage facility for LNG with a storage capacity of more than 200 tonnes (item *L.2* of *Part I* of *Schedule 2 of EIAO*);

- Dredging operation for the approach channel and turning circle that exceeds 500,000 m^3 (item *C.12* of *Part I* of *Schedule 2* of *EIAO*).

For the South Soko Island option only (1) :

- Installation of a submarine gas pipeline connecting the proposed LNG terminal at the South Soko Island and the Black Point Power Station (item *H.2* of *Part I* of *Schedule 2* of *EIAO*);

- Dredging operation for the installation of a submarine power cable connecting Shek Pik with the proposed LNG terminal at South Soko which is less than 500m from the nearest boundary of an existing Site of Cultural Heritage (item *C.12(a)* of *Part I* of *Schedule 2* of *EIAO*); and,

- Potential dredging operation for the installation of a submarine water main connecting Shek Pik Reservoir with the proposed LNG terminal at South Soko which is less than 500m from the nearest boundary of an existing Site of Cultural Heritage (item *C.12(a)* of *Part I* of *Schedule 2* of *EIAO*).

For the Black Point option only:

- Reclamation works (including associated dredging works) of more than 5 ha in size (item *C.1* of *Part I* of *Schedule 2* of *EIAO*).

This report is prepared by ERM-Hong Kong, Ltd (ERM) in accordance with the *EIA Study Brief* (No. ESB-126/2005) and the *Technical Memorandum of the Environmental Impact Assessment Process (EIAO-TM)*.

(1) For the South Soko option will require the installation of a submarine electricity circuit to provide power for the terminal. The South Soko option may also require the installation of a submarine water main connection to the Shek Pik Reservoir on Lantau Island. The need for this water main connection will not be determined until later in the design process; however, it has been included in this Environmental Impact Assessment (EIA) in case it is required.

1.3 PROJECT HISTORY

CAPCO conducted a study as early as in 1992 (1) to examine the optimum approach to provide a long term secure and reliable supply of natural gas to Hong Kong and in 2003 initiated site search studies (2) to examine the most suitable locations for the LNG terminal.

CAPCO commenced discussions with the members of the Environmental Study Management Group (ESMG) (3) in September 2004 to explain the site selection process and outline a way forward. The ESMG was represented by a range of Government departments on an administrative, advisory basis, to help CAPCO understand the requirements under the EIA Ordinance on environmental, conservation, gas and fire safety, planning, marine and land aspects.

Over a two year period, a number of assessments were undertaken in consultation with the ESMG members to further determine the feasibility of constructing and operating a LNG terminal at either of the two selected sites (South Soko or Black Point) and identifying any significant environmental or risk issues. These assessments were based on a set of conservative design assumptions and concluded that both South Soko Island and Black Point were considered feasible for locating a LNG terminal, subject to further analysis under the *Environmental Impact Assessment Ordinance (EIAO)* process.

At the same time, CAPCO commenced a dialogue with other key stakeholders including Non-governmental Organisations (NGOs) and community groups to seek feedback on their proposals and factor some of the issues raised into the design plans prior to commencing the formal *EIAO* process. More than 350 seminars, meetings, workshops and exhibitions were held in the past 18 months (4).

The outcome (5) of the discussions with Government and other stakeholders was that the two sites would be taken forward into the formal *EIAO* process and an EIA Study conducted on each.

(1) LNG Feasibility Study, Joint Study by CLP, Shell, Total with Guidance from EPD, September 1992
(2) a) EIA Project Profile, Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities, 13 May 2005, b) EIA Report: Part 1 - Introduction Section 4 – Identification of Alternative Site Locations
(3) Five ESMG meetings were held on 6 September 2004, 19 October 2004, 23 November 2004, 3 February 2005, and 26 April 2005, with representatives from Environmental Protection Department, Electrical & Mechanical Services Department, Marine Department, Lands Department, Home Affairs Department, Civil Engineering and Development Department, Antiquities & Monuments Office, Agriculture, Fisheries and Conservation Department, Planning Department, Fire Services Department
(4) "Interesting Facts on LNG Receiving Terminal Project in Hong Kong", CLP, 2006
(5) a) EIA Project Profile, Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facillities,13 May 2005, b) EIA Study Brief ESB-126/2005, c) this EIA Report

1.4 COMMUNITY CONSULTATION AND ENGAGEMENT

Over the course of the project, CAPCO has engaged a wide range of stakeholders, to obtain their input to the assessment and selection of a preferred site for the LNG terminal.

Stakeholders representing government departments, advisory and statutory bodies, local community groups, NGO's, District Councils, Rural Committees, political parties and professional organisations have participated in briefings, workshops and site visits. These interactions have facilitated CAPCO's understanding of the concerns of the project stakeholders and contributed to the project's design evolution which has enhanced its overall environmental performance. Site specific feedback is discussed in *Section 2* of Part 2 and Part 3 of this EIA Report.

Stakeholders expressed their input on a wide range of issues; security of supply, the environmental benefits of natural gas as a fuel for power generation, the site selection process, safety of LNG transport and storage, effects on tariff, and environmental impacts such as marine and terrestrial ecology, fisheries, and landscape and visual aspects. Their input assisted in guiding the progress of the EIA, and its presentation in this report (1) .

Since the consultation activities for the LNG terminal project began in September 2004, CAPCO's engagement activities have included:

- Ten familiarisation visits to the sites at Black Point and South Soko attended by ACE members, LegCo members, political party representatives, NGO's, and the media.
- Four Engagement Workshops attended by 10 different NGO groups attending one or more workshops.
- Individual meetings with NGO / Green Group representatives.
- Briefings for local political bodies, politicians, LegCo members and the Advisory Council on the Environment.
- Briefings to professional bodies such as the committee members of the Environmental Division and Electrical Division of the Hong Kong Institution of Engineers.
- A series of discussion sessions with representatives of the South Soko Fishermen's Groups and the Tung Chung residents representatives.
- Briefings have been provided to the Island District and Tuen Mun District councils, the Heung Yee Kuk, the Tuen Mun and the Tai O Rural Committee.

(1) NGO attendance and view sharing was on a no commitment basis and was for information and opinion sharing purpose.

- Briefings have been provided to Britcham, AMCHAM, HK General Chamber of commerce.

- Individual responses to written submissions.

- A telephone enquiry hotline (tel. 2678 8189) and an electronic feedback area on a designated LNG project website (www.clpgroup.com/environment/lng).

- A roving exhibition have been organised at Tuen Mun, Mongkok and Tung Chung.

To encourage wider understanding of the project, brochures in English and Chinese were prepared and distributed, and a short video "Cleaner Fuel for Cleaner Air" was uploaded onto the CLP corporate website and shown in CLP customer Service Centres. Information fliers were also distributed to all CLP customers through electricity bill inserts.

1.5 PURPOSE OF THIS EIA REPORT

The purpose of this EIA Study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project and related activities that take place concurrently. This information will contribute to decisions by the Director of the Environmental Protection Department on:

- The overall acceptability of any adverse environmental consequences that are to arise as a result of the Project and the associated activities of the Project;

- The conditions and requirements for the detailed design, construction and operation of the Project to mitigate against adverse environmental consequences; and

- The acceptability of residual impacts after the proposed mitigation measures are implemented.

The detailed requirements of the EIA studies of each site are set out in the *EIA Study Brief* in *Section* 2.1.

As specified in the EIA Study Brief, the respective EIAs have addressed the key environmental issues associated with the construction and operation of the Project. These key issues are discussed further in Part 2 and 3 of this EIA Report.

1.6 THE STRUCTURE OF THIS REPORT

This EIA Report comprises the following Parts and Sections.

PART 1	**MAIN INTRODUCTION**
Section 1	Presents the introduction to this EIA Report and the background to this Study.
Section 2	Provides information relating to the need for a LNG terminal in Hong Kong and how other options for provision of LNG were analysed
Section 3	Presents information on what the development of a LNG terminal in Hong Kong would entail.
Section 4	Presents information on the consideration of alternative sites for locating a LNG terminal within Hong Kong.
PART 2	**EIA OF SOUTH SOKO (see table of contents therein)**
PART 3	**EIA OF BLACK POINT (see table of contents therein)**
PART 4	**SITE PREFERENCE (see table of contents therein)**

In addition to the EIA Report there is a separate Executive Summary and Environmental Monitoring and Audit Manuals for South Soko and Black Point.

2 THE NEED FOR A LNG RECEIVING TERMINAL IN HONG KONG

2.1 INTRODUCTION

Since 1996 with the commissioning of the Black Point Power Station (BPPS), natural gas has been an important component of CAPCO's fuel supply. Use of natural gas has delivered significant environmental benefits as well as added diversity to the fuel mix used for electricity generation, thereby enhancing the security of electricity generation.

It is estimated that the existing source of CAPCO's gas supply, the Yacheng field off Hainan Island in the South China Sea, will be (1) depleted early in the next decade, depending upon the rate of offtake and actual reserve levels. As analysed in *Section 2.8* below, other South China gas reserves appear insufficient to supplement or replace the Yacheng field.

Natural gas is generally delivered to markets in two ways. One is to transport the gas through pipelines directly connecting a gas field to end users, as is now the case for CAPCO. The other alternative is to liquefy the gas and transport it by ship in its liquid state, to receiving terminals where it is then converted back to gas form for use.

2.2 FUEL DIVERSITY – BALANCING RELIABILITY, COST AND ENVIRONMENTAL BENEFITS

Over the past decade, the fuel used for electricity generation in Hong Kong has evolved from being primarily coal to a diverse mix that is roughly 30% gas, 30% nuclear, and 40% coal (2).

Due partly to the introduction of nuclear power and natural gas into the fuel mix, CLP's air emissions from power generation have significantly improved, with nitrogen oxides (NO_x down 77%, sulphur oxides (SO_x) down 44% and particulates down 70% over the period between 1990 and 2005 (3). Fuel diversity has enabled these improvements to be achieved while maintaining competitive tariffs and world-class electricity supply reliability in the supply of electricity. Often taken for granted, these factors are key contributors to Hong Kong's quality of life, competitiveness in the global market, and ability to attract investment. Businesses in Hong Kong, ranging from large multi-national companies to small local shops are all dependent on a cost-competitive and uninterrupted supply of electricity.

(1) Relevant details were provided to Economic Development and Labour Bureau on 2 December 2004. Those details are based on data provided by the Yacheng Gas Sellers and are therefore subject to confidential obligations owed to the Yacheng Gas Sellers under the Yacheng Gas Contract
(2) Estimate for 2004 – 2006 as set forth in the Financial Plan..
(3) CLP Group (2006) Social and Environmental Report 2005.

2.3 BENEFITS OF NATURAL GAS AS A FUEL

There are a number of benefits to utilising natural gas as a fuel in power generation, including:

Proven Use in Power Generation: Natural gas has been employed around the world for electricity generation for over 30 years (1) and is used in the Combined Cycle Gas Turbines (CCGT) at BPPS BPPS uses advanced technology in terms of equipment and operating systems. CCGTs have higher thermal efficiency than conventional fossil fuel fired power stations with the same generating capacity (2).

Adequate Reserves Available: The increasingly wider use of LNG indicates that more of the world's gas reserves are available to consumers in locations remote from existing sources. In 2005 there were 13 countries producing LNG and 15 importing LNG, with total consumption of 141.5 MTA (million tonnes per annum). According to the International Energy Agency (IEA), worldwide LNG production capability is expected to grow to approximately 500 MTA in 2030, representing a 5% annual growth rate (3).

Environmental Benefits: Natural gas is one of the cleanest and most efficient forms of energy available. Natural gas from LNG is clean burning, producing virtually no particulates, and less NO_x and carbon dioxide (CO_2) than other fossil fuels. Since sulphur is almost entirely removed as part of the liquefaction process, combustion of regasified LNG emits negligible amounts of sulphur dioxide (SO_2 (4)).

The Government's environmental policy includes the control of emissions from the existing power stations in Hong Kong. Central to this effort is the use of natural gas. The recognition of the role of natural gas in emissions control was affirmed by the Government in the 2005-06 Policy Address (5):

> *"**61.** To fully achieve the emissions reduction targets in 2010, we have asked the power companies to … use natural gas for power generation as much as possible.*

As a consequence, natural gas is positioned to play an increasingly important role in the generation of electricity. Maintaining a cost-effective, diverse, reliable and adequate supply of fuel will continue to be a priority.

(1) "Evolution of Electricity Generation by Fuel, International Energy Agency, 2006"
(2) 'Introduction to LNG', University of Houston, Institute of Energy, Law & Enterprise
(3) "Wood Mackenzie Research"
(4) IEA (International Energy Agency) Natural Gas Prospects to 2010 (1986)
(5) The 2005-06 Policy Address, Strong Governance For the People, Paragraph 61

2.4 WHAT IS LNG?

LNG is the liquid form of natural gas, the main component of which is methane. In the liquefied form, at atmospheric pressure, LNG occupies only 1/600th of its volume at gaseous state under normal temperature and atmospheric pressure and is therefore more economical to store and transport over long distances in contrast to the traditional pipeline delivery of natural gas.

LNG is produced by cooling natural gas to -162 °C (-260 °F) through a liquefaction process. Prior to cooling and condensing the natural gas into LNG, impurities such as carbon dioxide, water and sulphur are removed. The end result of this process is an odourless, colourless fuel consisting mostly of methane (approximate range 85% to 99%) with small amounts of ethane, propane, butane and pentane.

There are a number of environmental and safety benefits (1) to using LNG, including the following:

- Regasified LNG is clean burning, producing virtually no particulates and less NO_x and CO_2 than other fossil fuels. Since sulphur is almost entirely removed as part of the liquefaction process, combustion of regasified LNG emits negligible amounts of sulphur dioxide.
- LNG is stored at near atmospheric pressure, reducing the storage hazard compared with pressurised fuels
- LNG, when released to the atmosphere at normal temperatures, will evaporate and disperse quickly, leaving no residue behind and therefore requiring no environmental cleanup.
- LNG vaporises when warmed and the resulting natural gas is lighter than air and therefore rises when released.
- LNG is non-corrosive and non-toxic.

2.5 THE LNG VALUE CHAIN REQUIRES LONG TERM PLANNING

The LNG industry can be described by an LNG value chain consisting of 5 key elements :

1. Exploration, development and production of gas,
2. Liquefaction,
3. Shipping,

(1) a) IEA (International Energy Agency) Natural Gas Prospects to 2010 (1986)
b) ttp://www.lngfacts.org/faq/index.html#1 , FAQ, The Center for Liquefied Natural Gas

4. Storage and Regasification,

5. End use (e.g. power generation).

Each of these elements has its own technological and investment requirements, but they share a common characteristic. They all require long project lead time and significant resources and investment commitment. Each element of the chain must be carefully planned and integrated with other elements; hence the supply chain requires long term sales and purchase relationships between each participant.

2.6 DEPLETION OF THE EXISTING GAS RESERVES AT YACHENG 13-1

In the early 1990s, CAPCO examined potential sources of natural gas for Hong Kong (1). The feasibility of developing a LNG terminal was studied by both private interests and the Government. Although feasible sites were identified for a LNG terminal (one of which included locating the LNG terminal at the Soko Islands), the study also considered a submarine pipeline from the Yacheng 13-1 gas field in the South China Sea. The Yacheng field was eventually developed to supply the Black Point Power Station and was expected to provide sufficient gas for 20 years. With the identification and use of this option, the need for a LNG terminal in Hong Kong was deferred. Upon completion of this analysis, CAPCO secured the option of obtaining gas from the Yacheng field through private investments.

A map illustrating the location of the Yacheng 13-1 field and the pipeline connecting to Black Point Power Station is presented in *Figure 2.1.*

Figure 2.1 *Location of Yacheng 13-1 Gas Field and Existing Export Pipeline to BPPS*

(1) LNG Feasibility Study, Joint Study by CLP, Shell, Total with Guidance from EPD, September 1992

Under the contract for the supply of gas to CAPCO, the entire Yacheng 13-1 resource is dedicated to CAPCO, except for a small volume which is delivered to neighbouring Hainan. Gas delivery began in 1996 and was expected to last until 2015 (1).

Given the geological and technical uncertainties of gas production, it is industry practice for reserves to be periodically re-determined. CAPCO's estimates (2) indicate that the Yacheng field will be depleted early in the next decade based on the projected gas offtake rate and actual reserve levels.

2.7 *GAS SUPPLY CRITICAL FOR ELECTRICITY RELIABILITY*

As explained above, electricity reliability plays a key role in Hong Kong's quality of life. The 2,500 MW Black Point Power Station (BPPS) provides about 25% of Hong Kong's total electricity needs, and plays a large part in CLP's 8,888 MW of maximum available electricity supply. In the event that gas was not available to BPPS, CAPCO would need to meet electricity demand by a higher reliance on its available coal-fired generation which would result in increased air emissions beyond existing levels and Government targets. Moreover, with 2005 peak local electricity demand at 6,475 MW and the electricity demand growth from 2006 to 2011, CLP's supply capacity without BPPS would not be able to satisfy electricity demand (total capacity is not available at all times due to maintenance requirements) and Hong Kong consumers would be exposed to possible power cuts or rationing. Although the BPPS is able to use diesel as a fuel, this capability is designed only for short term emergency back up (3). Therefore, the absence of a replacement gas supply would not only entail an environmental impact in terms of increased coal burn and emissions of NO_x, SO_x and particulates, it would also compromise Hong Kong's electricity supply reliability.

Given Hong Kong's total dependence on imported fuel and the importance of a quality and reliable replacement gas supply, CAPCO can only reasonably consider gas supplies that will not compromise Hong Kong's electricity reliability. In order to assess the replacement options, it is vital to have a clear understanding of the requirements for supply of this important fuel. There are 5 fundamental requirements for the replacement gas supply:

1. **Certainty of timely availability**: Given the expected depletion of the Yacheng field early next decade, CAPCO must have absolute certainty that the replacement gas will be available on time. As the gas infrastructure and supply chain typically take 7 - 8 years to put in place (4),

(1) China Started to Supply Natural Gas to Hong Kong, 11 January 1996, Europe/Pacific Regional News (CND-EP, No. EP96-002), China News Digest

(2) Relevant details were provided to Economic Development and Labour Bureau on 2 December 2004. Those details are based on data provided by the Yacheng Gas Sellers and are therefore subject to confidential obligations owed to the Yacheng Gas Sellers under the Yacheng Gas Contract

(3) Long term diesel use would require additional investment in infrastructure, higher fuel cost, and would increase emissions beyond existing levels and Government's targets.

(4) Ranges based on industry project experience for new areas

only alternatives that have already achieved significant engineering and approval milestones together with proven gas reserves and operating track record can provide this certainty.

2. **Supply security for Hong Kong**: Gas is expected to represent up to 50% of CAPCO/CLP's fuel mix by early next decade, and security of gas supply is essential to maintain high levels of electricity reliability in Hong Kong. The required supply security can be provided by:

   a. Priority for CAPCO's gas requirements,

   b. Diversification of supply from at least two sources. Disruptions to fuel supply can occur, as evident with recent gas supply disruptions in Ukraine (1) (which left the country short of gas for a period during winter), Singapore (2) (which resulted in blackouts in many parts of the island state in the summer of 2004), and closer to home with offshore oil production facilities (3) in the South China Sea which were damaged by Typhoon Pearl and inoperational for a prolonged period. Given the increased share of gas in the fuel mix, it is not prudent to depend on only one gas supply source.

   c. Gas supply chain managed by companies with proven track records for operating in line with industry best practices.

3. **Adequate volume and flexibility**: CAPCO's LNG requirement for its current gas-fired generation facilities is about 2.6 million tonnes per annum (MTA) of LNG, which represents roughly 75% of Hong Kong's total gas demand. The replacement supply must be able to meet this initial requirement as well as the following:

   a. Meet gas demand growth in future years as a result of Government's environmental initiatives and Hong Kong's electricity demand growth,

   b. Provide the flexibility for CAPCO to meet seasonal demand patterns and the power plants' operational requirements, and

   c. Enable a smooth transition from Yacheng gas.

4. **Competitive supply**: CAPCO is competing with numerous other buyers for limited supplies of LNG. Suppliers are focusing their efforts on buyers with strong markets for the gas, in addition to having existing terminal infrastructure or comprehensive and advanced plans for developing such terminals. For CAPCO to attract suppliers and achieve the best possible terms on behalf of its electricity consumers, the procurement process must be structured efficiently so as to demonstrate

(1) Rice Faults Russia on Natural Gas Disruption, The Epoch Times, 5 Jan 2006
(2) Blackout plunges parts of Singapore into darkness – Reuters, Business Report, June 29 2004
(3) Update 1 – China oilfield still out after typhoon, Reuters, June 13, 2006

the strengths of CAPCO as a buyer able to undertake long term commitments and demonstrate Hong Kong as a sustainable market. Moreover, the process must be competitive and conducted through a fair and defensible process.

5. **High environmental and safety standards**: CAPCO is committed to responsible environmental management and safe operations. The replacement supply source and its suppliers must perform to internationally acceptable environmental and safety standards.

2.8 *REPLACEMENT GAS SUPPLY ALTERNATIVES*

Given the importance of the availability of replacement gas to Hong Kong, CAPCO has carefully explored and evaluated the possible alternatives to fulfil this fuel requirement. Five potential alternatives have been identified, and each has been systematically evaluated against Hong Kong's requirements as discussed below. The five potential alternatives are as follows:

1. Import gas via pipeline from a nearby gas field;
2. Import Natural Gas via the Guangdong Dapeng LNG terminal (GDLNG) located in Shenzhen;
3. Import Natural Gas via a new terminal outside Hong Kong;
4. Import LNG via a new terminal in Hong Kong; or
5. No action or defer decision.

2.8.1 *Import Gas via Pipeline from a Nearby Gas Field*

The South China Sea contains only limited discovered reserves of natural gas, with the majority of these gas reserves being exploited (1). These gas discoveries are significantly smaller than Yacheng, are of varying qualities and therefore less suitable for use as fuel for power generation, and have been committed to identified customers (aside from the Yacheng Y-13 gas field, other reserves include the Dongfang and Ledong fields which are committed to Hainan (2) and the Panyu and Huizhou fields which have been targeted for users in Zhuhai (3)). Given the above, importing gas from any of the proven South China Sea fields is not feasible because there is insufficient supply

(1) a) Operations Overview – CNOOC Limited 2004 Annual Report, b) Operations Review – CNOOC Limited 2005 Annual Report, c) China Country Profile, EnergyFiles, www.energyfiles.com/asiapacific/asia/countries/china.htm, retrieved on 16 Aug 2006), d) China's CNOOC to develop two new gas fields in South China soon – report, 21 Feb 2005, Beijing (AFX), e) Sinopec Hainan Refinery, CNOOC sign gas supply contracts, puworld.com

(2) a) CNOOC says gas-based fertiliser project to start production on Thursday, Gas Matters Today Asia, 28 June 05, b) Poten & Partners, CNOOC to Build Worlds Largest Methanol Production Base (SinoCast China Business Daily News), June 22 2006

(3) CNOOC Ltd starts gas production at Hui Zhou 21-field in Eastern South China Sea, Gas Matters Today Asia, 19 Apr 2006

available to meet CAPCO's and Hong Kong's long-term needs. Plans for the development of multiple LNG terminals in southern China is clear recognition that gas reserves are insufficient to meet growing demand, and LNG imports are required.

In 2006, there are reports (1) of what could be a significant deep water gas discovery in the South China Sea. At present, information is very preliminary and insufficient to assess whether this deep water field is commercially viable and can play a role in CAPCO's gas supply. Considerable work is required to appraise the reserves and obtain better definition of the field. The typical time to progress a deep water gas discovery from the discovery stage to gas delivery stage is between 8 and 14 years (2) (*Table 2.1*), which is an unacceptably long timeframe for CAPCO's replacement gas supply.

Table 2.1 ***Indicative Timing for Deepwater Development***

Step	Activity	Duration (months)
1	Discovery	0
2	Project owner review	3 - 6
3	3-D seismic acquisition and interpretation	20 - 48
4	Appraisal well drilling, reserves certification	13 - 30
5	Final assessment and Overall Development Plan (ODP) formulation (Marketing)	6 - 12
6	ODP approval	3 – 6
7	Drilling, facility design and construction	48 – 63
8	First Gas	0
	Total Time Required (years)	**8 - 14**

In view of Guangdong's rapidly growing gas needs (3), it is also questionable whether any new proven gas discovery would be available for Hong Kong. And if it were, gas supply from a South China Sea field would require a longer pipeline traversing the western waters of Hong Kong and introducing additional ecological and cost impacts.

2.8.2 Import Natural Gas via the Guangdong Dapeng LNG Terminal (GDLNG)

The GDLNG terminal in Shenzhen, China's first LNG terminal, was commissioned this year. GDLNG's initial capacity of 3.7 MTA (4) and supply are fully committed to its founding shareholders, including seven Mainland Chinese power and gas companies, Hongkong Electric and Hong Kong & China Gas (5). With regard to expanding the terminal, CAPCO assessed this

(1) Update 1 – Offshore China gas find lifts Husky Stock, Reuters, Jun 15 2006
(2) ExxonMobil Development Company, based on previous deepwater project experience
(3) a) CNOOC inks Australian gas deal for Guangdong (China Daily), 3 May 2004, b) On time finish is no pipe dream for LNG project, China Daily, 24 May2005
(4) CNOOC links Australian gas deal for Guangdong (China Daily), 3 May 2004
(5) ASX Announcement – Guangdong LNG Agreement, Woodside, 13 Dec 2004,

option and understands that the limited additional capacity will be dedicated to Guangdong gas users with unknown timing.

Even if a large portion of GDLNG's expansion capacity were available to CAPCO, there would still be environmental considerations, as a new pipeline would need to be installed to Black Point Power Station. An offshore route would be approximately 150 - 160 km in length, approximately four times the length of a pipeline from South Soko Island to BPPS, the latter part of which would traverse the same marine area in the western waters of Hong Kong as a Hong Kong terminal.

An overland route would be approximately 85 km in length of which approximately 55 km would traverse the densely populated city of Shenzhen as well as several populated areas of The New Territories in Hong Kong, including Sheung Shui and Yuen Lung (1). Key issues related to this option include:

- Acquisition and permitting of a technically viable route through several densely populated areas in Shenzhen and Hong Kong.
- Environmental and safety risk impact associated with routing the pipeline away from developed areas through rugged terrain.
- Satisfying the approvals process in two jurisdictions with a risk that permits may be denied in one or both jurisdictions.

From a regional supply security perspective, it would be unwise to have all of Hong Kong and Guangdong's gas needs supplied by one facility, as the entire region's energy supply could be significantly impacted in the event of a lengthy interruption. The need for diversity of supply infrastructure is demonstrated by overseas experience such as the U.S. (2), U.K, Japan, Singapore (3) and other energy-importing countries. Tokyo's LNG supply, for example, is received through 5 separate terminals.

Another consideration is that with Guangdong end-users having both equity in the terminal and most of the capacity rights, it is uncertain whether CAPCO could obtain the flexibility and priority of supplies to meet operational needs in the event of a supply disruption and to meet growing demand.

2.8.3 *Import Natural Gas via Proposed LNG Terminal in mainland China*

Development of a LNG terminal requires considerable time for planning, permitting, construction, and to achieve satisfactory commercial arrangements among all parties involved. As a reference, the Guangdong Dapeng LNG terminal took around 10 years from project planning to terminal

(1) CLP desktop study
(2) Senate Natural Resources Committee, Testimony of Victor G. Carrillo, Commissioner, Railroad Commission of Texas, June 2006
(3) Consultation Paper Initial Findings and Views on LNG Importation into Singapore, Energy Market Authority

commissioning in 2006 and the CAPCO project is estimated to take 8 years from start of planning in 2003 until commissioning in 2011 (*Table 2.2*). Two LNG terminals are proposed in the Zhuhai area, one to serve Zhuhai as part of China's long-term LNG importation plan and the other to serve Macau.

Table 2.2 Timing for Hong Kong LNG Terminal Development

Step	Activity	Timing
1	Project Planning	2003 – 2004
2	Environmental Impact Assessment, Permitting and Preliminary Engineering	2004 – 2007
3	Engineering, Procurement, Contracting and Construction	2007 – 2011
4	First Gas	2011

Import via a Proposed Mainland LNG Terminal

The Zhuhai terminal, with a planned capacity of 3 MTA, is intended to supply gas to the west Pearl River Delta. It is one of nine terminals planned for coastal cities in China. The Guangdong Dapeng terminal is the first to go into operation and a second terminal at Fujian is under construction. Although China has a clear plan (1) to develop a number of LNG terminals to serve major cities in the coastal provinces, these plans have been held back so that they are timed to match developments in LNG supply projects (2). The timing for a Zhuhai terminal, the second one for this region, is not clear (3).

Import via a Proposed Macau LNG Terminal

The Macau Terminal proposal is also in the early stages of development with the recent introduction of its conceptual proposal, which was the stage that the Hong Kong terminal was in back in 2003. Macau's present gas demand is small, about 10% of CAPCO's, and would not normally be sufficient to justify the cost of development and operation of a LNG terminal. In addition, project development is especially complex, involving multiple separate jurisdictions – Macau (4), Zhuhai, Guangdong province and the central government, plus Hong Kong if supply to Hong Kong is added.

CAPCO commissioned the Construction Advisory Services group of Deloitte Financial Advisory Services LLP ("Deloitte FAS") to analyse the proposed Macau LNG Terminal project and advise on whether it could rely on the proposed project to meet CAPCO's gas requirements. Deloitte used industry-standard procedures to take account of uncertainties in the project's approval, development and construction processes and in its confidential report (1) provided the following recommendation to CAPCO:

(1) Gas Matters Analysis – China-LNG, Gas Matters, September 2005
(2) Delays Best Bullish Plans for LNG Terminals In China, Horizon, December 14, 2005
(3) Plan may not go ahead, China Daily, 13 Sep 2006
(4) Program Analysis, Macau LNG Terminal and Pipeline Projects, Deloitte Financial Advisory Services LLP, October 2006 (Confidential Report to CAPCO)

"Deloitte recommends that CAPCO should not rely on the proposed Macau LNG terminal for supply of LNG in 2011.

CAPCO's customers are highly reliant on a secure supply of electricity. Given the importance of LNG availability in 2011 to ensure that there are no supply disruptions and to enable achievement of emissions targets, CAPCO needs to have a very high level of confidence (P90) that its source of gas for Black Point Power Station would be ready to supply gas in 2011.

Based on Deloitte FAS's global experience (including China) of analysing similar major infrastructure projects, Deloitte FAS advises CAPCO that CAPCO should not rely on the proposed Macau LNG Terminal project as it does not provide the required confidence level (P90).

The basis of Deloitte FAS's advice is set out in our report".

Project Timing

Execution and timing for these projects are uncertain. China has not been able to secure supply as planned, and this has led to delays in its terminal developments. According to Xu Dingming, Vice Chairman of the Office of China's national Energy Leading Group, China's LNG import plans must slow down (1). Other than these two proposed terminals, no other terminal has been proposed in Guangdong; any new terminal must commence the 8 - 10 year development process from the beginning.

Considering the early stages of development of the proposed projects, neither is likely to meet CAPCO's timing requirement as the development process is subject to negotiations of complex commercial, offtake and regulatory framework arrangements among various stakeholders, as well as compliance with local permitting and regulations in multiple jurisdictions. One such example is the submarine pipeline required to transport the gas from a new terminal to Black Point Power Station which would require rigorous approvals not only in Hong Kong but also in Macau and the mainland at the local and central level.

The other option, of utilising the existing Yacheng pipeline presents both commercial and technical challenges (2), which could not be resolved within the timeframe for the replacement gas supply. For example, the pipeline is not owned by CAPCO and its access would entail complex commercial negotiations. The technical challenges include:

- A pipeline will be required running between the new LNG terminal and the tie-in point on the existing pipeline, this would entail similar

(1) Price Concerns Dampen China's LNG Drive, International Gas Report, July 26, 2006
(2) This EIA Report, Part II Section 2.3- Consideration of pipeline alignment

environmental disturbance to the base case pipeline route and involve a permitting process in two jurisdictions;

- An extended interruption to the gas supply to BPPS would be necessary to allow the insertion of a tie-in assembly in the existing pipeline (1);

- The operation of connecting to the existing pipeline is extremely complex and would involve a significant risk of additional delay as a result of unforeseen events;

- CAPCO's Consultant studies confirm that blending of Yacheng gas and regasified LNG in the Yacheng pipeline would not be an appropriate solution due to the two types of gases being outside the interchangeability limit of the hardware design in BPPS. While blending the gases is theoretically possible, operating flexibility would be severely restricted and there would be potential for hardware modifications to be required several times catering for the change in fuel ratios that would occur as Yacheng gas supply is depleted. Accordingly, following conversion of the generator units to burn regasified LNG, the use of Yacheng gas would have to be curtailed (2).

LNG Supply

With a mainland terminal, CAPCO would be only one of several customers with competing gas demand. Accordingly, CAPCO would not have a priority right to access gas supply, which is essential to meeting Hong Kong's electricity generation demand, particularly during the peak summer demand period.

Given their early stages of project development, the potential Mainland terminal projects may struggle to attract sellers, particularly in the 2011 timeframe when LNG is in limited supply. LNG sellers face no shortage of interested buyers during this period. CAPCO's experience is that with limited resources and in a sellers' market, sellers put their efforts into engaging with those LNG buyers able to demonstrate a clear commercial structure, a comprehensive implementation plan and a realistic and detailed schedule, both for the terminal and other new end-user facilities such as power plants. The current CAPCO proposal meets all these expectations whereas the potential Mainland projects do not. Also, as a general rule, the addition of a third party terminal operator as a middleman in supply arrangements leads to increased cost and commercial complexity.

Notwithstanding the concern of supply security, for future purchases to meet demand growth, being limited to one supply arrangement may place CAPCO at an economic disadvantage. For example, with regard to a terminal outside

(1) Y13 Pipeline Tie-in Study – Aker Kvaerner, CAPCO Consultancy Study
(2) Alternative Natural Gas Supply Project: Feasible Options for Black Point Power Station, Advantica - CAPCO Consultancy Study

Hong Kong, CAPCO may have no other option for gas supply, and without influence over the LNG supply process, CAPCO and the Hong Kong consumer could be in a disadvantaged commercial position.

Environmental and Safety

Importing LNG via a proposed mainland terminal would result in impacts both inside and outside of Hong Kong. For example, pipelines connecting those terminals to BPPS would be considerably longer than a pipeline from Soko Island with increased ecological and cost impacts.

The environmental impact assessment, risk assessments and safety regulations would fall outside Hong Kong's jurisdiction, and it is unclear what standards would be applied to these facilities.

2.8.4 *Importing LNG via a New Terminal in Hong Kong*

Project Timing

Constructing a LNG receiving terminal in Hong Kong will be able to meet CAPCO's timing requirement in order to replace the depleting Yacheng field. An LNG terminal located entirely within Hong Kong enables smoother and faster project development under one single jurisdiction with clear policy and regulations applicable to infrastructure built in Hong Kong. Similar advantages are offered by CAPCO's well established commercial structure under the Scheme of Control. CAPCO has been progressing development activities for a LNG terminal in Hong Kong since 2003, the idea of such a terminal being first raised and supported by the Hong Kong Government as early as the early 1990's (1). Given the expected gas depletion by early in the next decade and a LNG terminal requirement date of 2011, CAPCO is progressing the development of a Hong Kong terminal as the best alternative (2).

LNG Supply

A Hong Kong terminal would enable both gas and electricity supply security and reliability for Hong Kong. Hong Kong would have control of the terminal with a LNG delivery priority to maintain CAPCO's electricity reliability. In the unlikely case of a supply interruption where a reduced volume is available, the Hong Kong terminal can ensure that Hong Kong's needs would be prioritised without the need to compete and share with other users.

(1) LNG Feasibility Study, Joint Study by CLP, Shell, Total with Guidance from EPD, September 1992

(2) For example, extensive site investigation work, preliminary engineering as well as the pipeline route survey have been completed. The 18-month Environmental Impact Assessment (EIA) process is also reaching a major milestone with the submission of the EIA study report. Consultation with Government and the public has been ongoing since 2004. Discussions with LNG suppliers and LNG shipping providers are also underway. In short, CAPCO's development of the Hong Kong LNG terminal is at an advanced stage to meet the 2011 timing. These activities could not have been conducted with the earlier options as they have only recently been raised.

A Hong Kong terminal would meet CAPCO's volume and flexibility requirements as the terminal can be planned, designed, built and operated specifically to meet anticipated growth in gas demand. It would also allow CAPCO to closely coordinate Yacheng gas supply with LNG deliveries during the transition period, taking into account BPPS's technical and operational requirements to ensure a reliable changeover to LNG. While primarily to fuel CAPCO's power plant at Black Point, other energy users in Hong Kong could be considered for terminal access.

With a Hong Kong terminal, CAPCO, as end user, would be responsible for negotiating directly with LNG suppliers to obtain a competitive gas supply. CAPCO can demonstrate that the terminal development plan is comprehensive and realistic, the project is well along in the site selection and approval processes, and it has an experienced team in place to take the project forward, all of which are very attractive to sellers. CAPCO would ensure that the procurement activities would be conducted in a fair and defensible manner, with contract details and results provided to the GOHK. Such direct negotiations with LNG suppliers also eliminates non-value added middlemen, which enables CAPCO to negotiate in the Hong Kong consumer's best interests directly with suppliers.

Environment and Safety

A Hong Kong terminal would be constructed to meet Hong Kong's stringent environmental and safety standards utilising CLP Power's experience in power plant operation and ExxonMobil's expertise in developing LNG terminals around the world. CAPCO, as both a terminal developer and a LNG buyer, will ensure the terminal and the fuel supply sources meet environmental and safety regulatory standards consistent with its existing power business operations.

Moreover, the Hong Kong terminal would be operated and maintained to world-class standards in full compliance with Hong Kong Government regulations to the same standard as CAPCO's existing operations, with seamless delivery of gas from terminal to the power plants.

2.8.5 No Action or Defer decision

As noted previously, with BPPS providing about 25% of Hong Kong's total electricity needs, having a reliable supply of natural gas that fuels this power station is critical for maintaining Hong Kong's electricity supply. In the event that gas was not available to BPPS, CAPCO will need to meet electricity demand by a higher reliance on coal-fired generation and more expensive diesel fuel generation (which is currently only used for emergency backup) both of which will increase emissions of NO_x, SO_x and particulates beyond existing levels and Governments targets. Under such circumstances, in order to meet Government's emission targets, Hong Kong consumers would be exposed to possible power cuts or rationing.

In summary, the absence or delay of a replacement gas supply would not only entail an environmental impact, in the form of incremental emissions of NO_x, SO_x and particulates, but would also compromise Hong Kong's electricity supply reliability.

2.8.6 *Summary Comparison of Alternatives against Hong Kong's Requirements*

The following *Table 2.3* summaries the requirements of the replacement gas supply and the assessment of the five potential alternatives in meeting those requirements.

Table 2.3 Summary Comparison of Alternatives against Hong Kong's Requirements

HK's Gas Requirements	Pipeline Gas from Nearby Field	GDLNG Terminal	New Mainland Terminal	Hong Kong Terminal	Do nothing / Defer decision
1. Certainty of timely arrival	Low – No proven gas field with adequate capacity and timing certainty available.	Low - Additional long-term capacity not available to CAPCO / HK. Priority for PRC users.	Unknown - No project to meet CAPCO / HK's needs within the time frame.	High - Terminal and supply preparation since 2003 and work progressing to achieve 2011 target.	None – Any indecision or delay will not provide timely gas arrival.
2. Supply Security for Hong Kong	Moderate – May serve as one of the multiple sources required for Hong Kong.	Low – Additional long-term capacity not available to CAPCO / HK. Also, imprudent to have the entire HK and Guangdong demand supplied through a single terminal	Unknown - No project to meet CAPCO / HK's needs within the time frame. Supply source also uncertain.	High. - Priority for CAPCO/HK is ensured. Additional security with multiple LNG sources.	None – Any indecision or deferral will not provide the required gas supply for Hong Kong.
3. Adequate Volume and Flexibility	Low - No credible gas field with adequate capacity and volume available.	Low – Additional long-term capacity not available to CAPCO / HK.	Unknown - No project to meet CAPCO / HK's volume and flexibility requirements.	High - Terminal designed to meet HK's increasing gas demand. Capacity will be assured for Hong Kong's needs.	None – No gas supply is available to serve Hong Kong's needs.
4. Competitive Supply of Gas	Low – Commercial structure and competitiveness of procurement process yet to be determined. No supplier with credible proven reserves to contract with.	Low – Long-term capacity and supply not available to HK. Presence of third party operator as middleman adds cost for their profit in the supply chain.	Unknown - No credible supply source identified. Presence of third party operator as middleman increases cost and complexity.	High – Competes in international LNG markets to allow a transparent process with competitive market pricing on supply terms.	None – No gas supply is available to serve Hong Kong's needs.
5. Environmental and Safety Standards	Issues/standards are not known at this time.	Issues/standards not known at this time. The required pipeline is longer with its latter part traversing same marine area as HK terminal.	Issues/standards not known at this time. The required pipeline is longer with its latter part traversing same marine area as HK terminal.	High - Environmental issues are understood and can be mitigated.	None - Increased emissions from more coal burn

Certainty of each of the five alternatives to meet Hong Kong's gas requirements is ranked as unknown, low, moderate, or high

There must be a degree of certainty to the arrival of a replacement gas supply for Black Point Power Station in 2011. CAPCO has systematically explored and evaluated the potential options for a replacement gas supply. The option that offers the highest degree of certainty for a replacement gas supply with respect to timing, security of supply, volume adequacy and flexibility and competitiveness is to import LNG via a new terminal in Hong Kong.

Following the due process, once an Environmental Permit is obtained which is anticipated for early 2007, and with timely progress on regulatory regime resolution and other key approvals, CAPCO will be able to enter into a long term LNG supply commitment. This will allow sufficient time for the construction of the LNG supply chain and ensure Yacheng replacement by 2011. Any indecision or deferral of decision now would push out the first gas delivery beyond end 2011.

This urgency also applies to LNG supply contracts, as the LNG negotiations and agreement with suppliers are integrated into the progress of the LNG terminal approval process. CAPCO must expeditiously finalise a Sales and Purchase Agreement to allow sufficient time for the upstream supply chain to commence construction. No buyer will commit to buy and no seller will commit to sell LNG if the availability of the Hong Kong terminal in 2011 is in doubt. CAPCO is competing with numerous users in the region, including Japan which has 25 LNG terminals, for limited LNG supplies. With the Yacheng field expected to deplete early in the next decade, obtaining Government support and site approval by early 2007 is a key milestone in the LNG procurement sequence.

In addition to meeting all of Hong Kong's replacement gas requirements, a Hong Kong LNG receiving terminal provides a number of strategic, social and economic benefits to Hong Kong. With energy issues high on government agendas internationally, the LNG terminal will be a strategic asset for Hong Kong as it will provide the means of access to global natural gas supplies when demand for energy is increasing. The social and economic benefits include the generation of capital investment, construction and engineering employment (1) as well as revenue for the Hong Kong Government in terms of tax and land revenues. In the environmental impact assessment appeal of KCRC on the Sheung Shui Station to Lok Ma Chau Spur Line, the ruling stated the following:

> [In] assessing whether an alternative is practical and reasonable all the circumstances must be taken into account and a balanced judgement reached…many matters which must be weighed in assessing "practical and reasonable" included are adverse impacts, engineering constraints, extra-time involved, additional cost and even government policy

(1) On the average, approximately 700 workers will be employed during the construction phase, and around 60 permanent jobs during operation

> (accepting it as a fact). No alternative is likely to be practical if government policy will not enable it. ….

The ruling further commented on the implementation of the EIA process:

> [T]here are two main matters of public interest involved. Both are important. The first is the public interest in the protection of the environment upon which the quality of life in Hong Kong will increasingly depend. The second is the public interest in ensuring that major designated projects are brought to fruition in a timely and efficient manner.

This section has been written to satisfy the study brief requirements as well as to demonstrate the need for the LNG terminal in Hong Kong.

Now that the engineering and environmental feasibility studies have been completed, and with timely progress on regulatory regime resolution and other key approvals, a terminal in Hong Kong can be completed by 2011 and will meet all of CAPCO's requirements. CAPCO believes that the Hong Kong LNG receiving terminal is the only reasonable and practical option to ensure electricity supply reliability for Hong Kong and to comply with the 2010 Hong Kong Government environmental initiatives.

3 WHAT IS REQUIRED TO BRING LNG TO HONG KONG

3.1 THE LNG SUPPLY CHAIN (1)

The process of LNG production involves the transport of the natural gas from the production fields via pipeline to a liquefaction plant. Prior to liquefaction the gas is first treated to remove contaminants, such as carbon dioxide, water and sulphur to avoid them freezing and damaging equipment when the gas is cooled to -162°C. The liquefaction plant is similar to a large refrigerator with compressors, condensers, pressure expansion valves and evaporators.

The LNG produced from the refrigeration process is piped to specially designed LNG storage tanks. Both the piping and tanks are insulated to maintain the low temperature and constructed using special materials to contain the cryogenic liquid. LNG is then drawn from the storage tanks and loaded onto specially equipped LNG carriers. The carrier delivers LNG to a receiving/regasification terminal where it is stored in LNG tanks and converted back to a gaseous state prior to being dispatched/piped to the end-user such as a power plant when needed.

The whole process is referred to as the LNG Supply Chain and is illustrated in *Figure 3.1*. The only elements of the supply chain that will take place in Hong Kong are the development and operation of the receiving terminal and the marine transit of LNG in a LNG carrier to the terminal site.

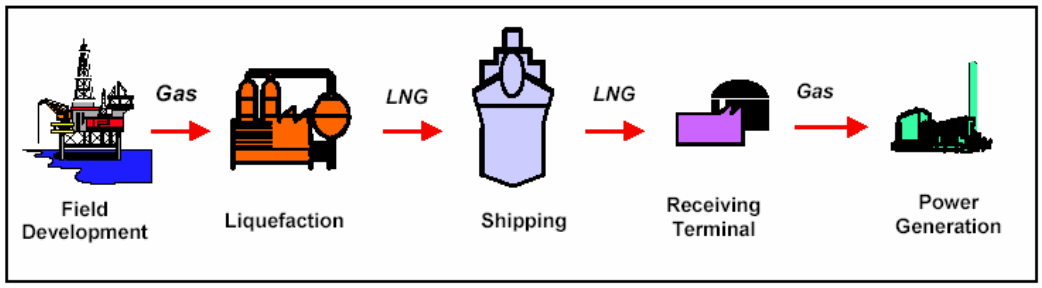

Figure 3.1 *LNG Supply Chain*

3.2 LNG RECEIVING TERMINAL

Near the end of the supply chain is the receiving terminal. The key components of the proposed LNG terminal, including marine jetty facilities for unloading LNG, special tanks for LNG storage, process equipment for the regasification of LNG, utilities and other infrastructure, are depicted in the process overview (*Figure 3.2*). Site specific details of the LNG terminals at the two selected sites are presented in *Part 2- Section 3* and *Part 3-Section 3*.

(1) 'Introduction to LNG', University of Houston, Institute of Energy, Law & Enterprise

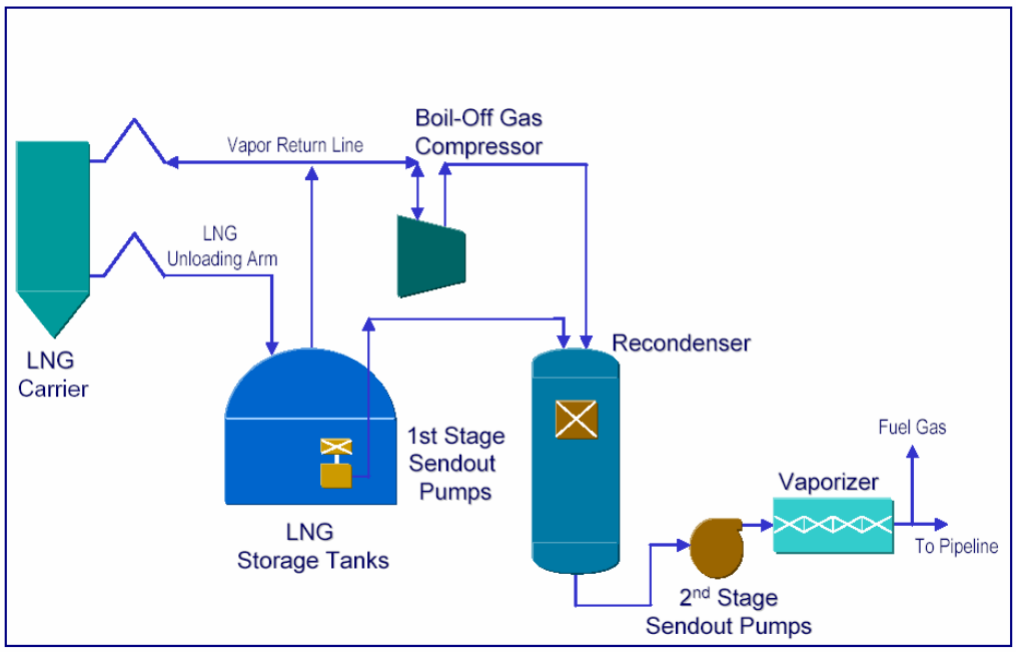

Figure 3.2 *LNG Terminal Key Components and Process Overview*

A receiving terminal, similar in size to this project, will typically require approximately 30 - 40 ha of land to locate the necessary infrastructure, which includes the following:

- Jetty and unloading arms
- Process Area
- LNG Tanks
- Low Pressure and High Pressure pumping systems
- Vaporisation (Regasification) Area
- Vents (low pressure and high pressure)
- Maintenance Workshop
- Administration Building
- Guard House
- Utility Area
- Control Room

3.2.1 Marine Facilities

A jetty and unloading arms are required to transfer the LNG from the carrier to the terminal. The length of the jetty is defined by specific site conditions, and the maximum length overall of the LNG carrier that will deliver the required cargo volume. In addition, a turning circle of sufficient size and depth is required to allow for turning the LNG carrier either prior to berthing or on departure after completion of unloading.

The unloading arms are moved with a remote-controlled hydraulic system located on the berth. When they are lined up with the LNG carrier, the two are then secured by bolts or quick connect couplings. Five arms are typically installed, three for unloading LNG, one for return vapours and one spare that can be used for either service. After connection is completed, the communication cable is connected to shore and the emergency shutdown system is tested.

After the unloading arms are cooled, the LNG will be transferred from the carrier to the storage tanks using the carrier's pumps. The discharge of LNG from the carrier takes approximately 18 hours. In addition, approximately 3 hours are required for mooring, cool down, connecting unloading arms, and cargo measurement, and approximately 3 hours for cargo measurement, arm purging, disconnecting arms, and unmooring.

3.2.2 *LNG Storage Tanks*

Following berthing, the LNG is pumped ashore via the carrier's pumps through unloading arms to a cryogenic pipeline and on to the storage tanks. For this project, an above-ground, full containment design has been selected. The LNG will be stored near atmospheric pressure and in full-containment LNG tanks that typically consist of the following:

- Primary inside tank - made of a "cryogenic material" such as 9% Nickel steel, aluminium alloy or reinforced pre-stressed concrete; it is now common practice to use 9% Nickel steel for the inner tank in LNG service;
- Insulation – loose insulation material (such as perlite) surrounding the inner nickel steel tank (sides, floor and roof);
- Vapour barrier tank – made of carbon steel to contain the insulation system and vapour pressure of the primary tank;
- Outer tank – reinforced, pre-stressed concrete designed to independently store both the LNG liquid and vapour should the inner wall fail; and,
- Domed roof – reinforced, pre-stressed concrete.

An illustration of typical full containment tank is presented in *Figure 3.3*.

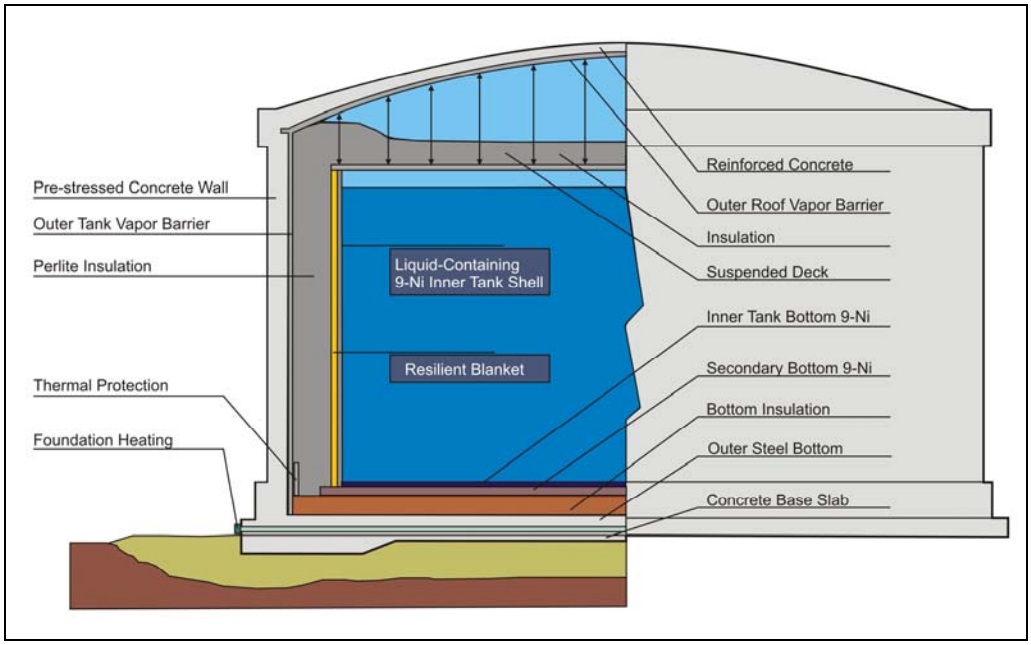

Figure 3.3 *Example of a Full Containment LNG Storage Tank*

LNG tanks are specially designed to contain the LNG at its cryogenic temperature of approximately -162 °C near atmospheric pressure. After initial transportation planning, which includes detailed shipping and storage simulation modelling of Black Point Power Station's requirements with regard to LNG volume, minimum inventory, and potential sources of supply and ship sizes, a LNG storage facility comprising two tanks of 160,000 to 180,000 m^3 each is planned. Space will be provided for a third tank for future expansion (180,000 m^3 tanks may be considered). This EIA is based on three LNG storage tanks, i.e., a total capacity of 540,000m^3.

The LNG tanks have a top entry point for both the loading and unloading operations. Two submerged send-out pumps per tank will be suspended from the top of the tank and pump the LNG out of the tanks. All tanks will be designed to simultaneously send out (to the vaporiser units) and to receive LNG (from unloading LNG carriers). The tanks will be fitted with a low-pressure vent, which will provide storage tank overpressure protection if the tank pressure exceeds the maximum operating limit of the LNG storage tank design pressure.

3.2.3 *Other Major Process Facilities*

Vapour Handling System and Boil-off Gas (BOG) Condenser

Boil-off gases (BOGs) are produced during normal terminal operations as a result of inevitable heat transfer arising from the storage and handling of LNG. This BOG is captured and sent to the BOG compressor for re-condensing (liquefying). A second BOG compressor will serve as a backup or a spare. The BOG condenser outlet liquid stream flows to the HP LNG Booster pumps to raise the LNG to the send-out pressure before feeding the

LNG to the LNG vaporisers. LNG is heated and converted back to gas in the vaporiser unit.

LNG Vaporisers

Stored LNG will need to be re-gasified in order for it to be transported by gas pipeline to the point of use. This will be accomplished via LNG Vaporisers, which will either utilise piped seawater (in open rack vaporisers) or hot combustion gases (in submerged combustion vaporisers) to raise the temperature of the LNG to ambient, thereby causing it to re-gasify. Once the LNG is vaporised the gas is then regulated for pressure and piped to the consumer.

Open Rack Vaporisers – The seawater will pass through a series of screens to remove debris to prevent blockage or damage to the seawater pumps before entering the open-rack vaporises (ORVs). In ORVs, seawater flows over the exterior of the vaporiser panels, which internally channel an upward flow of high-pressure LNG (HP LNG). LNG will then be vaporised by exchanging heat with seawater in the ORV's. The seawater flows over the panels to a trough below and is then discharged back to the sea via a submarine outfall.

Submerged Combustion Vaporisers - In Submerged Combustion Vaporisers (SCVs), LNG flows through tubes that are submerged in a heated water bath. LNG will then be vaporised.

Pumps

Each LNG storage tank will be configured with two in-tank LNG send-out single-stage centrifugal pumps. LNG send-out pumps discharge to the HP LNG booster pumps. The HP LNG booster pumps will be designed to meet the required send-out pressure for the pipeline option. Six HP LNG booster pumps including one spare will be used in the expansion case.

Gas Meter Stations

The outlet gas from the vaporisers will be metered at metering stations and sent to the gas pipeline at South Soko (South Soko option only).

Fuel Gas System

The fuel gas system including high- and low-pressure fuel gas systems will provide sufficient fuel gas for the various terminal users such as power generation, heating, and any SCV's in operation. Vaporised high pressure natural gas will be used for on-site power generation, while the low-pressure fuel gas system will provide sufficient natural gas for the various terminal users such as SCV, heating the gas to the gas turbines for power generation when needed, and other heating requirements. BOG and/or letdown vaporised LNG will be used for low-pressure natural gas at approximately 5.5 barg (80 psig).

Vent and Relief System

The LNG terminal is designed for the safe handling of vapour discharges from the system, such as from relief valves, which are sent to the vent header and then to the separator before going to the vent stack. There are two vent systems, a high-pressure (HP) vent stack and a low-pressure (LP) vent stack.

The LP and HP vent system is designed for the following possible situations:

- All the equipment will be provided with pressure relief devices. In the case of over-pressuring, the relieved vapour will be vented to the vent stacks which are designed to safely route the gas away from hazardous areas.
- LNG tank roll-over (1) and BOG from a sudden drop in barometric pressure.
- In the event of total facility power failure, the LNG send-out and the unloading operations will be stopped and the boil-off gas will be routed to the LP and HP vent systems.

3.2.4 *Utilities and Ancillary Facilities*

Nitrogen

Nitrogen is required at the terminal for equipment purging and maintenance purposes. Adequate on site nitrogen generation and storage for liquid nitrogen will be provided at the terminal. The nitrogen generation and storage tank size are based on normal purging and maintenance requirements. For start-up and/or LNG tank purging, additional nitrogen will be made available on site by providing liquid nitrogen tanks from supply vehicles.

Air

Instrument and utility air for use within the terminal are produced on site. Two air compressors on lead-lag demand, one dual and regenerative instrument air drying system, separate instrument and utility receivers, and piping headers will be provided.

Power Generation

The power supply for the LNG terminal can either be generated on-site using a gas turbine or imported. A battery supplied UPS (Uninterrupted Power Supply) system powers the Emergency Shutdown (ESD) and gas and fire

(1) **Rollover**. When LNG supplies of multiple densities are loaded into a tank one at a time, they do not mix at first. Instead, they layer themselves in strata within the tank. After a period of time, these strata may spontaneously rollover to stabilize the liquid in the tank. As the lower LNG layer is heated by normal heat leak, it changes density until it finally becomes lighter than the upper layer. At that point, a liquid rollover would occur with a sudden vaporization of LNG. The vapours produced would be sent to the vent system.

systems to ensure the operation of critical systems in the unlikely event of a complete failure of the power.

Waste and Wastewater Treatment

A system will be provided for the treatment of wastewater. A sanitary waste system consisting of a collection system, and a purpose designed and fabricated packaged sewage treatment unit will be provided. Domestic wastewater from the administration building and the various terminal control rooms will be treated at the sewage treatment unit prior to discharge. Sewage treatment will be via chemical or biological treatment methods in accordance with Hong Kong Government regulations.

Solid wastes will be collected and sent to the appropriately licensed disposal facility.

Communications

The terminal will be outfitted with up-to-date communications equipment capable of maintaining contact with the LNG carriers scheduled to offload at the terminal and with the standby tugs.

3.2.5 *Buildings*

The following permanent buildings will be provided on site for the operational phase:

- Administration Building – the administration building will provide offices, communications and a galley. For the South Soko option, it will also provide accommodation for approximately 50 persons.
- Control Building - the control room will contain all facility control functions, including plant monitoring, safety and control equipment consoles.
- Maintenance/Warehouse Building - equipment and spare parts will be stored in this building.
- Switchgear/MCC Building - will house switchgear, motor control centres, panel boards, UPS, batteries and battery charges, lighting transformers, PLC panels for switchgears, MCCs, generator control panels and other equipment. Power distribution transformers will be located on the roof of this building.

3.2.6 *Protective Systems*

Gas Detection, Alarm, Firefighting and ESD Systems

A centralised spill, fire and combustible gas alarm and control system will provide input to an information management system. Automatic detection

devices, manual alarms and audible and visual signalling devices will be strategically located throughout the terminal. Automatic detection devices will include flame, fire and heat, smoke, low temperature and combustible gas detectors. CCTV monitors will be installed to allow visual surveillance of critical facilities from the central control room. An emergency shutdown system (ESD) will be incorporated in the design of the terminal and provide the operators with the capability of remotely shutting down the entire or selective portions of the terminal. The unloading arms will also be equipped with Powered Emergency Release Couplers (PERCs). The PERC maintains containment integrity and prevents damage to the unloading arms in the event of an emergency.

Security

Security will be designed to prevent unauthorised access and to ensure the safety and integrity of the facilities. The site will be provided with a perimeter fence and access will be restricted. Perimeter lighting will also be provided.

3.3 LNG CARRIERS (1)

LNG carriers have insulated cargo tanks and are of double-hull design. The double hull provides the location for the segregated ballast and provides optimum protection for the integrity of the cargo tank containment in the unlikely event of collision or grounding. There are two types of LNG carriers: Moss and Membrane (2) (*Figure 3.4*).

Currently, a typical LNG carrier has a Length Overall (LOA) of approximately 285 m, a 43 m beam and a 12 m draft, with a cargo capacity of around 145,000 m^3. The LNG is transported in the tanks near atmospheric pressure and the boil-off gas can be used to supplement liquid fuels for propulsion. LNG carriers of larger capacities are under development (3). LNG carriers of larger capacities, up to 215,000 m^3 are currently being built for other projects and a carrier of this class has been selected for this EIA Study.

As illustrated in *Figure 3.4* for Moss carriers four or five spherical tanks contained in the hull, with a substantial proportion of each tank above the weather deck. In a membrane design the larger proportion of each tank is below the weather deck (*Figure 1.3*). Both carrier types are commonly utilised for LNG transit with no significant operational difference between them. Consequently, a navigable water depth of approximately -15m PD will be required for the vessels' transit to either Black Point or South Soko. That is similar to the requirement for bulk carriers and container ships currently trading to Hong Kong.

(1) 'Introduction to LNG', University of Houston, Institute of Energy, Law & Enterprise
(2) There is a third type referred to as the structural prismatic design which is used by approx 5% of LNG carriers.
(3) Different sizes of carriers are under development, such as 200,000 m^3, 220,000 m^3 and 250,000 m^3

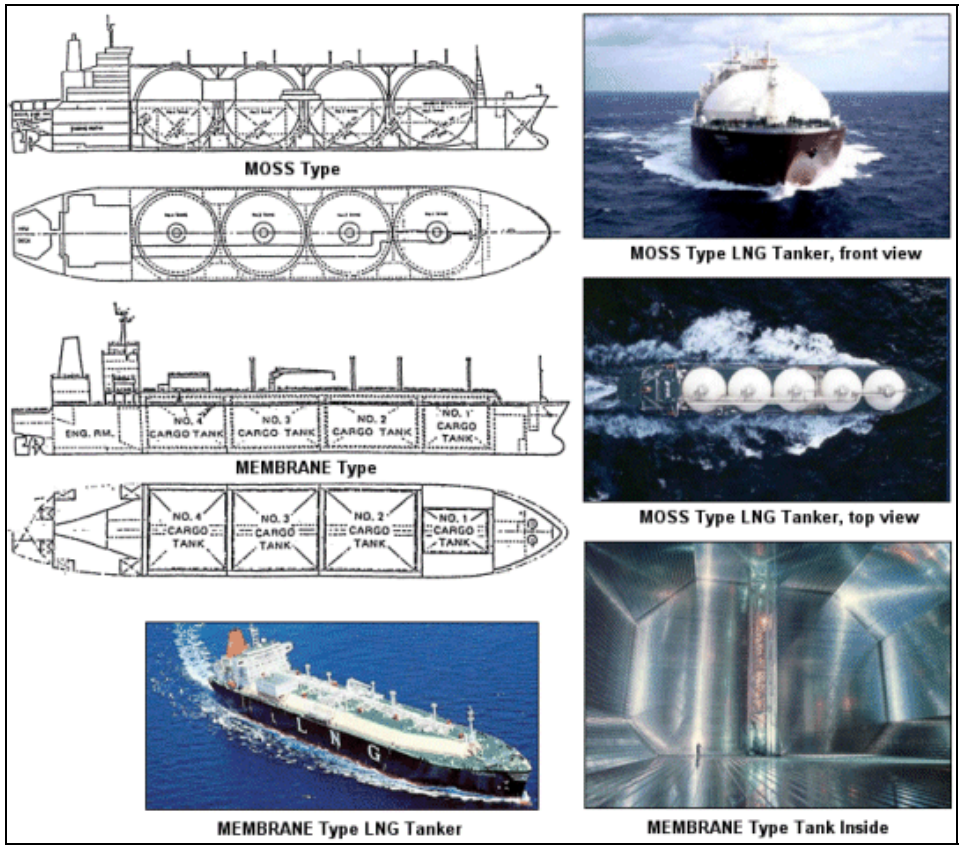

Figure 3.4 *Moss and Membrane LNG Carriers*

Prior to entry into Hong Kong waters, the LNG carrier will perform thorough pre-arrival safety checks on all critical equipment. Then when navigating in Hong Kong waters all LNG carriers will be required to have two experienced local pilots on board. The pilots provide local knowledge of the navigable route for the LNG carrier to the jetty. When the local pilot boards the LNG carrier, crew and the pilot will exchange navigational information to ensure the entire bridge navigating team work together to achieve safe passage through Hong Kong waters to the LNG berth. In addition, the appropriate number and size of tugboats are available for response should an emergency arise. These can also assist in facilitating diversion of traffic on a heading that would require the carrier to deviate from the intended track. The LNG carrier typically will be turned 180 degrees before berthing and then be slowly manoeuvred towards the berth, assisted by the tugs.

3.4 GLOBAL LNG INDUSTRY

The world's first large scale LNG trade began in 1964, with the UK as the importing country. Since then, the LNG industry has built up globally and in 2005 there were 13 countries producing (liquefaction) LNG and 15 importing/receiving (re-gasification) LNG. The world's four largest

producers in 2005 were Indonesia (17% global production), Malaysia (15%), Qatar (14%) and Algeria (13%) (1).

In terms of consumption of LNG, the largest importer by far is Japan, which has 25 receiving terminals (*Figure 3.5*). In 2005 these terminals received over 40% of the world's LNG imports (2), equivalent to roughly 36 times the annual gas consumption of the Black Point Power Station. East Asia as a whole accounts for over 60% of world's LNG imports through the terminals in Japan, South Korea, Taiwan and India. Mainland China began to be an importer recently with the commissioning of the Guangdong Dapeng LNG terminal. A terminal in Fujian is under construction while others are in their planning or proposal stages (*Figure 3.6*).

In Europe there are 14 LNG terminals. France is the largest importer of LNG (*Figure 3.7*). Other countries with terminals include Spain, Italy, Greece, Turkey, Portugal and Belgium and further receiving terminals are planned or under construction in the UK, Spain and Turkey.

In the Americas there are 5 receiving terminals in the US, 1 in the Dominican Republic and 1 in Puerto Rico (*Figure 3.8*). The Americas is currently the area with the largest number of planned/proposed receiving terminals. Africa has no import terminals at present but has export terminals in Algeria, Libya, Egypt and Nigeria (*Figure 3.9)*.

3.5 LNG SAFETY

The LNG industry has an excellent safety record (3) in all aspects of shipping, storage and regasification. This is due to both the high technical standards that are used in the design, construction and operation of LNG facilities and carriers and also the physical properties of LNG, as described in *Section 2.2*. In part, the safety record is a result of the adoption worldwide of a series of standards, codes and regulations (4).

3.5.1 *Shipping*

LNG shipping has an outstanding safety record (5). LNG has been safely transported across the world's oceans over the last 40 years. In that time there have been over 45,000-LNG carrier voyages covering more than 90 million miles without any loss of life in port or while at sea (6). At the end of 2005, there were approximately 190 LNG carriers in the world fleet.

LNG carriers frequently pass through areas and ports that have high traffic densities, such as in Japan. The favourable safety record of LNG carriers is

(1) Wood Mackenzie Research
(2) The Changing World LNG Market and its Impact on Japan, The Institute of Electrical Engineer Japan, June 21, 2005
(3) LNG Safety & Security, University of Houston, Institute of Energy, Law & Enterprise
(4) LNG Safety & Security, University of Houston, Institute of Energy, Law & Enterprise
(5) Introduction to LNG', University of Houston, Institute of Energy, Law & Enterprise
(6) Introduction to LNG', University of Houston, Institute of Energy, Law & Enterprise

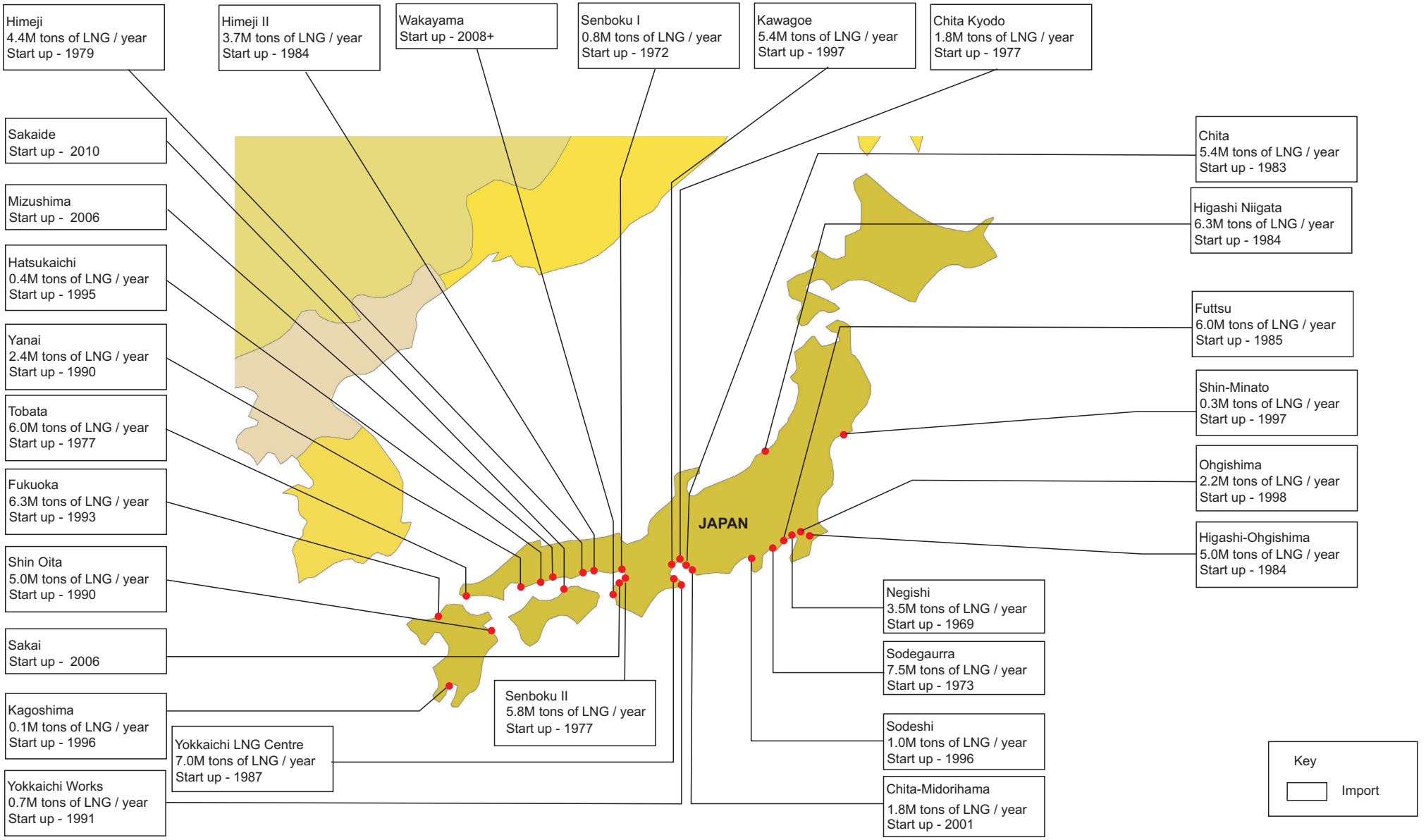

Figure 3.5

LNG IMPORT TERMINALS (JAPAN)

(SOURCES: WORLD LNG MAP FEBRUARY 2006 EDITION. PETROLEUM ECONOMIST)

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DATE: 13/07/06

Environmental Resources Management

ERM

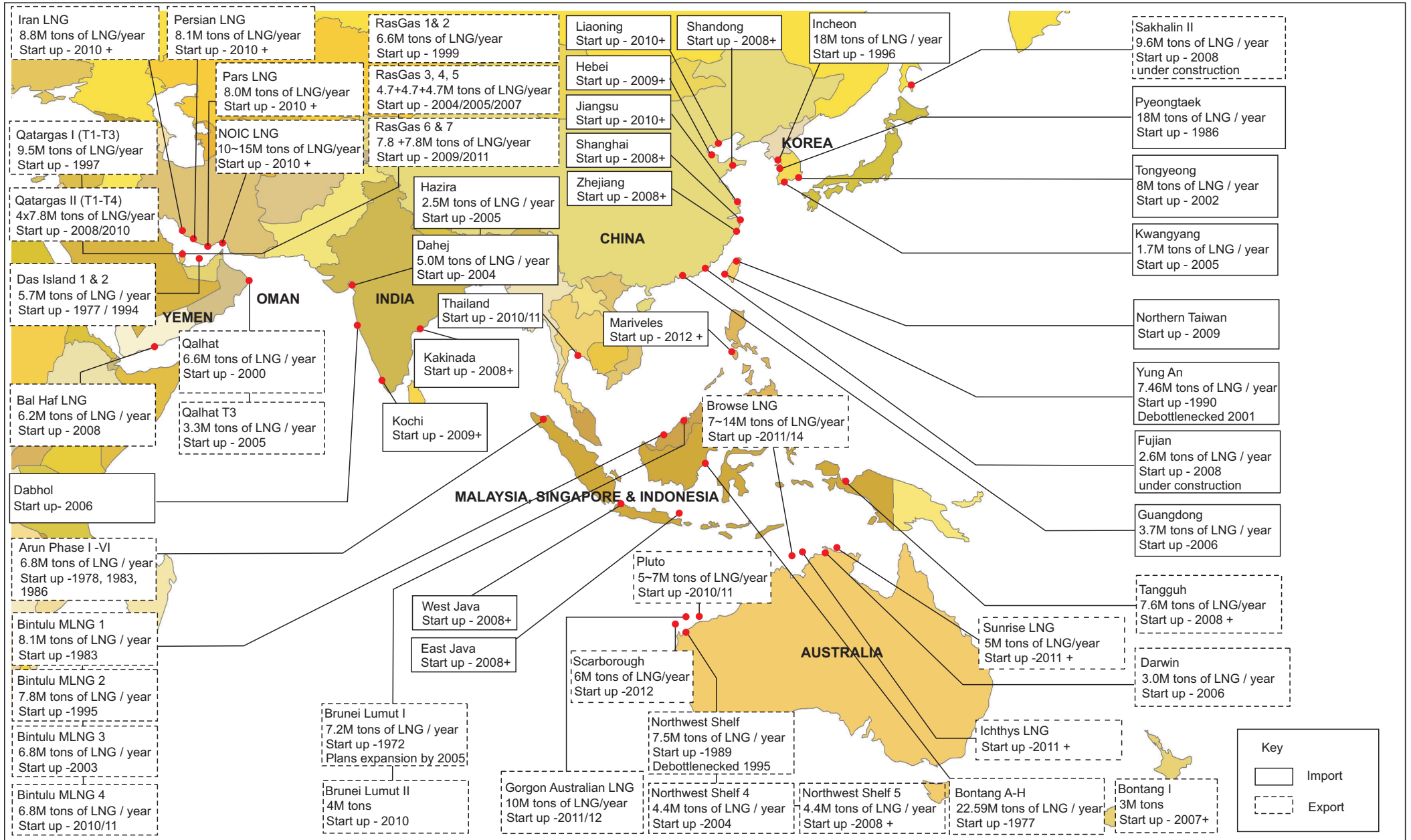

Figure 3.6

LNG TERMINALS AND SUPPLY PROJECTS (ASIA PACIFIC AND MIDDLE EAST)

(SOURCES: WORLD LNG MAP FEBRUARY 2006 EDITION. PETROLEUM ECONOMIST &
THE GLOBAL LIQUEFIED NATURAL GAS MARKET : STATUS AND OUTLOOK.
ENERGY INFORMATION ADMINISTRATION, US DEPARTMENT OF ENERGY. DECEMBER 2003 AND OTHER INDUSTRY SOURCES)

FILE: 0018180 eia_Docu-set2_94
DATE: 13/07/06

Environmental Resources Management

ERM

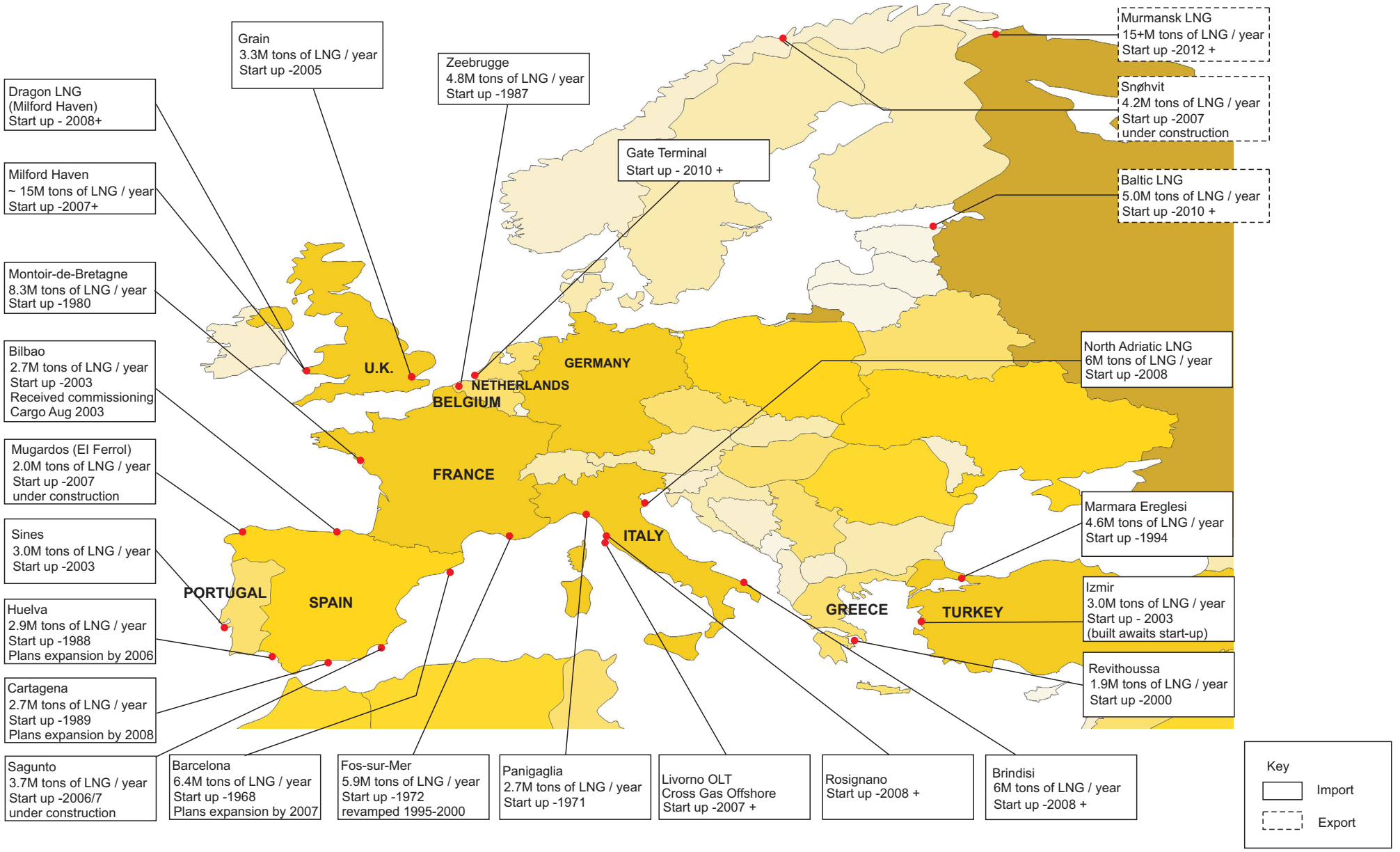

Figure 3.7

LNG TERMINALS (EUROPE)

(SOURCES: WORLD LNG MAP FEBRUARY 2006 EDITION. PETROLEUM ECONOMIST &
THE GLOBAL LIQUEFIED NATURAL GAS MARKET : STATUS AND OUTLOOK.
ENERGY INFORMATION ADMINISTRATION, US DEPARTMENT OF ENERGY. DECEMBER 2003)

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DATE: 13/07/06

Environmental Resources Management

ERM

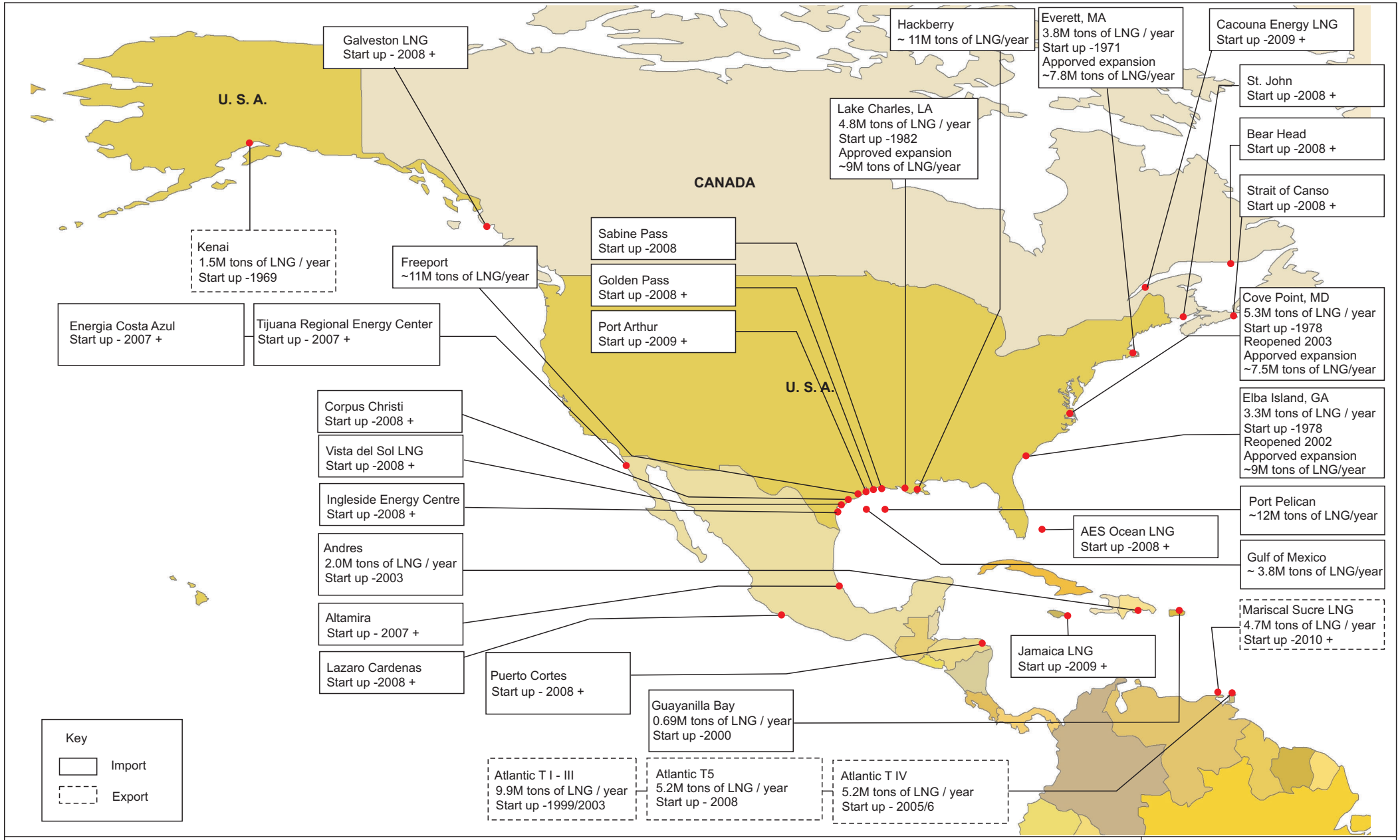

Figure 3.8

LNG TERMINALS (NORTH & CENTRAL AMERICAS*)

(SOURCES: WORLD LNG MAP FEBRUARY 2006 EDITION. PETROLEUM ECONOMIST &
THE GLOBAL LIQUEFIED NATURAL GAS MARKET : STATUS AND OUTLOOK.
ENERGY INFORMATION ADMINISTRATION, US DEPARTMENT OF ENERGY. DECEMBER 2003 AND FERC WEBSITE JUNE 2004)
(*IN ADDITION TO THE ABOVE, ROUGHLY 16 TERMINALS ARE UNDER DEVELOPMENT IN NORTH AMERICA)

FILE: 0018180 eia_Docu-set2_92
DATE: 13/07/06

Environmental Resources Management

ERM

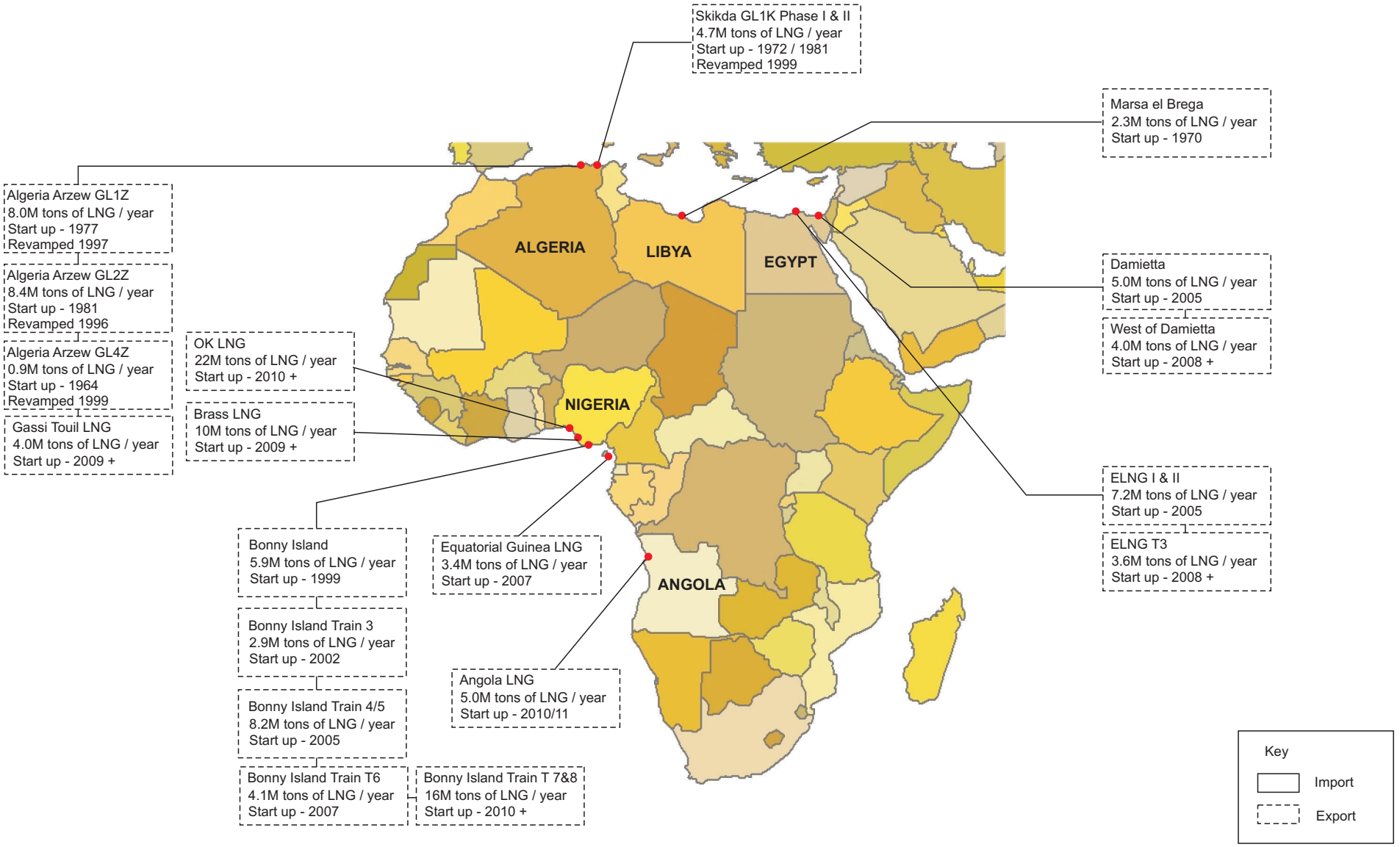

Figure 3.9

LNG EXPORT TERMINALS (AFRICA)
(SOURCE: WORLD LNG MAP 2006 EDITION. PETROLEUM ECONOMIST)

FILE: 0018180 eia_Docu-set2_93
DATE: 13/07/06

Environmental Resources Management

ERM

largely due to their double-hull design and multiple levels of protection associated with cargo operations, as well as the industry's focus on safety in operations, maintenance and crew training.

3.5.2 *Safety Considerations in LNG Carrier Design and Operation*

LNG carriers have insulated cargo tanks and are of double-hull design. The double hull provides the location for the segregated ballast and provides optimum protection for the integrity of the cargo tank containment in the event of collision or grounding. LNG carriers also have safety equipment to facilitate ship and cargo system handling. The ship-handling safety features include sophisticated radar and positioning systems that enable the crew to monitor the carrier's position, traffic and identified hazards around the carrier. A global maritime distress system automatically transmits signals if there is an onboard emergency requiring external assistance. The cargo-system safety features include an extensive instrumentation package that safely shuts down the system if it starts to operate outside of predetermined parameters (1). LNG carriers also have fire detection systems and gas leak detection within the cargo tank insulation, and nitrogen purging for hold space and interbarrier protection. Should a cargo tank on a LNG carrier be subjected to fire exposure, two safety relief valves are fitted to each cargo tank to provide vapour release to atmosphere thereby preventing over-pressuring of the tank from boil-off.

LNG carriers are provided with instrumentation to ensure that the prescribed approach velocity for the berth fenders is not exceeded. When moored, automatic mooring line monitoring provides individual line loads to help maintain the integrity of the mooring arrangement. When connected to the onshore system, the instrument systems and the shore-ship LNG transfer system acts as one system, allowing emergency shutdowns of the entire system from carrier and from shore. LNG carriers and facilities have redundant safety systems, for example Emergency Shutdown (ESD) systems. A redundant safety system shuts down unloading operations when the carrier or unloading facility is not performing within the design parameters.

3.5.3 *LNG Receiving Terminals*

LNG receiving terminals also have an outstanding safety record. Safety of receiving terminals is ensured by five elements (2) that provide multiple layers of protection both for the safety of the LNG industry workers (on-site population) and the safety of the community (off-site population). While these safety elements apply to receiving terminals, some are also applicable to LNG shipping.

- **Primary Containment:** This is the first and most important requirement for containing the LNG product. This first layer of protection involves

(1) University of Houston, Institute of Energy, Law & Enterprise, Report titled 'Safety and Security'.
(2) University of Houston, Institute of Energy, Law & Enterprise, Report titled 'LNG Safety and Security', Page 11.

the use of appropriate materials as well as the proper engineering design of storage tanks onshore and on LNG carriers.

- **Secondary Containment:** This ensures that if leaks or spills occur beyond primary containment, the LNG can be fully contained and isolated.

- **Safeguard Systems:** The goal of these systems is to limit the frequency and size of LNG releases and prevent harm from potential associated hazards, such as fire. Typically this will involve the use of technologies such as high level alarms and multiple back-up safety systems, which include Emergency Shutdown (ESD) Systems. All LNG facilities have set operating procedures, training, emergency response and regular maintenance to protect people, property and the environment.

- **Separation Distances:** Accepted codes, such as the European Standard (1), give guidelines for the design, construction and operation of stationary LNG installations, including those for liquefaction, storage, vaporisation, transfer and handling of LNG.

- **Codes and Standards:** LNG industry standards, codes, and regulations have been developed over years of application. Importantly, they incorporate lessons learned from the very few failure incidents related to single containment tanks in the early period of the LNG industry (1940-1970). These proven codes and standards (2) help ensure safety and reliability. Organisations such as the Society of International Gas Tanker and Terminal Operators (SIGTTO), Gas Processors Association (GPA), European Standard (EN), and (NFPA) produce guidance which results from industry best practices.

(1) The European Standard EN 1473 – Installation and Equipment for Liquefied Natural Gas – Design of Onshore Installations

(2) Such as European Standard EN 1473:1997 - Installation and equipment for liquefied natural gas – Design of onshore installations

4 IDENTIFICATION OF ALTERNATIVE SITE LOCATIONS

4.1 CONSIDERATION OF DIFFERENT OPTIONS FOR AN LNG SUPPLY FACILITY WITHIN HONG KONG SAR

This section of the *EIA Report* presents a summary of the alternatives that have been considered by CAPCO for provision of LNG within Hong Kong SAR, namely:

- Artificial Island in Hong Kong,
- Gravity Base Structure (GBS);
- Floating Storage and Regasification Unit (FSRU);
- Shipboard Regasification;
- Coastal Location; and
- The No Action Alternative.

4.2 USE OF AN ARTIFICIAL ISLAND IN HONG KONG

One option that was examined by CAPCO was that of constructing an artificial island for the purposes of siting the LNG Terminal. The intention was that the island would be constructed using public fill, referred to as Construction and Demolition (C&D) materials. A preliminary engineering and environmental appraisal of this option has been conducted and is summarised below.

4.2.1 *Background*

In recent years, a number of investigations have been carried out to identify suitable sites for the construction of artificial islands. Their uses have varied from disposal of C&D materials to urban landfills, and developments have included waste management and other industrial facilities for which sites elsewhere may be more heavily constrained. A site search exercise taking on board a wide range of constraints, identified an area in the West Lamma Channel (south of Cheung Chau and south west of Lamma) for further consideration. The site which was termed, Lamma South West, was investigated further as a potential location for an artificial island constructed for the purpose of locating a LNG terminal.

4.2.2 *Preliminary Engineering Appraisal*

Artificial Island Location

From constraints mapping carried out previously for a Government-led site search study, an area was identified as potentially suitable for development. The Lamma South West (LSW) potential site is located to the southeast of Cheung Chau and the west of Lamma Island.

This appraisal assumed that an artificial island for a LNG terminal would utilise the large surpluses of Construction and Demolition (C&D) material. The option will also require the laying of a pipeline to Black Point Power Station, which is also considered within this analysis.

Costs have noted been discussed below but it should be noted that this option is disadvantaged on cost terms due to the remote location, high cost coastal defences, dredging volumes and extended programme.

Indicative Island Layout

Preliminary engineering work has indicated that the island would have high sloping seawalls on the eastern, southern and western side to resist typhoon wave attack. The sheltered northern side would be protected from the east and west by short breakwaters. The LNG jetty would be located in the sheltered water between the breakwaters. The internal sloping faces of the breakwater would absorb wave energy rather than reflect it to the LNG berth. There would also be a sheltered vertical sea wall, which would be required to allow offloading of C&D material during construction and to also provide berthing for service vessels and ferries.

It is assumed that the LNG tanks would be located at the south side of the island but at a sufficient distance from the seawall so as not to be affected by wave overtopping during typhoons. The terminal seawater intake would be located on the sheltered northern side, with the outfall located on the western seawall of the island so that there would be no thermal recirculation effects.

Indicative Construction Programme

A construction programme for the island was prepared on the basis that the use of C&D materials is maximised and that the whole Hong Kong supply rate is used in the construction of the island. This is an optimistic assumption and relies on there being no competing outlets for C&D materials. The rate of island development programme would be subject to:

- The supply of C&D materials; and
- The need to protect the island construction by building the east and southern seawalls first. These seawalls require screened and sorted C&D materials at a lower percentage of the original C&D supply rate. The

rate for suitable screened and sorted material has been assumed at 30% of the C&D material supply rate.

The resulting programme indicates that construction of the infrastructure for the LNG Terminal could not start until 5.5 years after commencement of construction on the eastern side of the island and 6.3 years after commencement on the western side based on the high forecast C&D material supply rates, and almost twice as long assuming the low forecast C&D material supply rates. Such a timeline would present insurmountable programming constraints.

Pipeline Issues

The artificial island would require a submarine pipeline to transport the re-gasified natural gas to the Black Point Power Station (BPPS). The alignment for the pipeline would run west of the site prior to following the same alignment as the option for the South Soko. The pipeline would be significantly more complex than the South Soko option. This is because the pipeline would be approximately 60 km in length and would cross between 8 and 10 utilities (depending on the exact alignment adopted).

Another major constraint would be the need to pass the active South Cheung Chau Disposal Ground (SCCDG). The seabed in and around the SCCDG varies considerably in bathymetry from – 6mPD to -16mPD. The seabed sediments are also dredged muds of low *in situ* density, low load bearing capacity and hence geotechnically unstable. For the submarine pipeline to pass through this area, remedial measures would have to be taken to ensure the long term stability of the pipeline in order to prevent unacceptable span stresses. Such measures would involve the dredging of deep trenches along possibly the entire length of the pipeline in this area, the result of which would be significant quantities of mud for offsite disposal.

Environmental Appraisal

From an environmental perspective the construction of the artificial island for locating the LNG terminal introduces the following issues.

Water Quality: The information summarised above has indicated that the construction of the island would require extensive dredging for the seawalls which has the ability to cause impacts to water quality. The pipeline from the site to BPPS would run west of the site prior to following the same alignment as the option for South Soko. The pipeline will be longer and much of it will require dredged trenches with rock armour protection due to the presence of anchorages and shipping lanes. Consequently the pipeline has a greater potential to cause adverse impacts to water quality in an area where key sensitive receivers are located such as the Potential South Lamma Marine Park.

Marine Ecology: If the LNG terminal were located on an artificial island southwest of Lamma, then it would introduce a permanent loss of habitat to the Finless Porpoise. The area to the southwest of Lamma is regarded as one of the key areas for Hong Kong's population of Finless Porpoise and is an area where they are known to calve. The Potential South Lamma Marine Park is also located < 2 km to the site.

Landscape/Visual: The artificial island would introduce a permanent change to the landscape and seascape of the southern waters. In terms of visual sensitive receivers the island and terminal would be visible mainly from Lamma Island and Cheung Chau.

Conclusions and Recommendations

From an environmental perspective, if the LNG terminal were located on an artificial island southwest of Lamma, then it would introduce a permanent loss of habitat to the Finless Porpoise. The area to the southwest of Lamma is regarded as one of the key areas for Hong Kong's population of Finless Porpoise and is an area where they are known to calve. The pipeline from the site to BPPS would run west of the site prior to following the same alignment as the option for South Soko. The pipeline would be significantly more complex than the South Soko option and would be expected to involve substantially larger amounts of dredging.

Although construction of an artificial island at South West Lamma is technically feasible, the proposal has two major constraints in comparison to other sites, namely timing and cost. Additionally, impacts to landscape and water quality would potentially be significant.

Even using the high forecast for C&D materials supply, it is considered that the minimum time of six years needed for the construction of the island will mean that the first gas would not be available before the Yacheng would be essentially depleted. If lower supply rates of screened C&D material are used, longer delays to commissioning a LNG terminal will result.

If rockfill was also used for the seawall core and sandfill used for the reclamation, as well as the use of C&D materials, the construction period could be significantly reduced. However, because of the thickness and low level of the base of the marine deposits and depth of water, the seawall construction, reclamation filling and surcharge periods are going to be longer than the options for South Soko and Black Point.

4.3 CONSIDERATION OF A GRAVITY BASE STRUCTURE

An option that has been examined worldwide is an offshore facility referred to as a Gravity Base Structure (GBS). The option of a GBS is typically considered for shallow water locations, with water depths limited to the range of 15 to 30m. LNG storage tanks are placed inside large concrete caissons that sit on the seabed. Receiving and re-gasification facilities are installed on

top of these concrete structures. Breakwater protection may be required to increase the operating availability of offshore unloading of the LNG carriers. Regasified LNG is sent out as natural gas using a submarine pipeline to the end user.

An offshore terminal in the form of a GBS was considered as a potential alternative to a land-based terminal. The use of a GBS LNG terminal in Hong Kong was examined and serious geotechnical concerns were raised on the use of such a structure on the muds that are prevalent in Hong Kong. A GBS facility is a relatively new technology. At present, there are no GBS LNG receiving terminals in operation worldwide. Due to the geotechnical uncertainties associated with siting a GBS in Hong Kong waters, which may introduce schedule issues, it was concluded that the site selection efforts should focus on a land-based terminal.

4.4 *FLOATING STORAGE AND REGASIFICATION UNIT*

A Floating Storage and Regasification Unit (FSRU) is a floating LNG storage vessel with regasification and offloading facilities on top. The FSRU would be moored to an anchored turret and would weathervane to adapt to changing weather conditions. LNG carriers moor alongside the FSRU to offload LNG to the FSRU to be vaporised. Industry has several proposals for FSRU's, but no actual installations.

The FSRU is not as dependent on soil conditions as the GBS, which results in greater location flexibility. However, the FSRU concept requires a sufficient water depth, 40 - 60 metres, to provide for a long term, safe operating environment for the risers that connect the gas pipeline to the FSRU. During severe weather, the risers in water depths less than 40 - 60 m may get damaged, posing safety, environmental, and economic risks. CAPCO was not able to locate a site with a suitable water depth within the HKSAR that also had suitable environmental and metocean conditions. The siting constraints coupled with the lack of actual installations (ie not proven technology which is critical where security of gas supply is so important) mean that the FSRU option was not considered further.

4.5 *SHIPBOARD REGASIFICATION*

The shipboard regasification option is similar to an FSRU, however it is comprised of a fleet of LNG vessels that have been constructed specifically with regasification and offloading facilities on the deck. These ships serve as both the transport ships and the regasification terminals that offload gas to a pipeline via an offshore buoy (2 buoys for continuous operation). This concept eliminates the requirement to offload LNG offshore between two vessels (required for an FSRU). The first shipboard regasification terminal has just been implemented by Excelerate in the U.S. and it is called Energy Bridge™ and uses ExxonMobil licensed vaporisation technology.

Like the FSRU concept, commercially proven Shipboard Regasification requires a sufficient water depth, 40 - 60 metres, to provide for a long term, safe operating environment for the risers that connect the gas pipeline to the vessels. During severe weather, the risers in water depths less than 40 - 60 m may get damaged, posing safety, environmental, and economic risks. CAPCO was not able to locate a site with a suitable water depth within the HKSAR.

With this technology, regasification equipment is installed on each LNG carrier. It also requires an additional LNG carrier in the fleet, since each remains on station to act as a LNG storage tank. This technology can be cost effective only if the source of LNG is very close to Hong Kong. The longer the voyage, the more ships are needed to deliver the required annual volume. Since each ship must be outfitted with regasification equipment, thus adding substantially to the project costs.

In addition, since the LNG ship is used as storage, it could take up to 11 days to unload the LNG ship versus 14-18 hours when it is transferred to shore-based storage tanks. If severe weather occurs, the LNG ship would be required to disconnect from the mooring system and stop gas transfer. Conversely, with onshore LNG storage and regasification the gas transfer would continue. Therefore, this technology is used where the market does not require a highly reliable supply of gas, ie a situation which is in direct contrast with Hong Kong where we require a stable and secure supply to be able to burn gas at Black Point Power Station. For these reasons, this technology was determined to be unacceptable for Hong Kong.

4.6 CONSIDERATION OF A COASTAL LOCATION

The above discussions and analyses of options for LNG provision have indicated that siting a LNG receiving terminal along the coast in Hong Kong would be the most preferred option. Further details on the selection of appropriate sites for a coastal LNG receiving terminal are presented in *Section 4.9*.

4.7 THE NO ACTION ALTERNATIVE

The alternative of not replacing the depleting gas source from Yacheng 13-1 would signify that CAPCO would eventually, once the gas source was exhausted, have to suspend power generation at Black Point Power Station. This would increase the burden of electricity generation on CAPCO's other power plants, particularly the Castle Peak Power Station which utilises coal.

CAPCO would therefore have to increase the percentage of coal in its fuel mix which would lead to an increase above existing levels of emissions of NO_x, SO_x and total particulates until a replacement source of natural gas is identified. The no action alternative has also been discussed in *Section 2.8.5*.

4.8 CONCLUSION

The assessment presented above supports the conclusion that the development of a LNG terminal at a coastal location in Hong Kong is the preferred alternative for securing the timely implementation of a future reliable gas supply to the Black Point Power Station.

4.9 ALTERNATIVE SITE LOCATIONS STUDY

An alternative site location study was conducted by CAPCO in order to aid in the identification of suitable sites in Hong Kong for the development of a LNG terminal. In conducting the siting study CAPCO was mindful of the EIA Study Brief requirement (Clause 2.1v) to avoid and reduce potential environmental impacts on marine waters and ecological sensitive areas. Consequently, as discussed below in *Section 4.10.2* a series of environmental sensitive uses were identified such as Country Parks, Marine Parks, bathing Beaches etc and these were excluded from further consideration.

4.9.1 *Overview of Methodology*

In considering alternatives for securing timely implementation of a future reliable gas supply to the Black Point Power Station, the preferred option was to develop the LNG terminal at a coastal location in Hong Kong. To identify potential suitable coastal sites where the LNG terminal and its associated infrastructure could be located and to examine the feasibility of the development, an alternative site location study has been conducted.

The alternative site location study used a qualitative approach consistent with other similar studies undertaken in Hong Kong (1) (2).

The study was subdivided in two consecutive phases. The first phase allowed, through a constraint mapping exercise, the identification of a longlist of potential LNG sites within HK SAR compatible with environmental, physical and social constraints.

In the second phase, the longlist of potential sites was subjected to a three step screening assessment during which the sites were evaluated in a qualitative narrative manner and eliminated from the longlist on the basis of their environmental, social, planning and marine transit drawbacks.

The methodology therefore comprises a series of consecutive tasks which are listed and briefly discussed below:

(1) ERM - Hong Kong, Ltd (1999) Environmental Impact Assessment of a 1,800MW Gas-fired Power Station at Lamma Extension. For Hongkong Electric Co. Ltd. AEIAR-010/1999, approved 5 May 1999.

(2) ERM-Hong Kong, Ltd (2005) Detailed Site Selection Study for a Proposed Contaminated Mud Disposal Facility within the Airport East/East of Sha Chau Area. Environmental Impact Assessment (EIA) and Final Site Selection Report. For the Civil Engineering and Development Department, Hong Kong SAR Government. AEIAR-089/2005, approved 1 September 2005.

Phase I – Longlisting of Viable Sites

Task 1 **Definition of Necessary Characteristics/ Features of the Required Site.** In order to guide the alternative site location process, the first step was to define general site requirements for the LNG terminal's construction and operation.

Task 2 **Environmental Constraint Mapping:** A comprehensive set of environmental screening criteria was identified and compiled onto digital base maps using a Geographic Information System (GIS). This exercise allowed the identification of existing environmental constraints within HK SAR coastal areas, thus highlighting environmentally suitable sites for the LNG.

Task 3 **Physical & Social Constraint Mapping.** Similar to the previous task, a comprehensive set of physical and social constraint screening criteria was identified and compiled onto digital base maps using a GIS. This exercise permitted the identification of sites compatible with HK SAR's physical and social constraints.

Task 4 **Identification of Longlist of Viable Sites.** The environmental and physical & social constraint maps were combined to determine the areas that would not be considered further for the siting of the LNG terminal. The remaining unconstrained areas became, in essence, the potential coastal locations for the LNG terminal within Hong Kong. These areas were further scrutinised to determine the longlist of 27 sites deemed potentially viable for the location of the LNG terminal.

Phase II – Analysis and Identification of Preferred Site(s)

Task 5 **Preliminary Screening of Longlisted Sites.** The longlisted sites identified in *Task 4* were subjected to a feasibility review against three key site suitability criteria:

- Proximity to residential/commercial population,
- Land availability/constraints, and
- Exposure to meteocean conditions.

This approach led to the direct elimination of 20 sites and the identification of 7 potentially suitable shortlisted sites.

Task 6 **Detailed Review of Shortlist of Sites.** The 7 shortlisted sites identified in *Task 5* were subject to further review. The approach adopted was a qualitative narrative one which identified the potential environmental, social, planning and marine transit advantages and disadvantages of each site based on preliminary conceptual layouts. The screening process led to the direct elimination of 4 of the 7 shortlisted sites.

Task 7 **Final Selection:** The 3 sites remaining from *Task 6* were subjected to further detailed qualitative narrative assessment based on a suite of pre-defined environmental and technical criteria. This final detailed assessment provided the necessary support for the elimination of one of the 3 sites and the election of the 2 preferred sites to carry forward to the EIA.

The following sections present in detail the rationale and outcome of each of the seven tasks which brought the election of the two preferred sites for the LNG terminal location: Black Point and South Soko. The environmental, social and planning suitability of these two sites is further assessed in Parts 2 and 3 of this *EIA Report*.

4.10 PHASE I - LONGLISTING OF VIABLE LOCATIONS

4.10.1 Task 1 - Definition of Necessary Characteristics/ Features of the Required Site

In order to guide the alternative site analysis process, the general site requirements of the LNG terminal were defined. Overall, the LNG terminal would require the following:

- About 30 – 40 ha of land to locate the terminal infrastructure;
- Approach channel, turning basin and berth of depth around –15 mPD;
- Submarine gas pipeline to the Black Point Power Station.

4.10.2 Task 2 – Environmental Constraint Mapping

Constraint mapping makes extensive use of GIS-presented information to take account of potential territorial constraints. For the purpose of this alternative site selection study, the first step was to identify a broad range of environmental features and characteristics of Hong Kong coastal areas that would constitute a constraint for siting and operation of the LNG terminal and its associated facilities. The general site requirements identified in Task 1 were also considered in the context for the compilation of the constraint map.

The key sets of environmental information used were:

- Designated marine park or marine reserves;
- Gazetted fish culture zones;
- Wild animal protection areas;
- Coastal protection areas;
- Conservation areas;
- Sites of Special Scientific Interest (SSSIs);
- Gazetted and potential artificial reef deployment sites; and
- Country Parks.

The environmental constraints that have been reviewed include formally identified areas under the *Environmental Impact Assessment Ordinance* (*EIAO*) and other constraints associated with areas recognised under existing legislation/regulations as being of environmental importance that could be expected to be of interest to key government departments.

There are a number of areas within Hong Kong waters that are considered to be important for marine life which, at present, have no official protection status. It is noted though that some of the items listed below are regarded as recognised sites of conservation importance and/or important habitats where ecological impact assessment is necessary under the *EIAO TM*. Such marine life and/or habitats are as follows, and are included in the review and evaluation of each environmental feature presented in *Table 4.3*:

- Marine mammal habitat;
- Mudflats;
- Mangroves;
- Seagrass Beds;
- Horseshoe crab breeding grounds;
- Sea turtle nesting grounds;
- Coral communities of high abundance and diversity;
- Important areas for marine life; and
- Potential Marine Parks and Marine Reserves.

A detailed description and evaluation of the environmental constraint mapping criteria utilised in this task is outlined in *Section 4.10.4*. The composite outcome of the environmental constraint mapping exercise is presented in *Figure 4.8*.

4.10.3 Task 3 – Physical and Social Constraint Mapping

In a similar fashion to *Task 2*, a broad range of key physical and social features and characteristics of Hong Kong coastal areas were identified and reviewed to determine whether they constitute a constraint for siting and operation of the LNG terminal and its associated facilities. The key set of physical and social information used were:

Physical Constraints

- Designated areas of marine dredging and mud disposal;
- Existing anchorages;
- Marine vessel fairways;
- Areas of current, future or proposed reclamation;
- Restricted areas;
- Gazetted bathing beaches;
- Typhoon shelters;
- Utilities (submarine cables, pipelines and outfalls); and,
- Water depth.

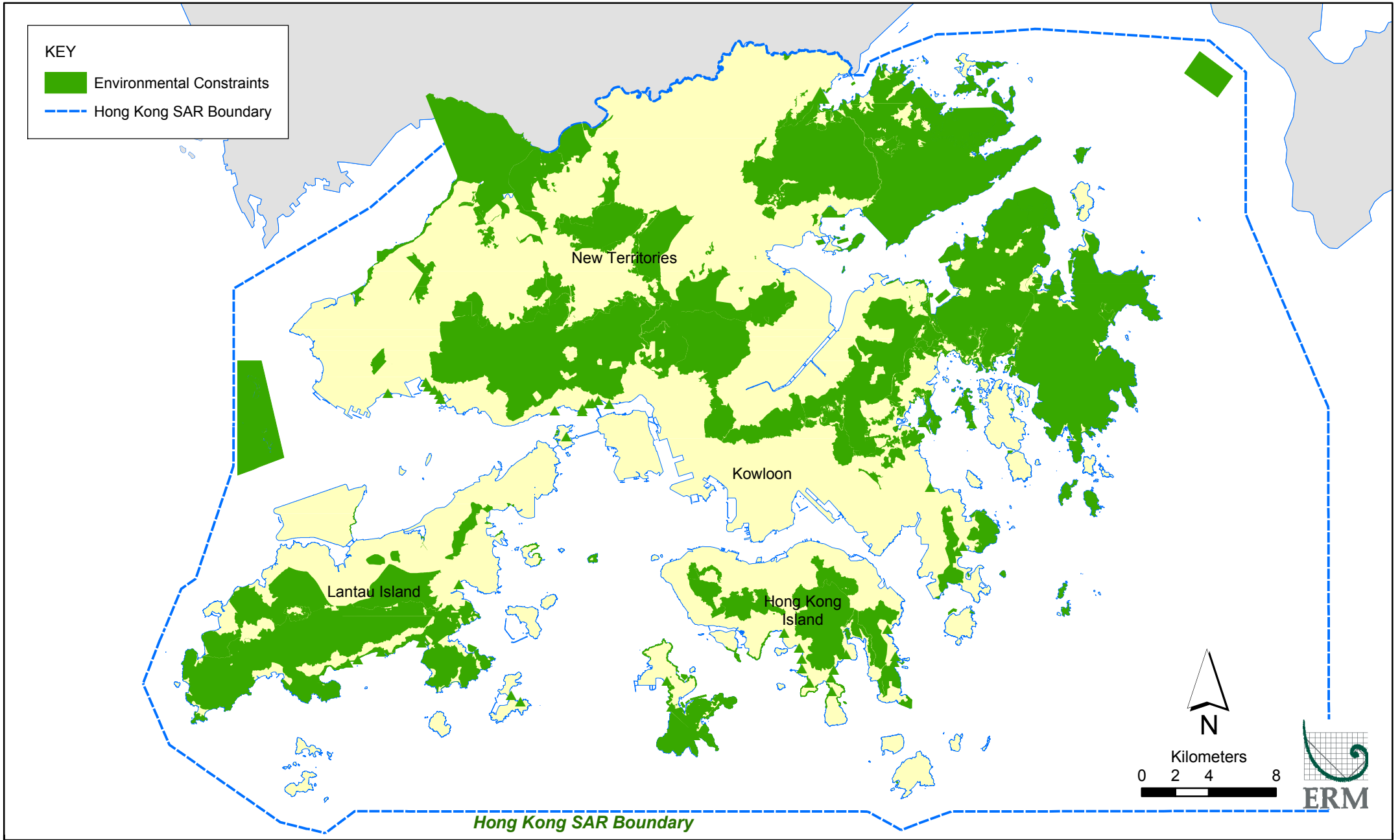

Figure 4.8

Areas Excluded Based on Environmental Exclusion Constraints for the Siting of a LNG Terminal and Its Associated Facilities within the Hong Kong Special Administrative Region (SAR)

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Social Constraints

- Areas of high population density; and
- Areas of marine recreational value.

A detailed description and evaluation of the physical and social constraint mapping criteria utilised in this task is outlined in *Section 4.10.4*. The composite outcome of the physical and social constraint mapping exercise is reported in *Figure 4.9*.

4.10.4 Constraint Mapping Criteria

For the purpose of the constraint mapping exercise, environmental, physical and social constraints were examined and subdivided into either **Exclusion Constraints** or **Non-exclusion Constraints** to the siting of a LNG terminal and its associated facilities:

- **Exclusion constraints** consist of locations/areas which possess features where Government Departments/ Policies would not be compatible with a LNG terminal and would thereby be recommended to be avoided; and,

- **Non-exclusion constraints** exist at locations/areas that are considered to be either important in terms of their ecological or environmental value; *or* recognised by Government Departments that, although not considered to be "no go areas", their sensitivity should be taken into account during the alternative site location analysis so as to facilitate future permitting requirements and to allow an objective assessment of the implementation risk.

A summary of this classification is presented in *Table 4.1* and *4.2* and a detailed description and evaluation of the environmental constraint mapping criteria utilised in *Tasks 2* and *3* is reported in *Tables 4.3* and *4.4*.

Table 4.1 Classification of Environmental Constraints

Exclusion Constraints	Non-exclusion Constraints
Designated marine parks and marine reserve	Important areas for marine life
Gazetted fish culture zones	Coral communities
Wild animal protection areas	Potential marine parks and marine reserves
Coastal protection areas	Biologically Productive Areas such as Spawning Grounds and/or Nursery Areas for Commercial Fisheries Resources
Conservation areas`	Mudflats
Sites of Special Scientific Interest	Sandy Shores
Gazetted artificial reef deployment sites	Mangroves
Country parks and special areas	Seagrass Beds
	Horseshoe crab breeding grounds
	Sea turtle nesting grounds
	Marine mammal habitat

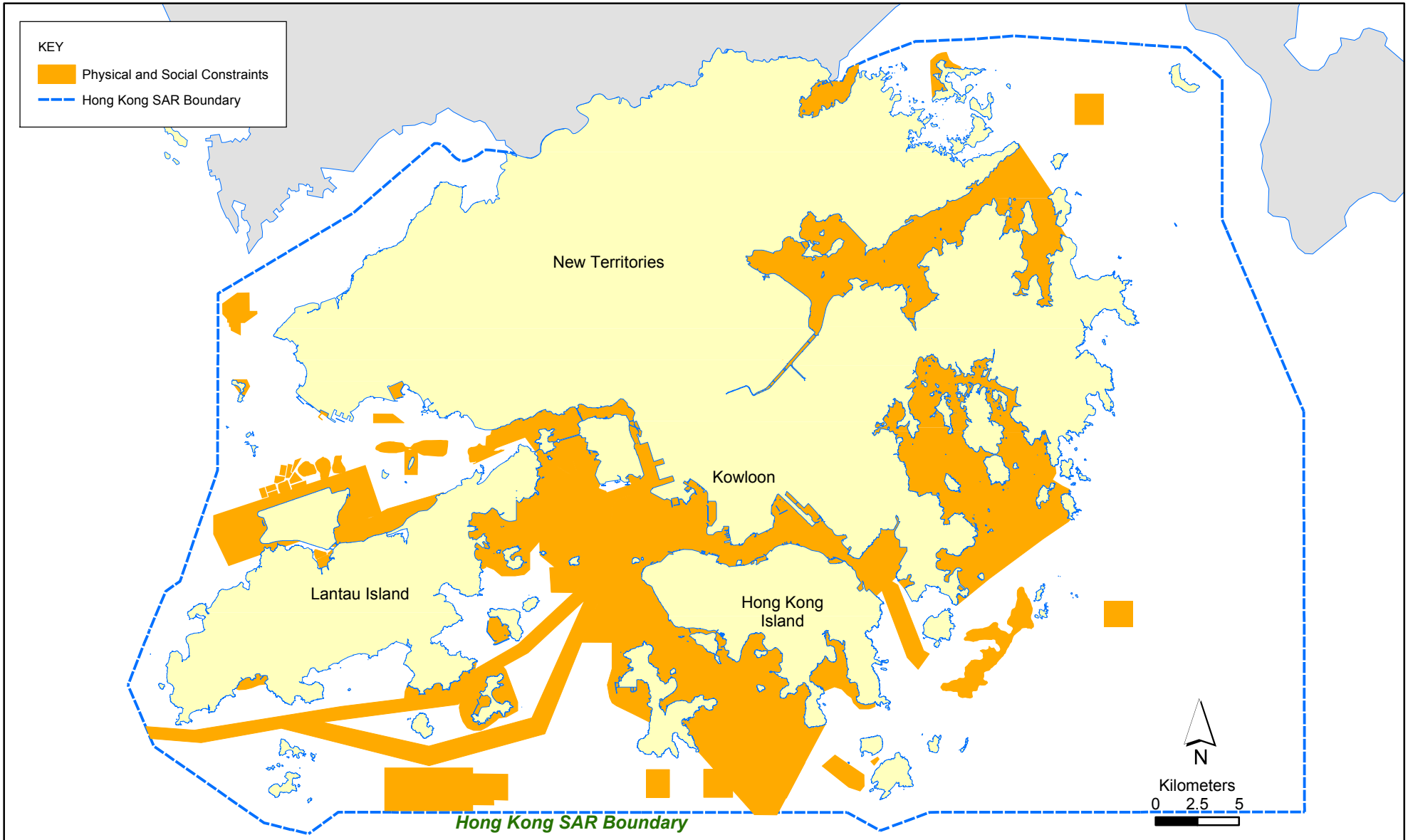

Figure 4.9

Areas Excluded Based on Physical and Social Exclusion Constraints
for the Siting of a LNG Terminal and Its Associated Facilities
within the Hong Kong Special Administrative Region (SAR)

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Table 4.2 Classification of Physical & Social Constraints

Exclusion Constraints	Non-exclusion Constraints
Designated or gazetted areas of marine dredging and mud disposal (active areas)	Designated or gazetted areas of marine dredging and mud disposal (gazetted inactive areas and constrained sand deposits)
Existing anchorages	Marine vessel fairways (minor fairways)
Marine vessel fairways (major fairways)	Future or proposed reclamations
Areas of current reclamation	Utilities (submarine cables, pipelines and outfalls)
Restricted areas	Water depth
Gazetted bathing beaches	Areas of recreational value
Typhoon shelters	
Areas of high population density	

Table 4.3 Evaluation of Identified Environmental Features

Feature	Review	Evaluation
Designated Marine Parks and Marine Reserve (*Figure 4.2*)	There are four designated Marine Parks in Hong Kong waters and one Marine Reserve (1) . These are as follows: • *Marine Parks* - Yan Chau Tong - Hoi Ha Wan - Tung Ping Chau - Sha Chau and Lung Kwu Chau • *Marine Reserve* - Cape d'Aguilar The Marine Parks Ordinance allows for the prohibition of a number of activities within marine parks and reserves, including development. The Sha Chau and Lung Kwu Chau Marine Park contains within it a temporary Aviation Fuel Receiving Facility (AFRF). The AFRF was permitted prior to the designation of the Marine Park, which was recommended in the EIA for the AFRF as a mitigation measure.	Designated Marine Parks and Marine Reserve can be considered to be **Exclusion Constraints** to the siting of a proposed LNG terminal in Hong Kong waters.
Gazetted Fish Culture Zones (*Figure 4.3*)	Marine fish culture in Hong Kong is protected and regulated by the *Marine Fish Culture Ordinance* (*Cap. 353*) that requires all marine fish culture activity to operate under licence in designated Fish Culture Zones (FCZs). At present, there are 26 FCZs in Hong Kong (2) that, in total, occupy an area of 209 ha with approximately 1,200 licensed operators. No developments (eg reclamation) are allowed inside the gazetted area of an FCZ.	Each FCZ is considered to be an **Exclusion Constraint** to the siting of a proposed LNG terminal in Hong Kong waters.

(1) Agriculture, Fisheries and Conservation Department (2003) Annual Report.
(2) Agriculture, Fisheries and Conservation Department (2003) Annual Report.

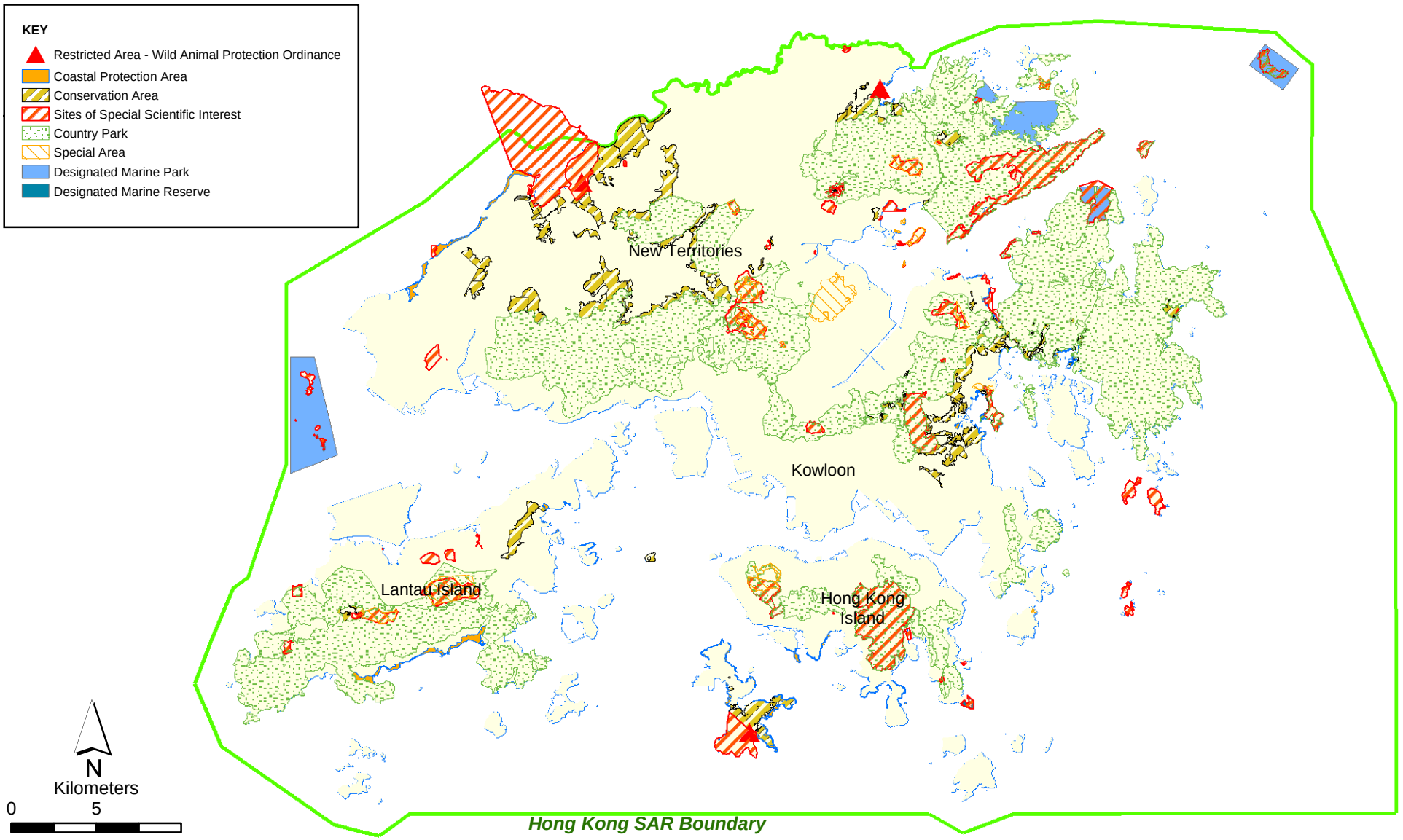

Figure 4.2

Key Areas of Conservation Importance

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Date: 04/11/2005

(Sources: Agriculture, Fisheries and Conservation Department, 2000, 2001, 2003; Environmental Protection Department, 2001; Planning Department 2001)

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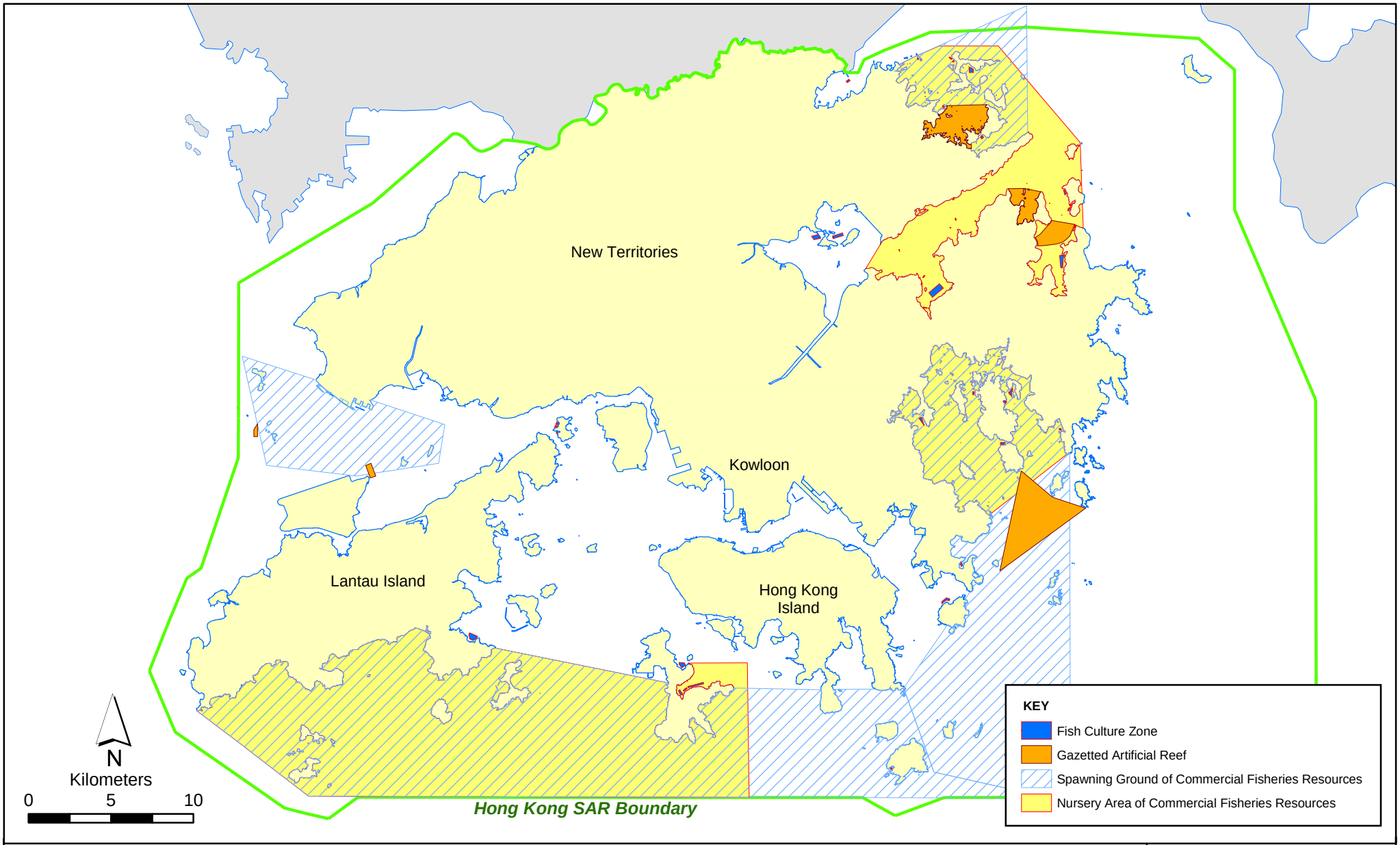

Figure 4.3

Key Marine Fisheries Resources and Operations

(Sources: Agriculture, Fisheries and Conservation Department, 1998, 2003)

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Date: 04/08/2006

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Feature	Review	Evaluation
Wild Animals Protection Areas (*Figure 4.2*).	The Wild Animals Protection Ordinance (Cap. 170) restricts access to designated areas of wildlife habitat. Under the Ordinance three areas have been designated as Wild Animal Protection Areas and are protected by the Agriculture, Fisheries and Conservation Department. These areas are identified as the Mai Po Marshes, Sham Wan Turtle Nesting Area and the Yim Tso Ha Egretry (1) .	Wild Animal Protection Areas can be considered to be **Exclusion Constraints** to the siting of a proposed LNG terminal in Hong Kong.
Coastal Protection Areas and Conservation Areas (*Figure 4.2*)	To promote the environment, areas of conservation value may be declared as Conservation Zones under the Town Planning Ordinance. Such areas include Coastal Protection Areas, which have been identified to retain natural coastline, and Conservation Areas, which have been identified to retain existing natural features and rural use (2) .	Coastal Protection Areas and Conservation Areas can be considered to be **Exclusion Constraints** to the siting of a proposed LNG terminal in Hong Kong.
Sites of Special Scientific Interest (SSSIs) (*Figure 4.2*).	Sites of Special Scientific Interest (SSSIs) may be land based or marine sites that are of special interest because of their flora, fauna, geographical, geological or physiographic features as identified by the Agriculture, Fisheries and Conservation Department. Hong Kong has a total of 64 SSSIs, distributed throughout the region (3) .	SSSIs can be considered to be **Exclusion Constraints** to the siting of a proposed LNG terminal in Hong Kong.
Important Areas for Marine Mammals	The Indo-Pacific Humpback or Chinese White Dolphin (*Sousa chinensis*) and the Finless Porpoise (*Neophocaena phocaenoides*) are the only species of marine mammal regularly sighted in Hong Kong waters (4) . The population of *Sousa chinensis* is reported to be centred around the Pearl River Estuary and Hong Kong waters are thought to represent the eastern portion of its range (1). West and Northwest Lantau represent the major areas of distribution of *Sousa chinensis* in Hong Kong waters.. Individuals are most frequently sighted in the western part of these waters around the Sha Chau & Lung Kwu Chau Marine Park, the Chek Lap Kok platform and the west coast of Lantau near Tai O. Furthermore, it appears that dolphins breed, calf and feed throughout their range in Hong Kong waters and do not restrict particular activities to specific areas.	Both of these species are mobile and have large areas that they inhabit, often seasonally. Because of their mobile nature and the large areas of their habitats, they are considered to be **Non-exclusion Constraints** to the siting of a proposed LNG terminal in Hong Kong waters.

(1) Environmental Protection Department (2001) Annual Report
(2) Planning Department (2001) Study on the Sustainable Development for the 21st Century in Hong Kong (SUSDEV 21).
(3) Agriculture, Fisheries and Conservation Department (2000) Annual Report
(4) Agriculture, Fisheries and Conservation Department (2004) *Sousa chinensis* and *Neophocaena phocaenoides* monitoring data 1995 – 2004 Incorporates Ocean Park Conservation Foundation (OPCF) monitoring data 1995-1998

Feature	Review	Evaluation
	The finless porpoise, *Neophocaena phocaenoides*, is a small cetacean endemic to southern and eastern Asia and is protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix I. In Hong Kong, until recently, little information was available regarding the distribution and abundance of the finless porpoise in local waters. Surveys were conducted in southern waters for 12 months between December 1996 and November 1997. The surveys revealed that the finless porpoise is the most common and most important species of cetacean in the Lamma Island area and these waters appear to be the most important habitat in Hong Kong for this marine mammal (2). The presence of the porpoise in the waters around Lamma Island appears to vary on both a spatial and temporal basis. Sightings to date indicate that the only months of the year when this cetacean is absent from Lamma Island are July and August. During these months the porpoise is thought to move east to the waters around Po Toi, Waglan and Sung Kong Islands. Sightings of the porpoise in SW Lantau usually occur only in winter and spring.	
Biologically Productive Areas such as Spawning Grounds and/or Nursery Areas for Commercial Fisheries Resources (*Figure 4.4*)	The location of spawning grounds and nursery areas for commercial fisheries resources was identified in the Hong Kong wide fisheries study (3). Although seasonal, the majority of the southern and eastern inshore waters are considered to be spawning grounds, whereas, nursery areas are more restricted being limited to the southwestern waters, Port Shelter and the inshore waters of the northeast New Territories.	As these areas cover large areas and are seasonal they can be considered to be **Non-exclusion Constraints** to the siting of a proposed LNG terminal in Hong Kong waters.

(1) Jefferson TA (1998) Population Biology of the Indo-Pacific Hump Backed Dolphin (*Sousa chinensis* Osbeck, 1975) in Hong Kong Waters. Final Report to the Agriculture, Fisheries and Conservation Department, Hong Kong SAR Government.

(2) Jefferson TA, Hung SK, Law L, Torey M and Tregenza N (2002) Distribution and abundance of finless porpoises in Hong Kong and adjacent waters of China. Facultative Freshwater Cetaceans of Asia: Their Ecology and Conservation, pp43-52. The Raffles Bulletin of Zoology. Supplement No. 10. National University of Singapore.

(3) ERM - Hong Kong, Ltd (1998) Fisheries Resources and Fishing Operations in Hong Kong Waters. Final Report. For the Agriculture, Fisheries and Conservation Department, Hong Kong SAR Government.

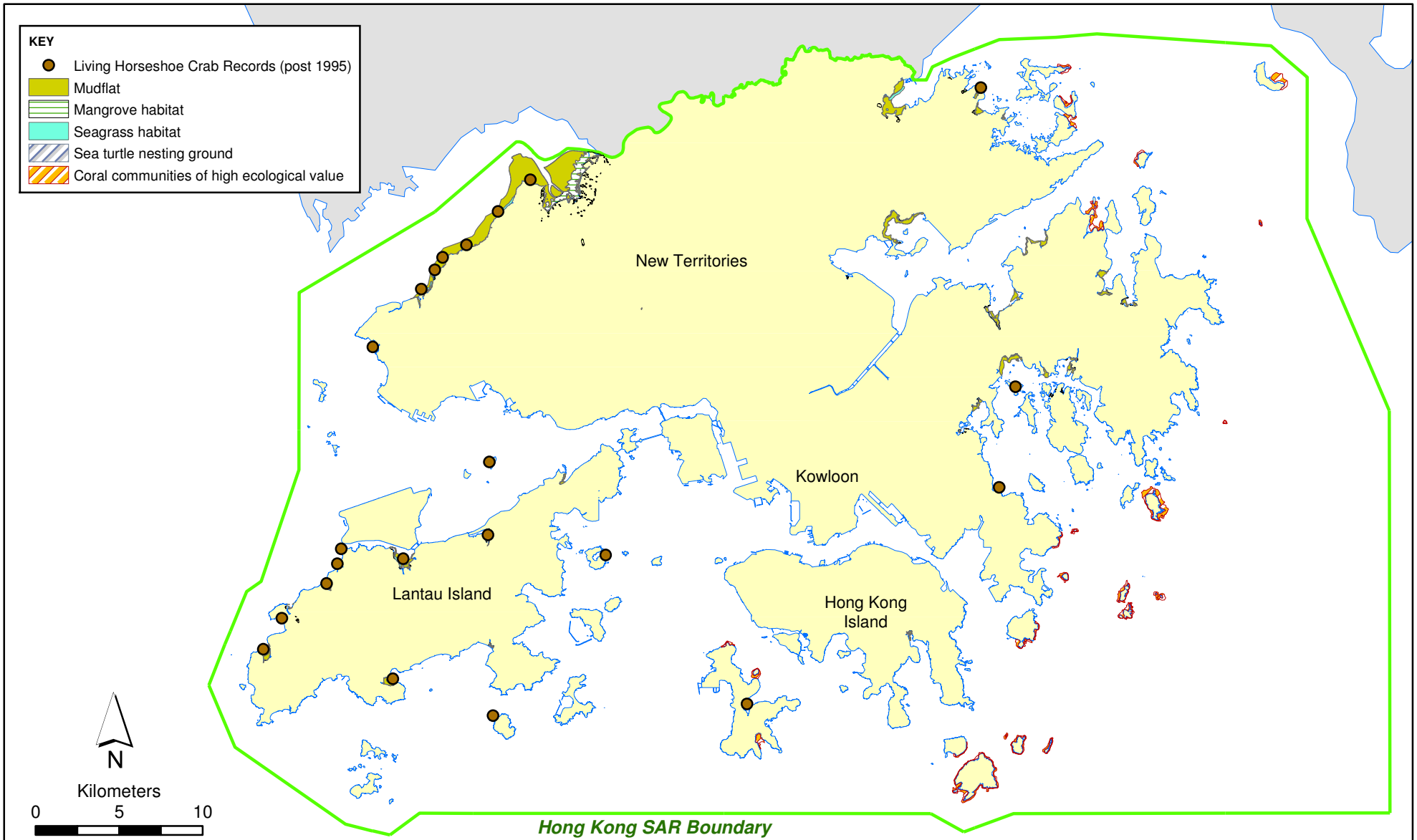

Figure 4.4

Key Marine Ecological Resources

(Sources: Agriculture, Fisheries and Conservation Department, 1998; Environmental Resources Management, 1999; Planning Department 1999; The Hong Kong Marine Conservation Society 1997; Binnie Consultants Ltd 1995, ERM 2001)

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Feature	Review	Evaluation
Mudflats (*Figure 4.4*)	Mudflats often lie in sheltered heads of harbours or in bays land-locked by the surrounding coasts (1) . They are classified as areas of fine-grained sediment (ie silt or fines) which lie between the high and low tide marks and which are not covered by seagrasses, mangroves or typical wetland vegetation. The habitat is generally fed with freshwater streams. Wave action is weak but currents agitate fine sediments from the substrate and create constantly turbid conditions. The habitat is susceptible to pollution because of its poor flushing conditions. Mudflats are known to support a variety of soft-bottom invertebrates and thus provide valuable feeding habitat for migratory bird populations as well as other organisms (2). The largest of Hong Kong's mudflats occurs in Deep Bay where the ample sediment load provided by the Pearl River and shelter from wave action allows the accumulation of silt. Deep Bay's mudflat benthos forms the trophic basis for the large number of resident and wintering birds in the area.	Mudflats are considered to be a **Non-exclusion Constraint** to the siting of a proposed LNG terminal in Hong Kong waters.
Sandy shores (*Figure 4.4*)	Sandy shores are mobile and unstable environments subjected to constant water movement and wave action and harbour an array of marine species. Sandy shores may provide nursery and spawning ground for fish as well as marine invertebrates. They may also be foraging habitat for avifauna. Findings of a territory wide habitat survey of soft shores (predominantly sandy shores) conducted in 2000-2002 have been used to rank the conservation importance of 40 soft shores, which covered about 80% of Hong Kong's total number of soft shores (3) . Based on a variety of defined criteria, the shores were ranked for conservation value and classified into 5 conservation categories. The findings were that one shore, located on South Lantau, was assigned the top ranking of "extremely important". A total of 12 shores were classified as "very important", 16 were classified as "important", while 9 were in the category "can be conserved" and 2 shores were given the conservation ranking of "low priority".	Sandy shores are considered to be a **Non-exclusion Constraint** to the siting of a proposed LNG terminal in Hong Kong waters.

(1) Planning Department (1999-2000) Environmental Baseline Survey Report: Terrestrial Habitat Mapping and Ranking Based on Conservation Value. For: Study on Sustainable Development for the 21 Century Study (SUSDEV 21).
(2) Morton B and Morton J (1983) The Sea Shore Ecology of Hong Kong. Hong Kong University Press.
(3) City University of Hong Kong (2005) A Study of Soft Shore Habitats in Hong Kong for Conservation and Education Purposes. ECF Project 23/99

Feature	Review	Evaluation
Mangroves (*Figure 4.4*)	Mangroves are characteristic of the tropics and mostly are found on intertidal to high shore areas in the estuarine waters of sheltered bays, and seawards of salt meadows. The mild climate and the massive freshwater of the Pearl River (especially during the summer) promote the development of mangrove communities in Hong Kong, particularly in the western region (eg Deep Bay). The local distribution of the mangrove community is governed by the salinity regime and the availability of sheltered, depositing shores (1). Apart from the largest mangroves established in Mai Po, much smaller patches of mangrove are scattered in areas such as Three Fathoms Cove and Ting Kok in Tolo Channel. Mangrove habitats are generally highly productive areas that support biological diversity and which area known as breeding and nursery grounds for a range of fauna. They can also serve to reduce coastal erosion.	Acknowledged mangrove habitats in Hong Kong are considered to be a **Non-exclusion Constraint** to the siting of a proposed LNG terminal in Hong Kong waters.
Seagrass Beds (*Figure 4.4*).	Seagrass beds occur in shallow, sheltered intertidal or subtidal areas and are recognised as areas of high biological productivity. As such, they provide high value habitat as feeding and nursery grounds for a range of marine species (2). However, seagrass beds have been recorded with a very low distribution in Hong Kong and occupy less than 0.1% of the total land area. Seagrasses are protected under the *Marine Parks Ordinance* (*Cap 476*) under the category of marine grasses in designated Marine Parks and Marine Reserves only. Rapid development of the inshore environment and the associated terrestrial catchments, together with impacts to offshore water quality threaten the survival of the Hong Kong seagrasses, and hence the extent of the seagrass habitat.	Seagrass habitats in Hong Kong are considered to be a **Non-exclusion Constraint** to the siting of a proposed LNG terminal in Hong Kong waters.

(1) Morton B, Williams GA and Lee SY (1996) The benthic marine ecology of Hong Kong: a dwindling heritage? In Coastal Infrastructure Development in Hong Kong: A Review, 233-267. Hong Kong SAR Government.
(2) Lee SY (1997) Annual cycle of biomass of a threatened population of the intertidal seagrass *Zostera japonica*. Marine Biology 129: 183-193.

Feature	Review	Evaluation
Horseshoe Crab Breeding Grounds (*Figure 4.4*)	Two species of Horseshoe Crabs (*Tachypleus tridentatus* and *Carcinoscorpius rotundicauda*) have been recorded in Hong Kong waters. As numbers of these marine organisms are known to have drastically declined in recent years, recommendations for their conservation have been made (1). In Hong Kong, the intertidal sand/sandy-mud flats at Shui Hau and San Tau, on Lantau Island, the mud flats at Pak Nai, in Deep Bay have recorded juveniles of both species, whereas, adult horseshoe crabs are occasionally fished from the subtidal mud along the northwest coast to the Lantau Island, including Tai O, Yi O, Sham Wat Wan, Sha Lo Wan and Tung Chung Bay.	These habitats are considered to be **Non-exclusion Constraints** to the siting of a LNG terminal in Hong Kong.
Sea Turtle Nesting Grounds (*Figure 4.4*).	Although four (2) species of sea turtle have been found in Hong Kong waters, only the Green Turtle (*Chelonia mydas*) has been recorded as breeding locally (3). The Green Turtle is a highly endangered species listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix I. Locally, the Green Turtle is protected under the Wild Animals Protection Ordinance Cap.170. Presently, the sandy beach at Sham Wan on Lamma Island is the only Green Turtle nesting site known in Hong Kong and is one of the few remaining nesting sites in Southern China.	The beach has been designated as a Restricted Area and can be considered to be a **Non-exclusion Constraint** to the siting of a LNG terminal in Hong Kong.

(1) Chiu HMC and Morton B (2001) The Biology, Distribution and Status of Horseshoe Crabs, *Tachypleus tridentatus* and *Carcinoscopius rotundicauda* (Arthropoda: Chericerata): Recommendations for Conservation and Management. Final Report.

(2) Chan S (2003) Green Turtles in Hong Kong. Agriculture, Fisheries and Conservation Department. Cosmos Books Ltd, Hong Kong

(3) McGilvray & Geermans S (1997) The status of the Green Turtle in Hong Kong and an action plan for its survival. The Hong Kong Marine Conservation Society.

Feature	Review	Evaluation
Gazetted Artificial Reef Deployment Sites (*Figure 4.3*).	At present, the Agriculture, Fisheries and Conservation Department is undertaking an artificial reef deployment programme to enhance fisheries and promote bio-diversity in Hong Kong's marine environment. Artificial reefs are recognised worldwide as having the potential to encourage growth and development of marine organisms, which in turn provide food, shelter and protection for fish. The programme is being implemented in two phases. The first phase deployed a number of gazetted artificial reefs within the waters of the Hoi Hai Wan and Yan Chau Tong Marine Parks as well as biofilter reefs within the Kai Sai Chau gazetted Fish Culture Zone. The second phase will deploy artificial reefs in Port Shelter and Long Harbour, and was completed in 2003 (1) .	Due to their ecological and fisheries value, gazetted artificial reef deployment sites in Hong Kong are considered to be an **Exclusion Constraint** to the siting of a proposed LNG terminal in Hong Kong waters.
Coral Communities (*Figure 4.4*) (2) (3) (1) (2).	The Agriculture, Fisheries and Conservation Department report that there are over 80 species of corals recorded in Hong Kong waters (3). Coral reefs support a range of species providing shelter, feeding, spawning and nursery areas, resulting in the large and diverse community for which they are renowned. The greatest diversity and abundances of corals are generally found in the northeastern waters of Hong Kong due to the optimal environmental conditions for settlement, growth and survival found in these waters. The western and southern waters of Hong Kong are influenced by the Pearl River, greatly reducing salinities, increasing turbidity and therefore reducing light penetration. Ahermatypic octocorals, including soft and black corals, which unlike the hermatypic hard corals do not require light for zooxanthellae photosynthesis, are more widely distributed and often occur at greater depths. Numerous studies have been undertaken in Hong Kong that have provided information on the distribution of corals in Hong Kong. However, it is relatively widely acknowledged that this information is data limited and the actual distribution of corals is likely to be more extensive than currently documented.	Coral communities can be considered to be **Non-exclusion Constraints** to the siting of a proposed LNG terminal in Hong Kong waters.

(1) Agriculture, Fisheries and Conservation Department (2003) Annual Report
(2) Binnie Consultants Ltd (1995) Marine Ecology of Hong Kong. Coastal Ecology Studies. Civil Engineering and Development Department, Hong Kong SAR Government.
(3) ERM - Hong Kong, Ltd (1999) *Op cit.*

Feature	Review	Evaluation
Country Parks and Special Areas (*Figure 4.2*)	A total of twenty-three Country Parks and fifteen Special Areas (eleven of which lie inside Country Parks) have been established in Hong Kong under the *Country Parks Ordinance*, which provides a legal framework for their designation, development and management (4) . In total, the area of land protected under this Ordinance covers approximately 42,000 hectares. Country Parks comprise scenic hills, woodlands, reservoirs and coastline throughout Hong Kong Several islands, such as Tung Ping Chau in Mirs Bay, are also included. Country Parks are designated for the purposes of nature conservation, countryside recreation and outdoor education, whereas, Special Areas have been designated mainly for the purpose of nature conservation.	Due to their conservation and recreation value, Country Parks are considered to be an **Exclusion Constraint** to the siting of a proposed LNG terminal in Hong Kong.

(1) ERM - Hong Kong, Ltd (2000) EIA of the Construction of an International Theme Park in Penny's Bay of North Lantau and Its Essential Associated Infrastructures. For the Civil Engineering and Development Department, Hong Kong SAR Government.
(2) ERM - Hong Kong, Ltd (2001) Focussed Cumulative Water Quality Impact Assessment for the West Po Toi Sand Borrow Area. For HAM Dredging.
(3) Agriculture, Fisheries and Conservation Department website: http://www.afcd.gov.hk
(4) Planning Department (2001) Study on the Sustainable Development for the 21st Century in Hong Kong (SUSDEV 21).

Feature	Review	Evaluation
Potential Marine Parks and Marine Reserves (*Figure 4.2*)	In addition to Hong Kong's existing gazetted four Marine Parks and one Marine Reserve, discussed above, five other sites are currently under consideration to be designated as Marine Parks. These areas are: • Proposed Southwest Lantau Marine Park; • Proposed Soko Islands Marine Park; • South Lamma Potential Marine Park; • Outer Port Shelter Potential Marine Park; and, • Tai Long Wan Potential Marine Park. Due to the potential for these areas to be gazetted under the *Marine Parks Ordinance* and thereby being granted protection from development, each of these areas are considered to be Non-exclusion Constraints to the siting of a LNG terminal in Hong Kong. It should be noted, that although it is understood that South Lamma, Outer Port Shelter and Tai Long Wan in Sai Kung have also been identified as potential marine parks (1) it is presently understood that these areas are only at the feasibility stage and no firm plans have been drawn up. It is noted that under the Southwest New Territories Development Study the Southwest of Lantau as well as the Soko Islands were identified as Potential Marine Parks. The two were subsequently the subject of a study examining their feasibility for marine park designation (HKIE 1999). The recently published Lantau Concept Plan has an area from Fan Lau to Peaked Hill marked as recommended for Marine Park designation but not an area around the Soko Islands. It is also noted that the operation of a LNG terminal is not considered incompatible with the designation of marine park status should that occur at a later date at the South Soko Island. Reference is made to the Lung Kwu Sha Chau Marine Park which has the Aviation Fuel Receiving Facility operating within its boundaries. Consequently, potential marine parks as such are not considered to be a constraint.	As those areas have yet to be designated under the *Marine Parks Ordinance* these areas are considered to be **Non-exclusion Constraints** to the siting of a LNG terminal in Hong Kong.

(1) It is noted that Potential Marine Parks are not listed in *Note 1 of Annex 16* of the *EIAO TM*.

Table 4.4 Evaluation of Identified Physical Features

Feature	Review	Evaluation
Designated or Gazetted Areas of Marine Dredging and Mud Disposal (active and inactive) *(Figure 4.5)*	The Civil Engineering and Development Department (CEDD) of the Hong Kong SAR Government currently maintains a number of gazetted areas in Hong Kong waters for sand dredging and mud disposal purposes. Within these areas, there are areas that have been designated for specific marine fill/disposal uses. These are classified as: • Open sea disposal areas for uncontaminated mud; • Exhausted sand borrow pits for disposal of uncontaminated mud; • Sand deposit areas (extent prior to dredging, sand remaining); and, • Contained disposal pits for contaminated mud.	Each of areas designated for specific marine fill/disposal uses is considered to be an **Exclusion Constraint** to the siting of a LNG terminal in Hong Kong waters. However, as there are no formal restrictions on the inactive waters within the gazetted areas, these areas, as well as areas of sand deposits that are not being used due to constraints based on either environmental or other grounds, are only considered to be **Non-exclusion Constraints**.
Existing Anchorages (*Figure 4.6*)	There are a total of nineteen existing anchorages in Hong Kong waters, excluding the typhoon shelters. A number of these anchorages have been designated for Immigration and Quarantine purposes, whereas, others have been designated for dangerous goods or are simply general-purpose anchorages providing temporary berthing spaces for vessels. The areas and water depths of the anchorages are diversified in order to accommodate difference sizes and draughts of vessels.	The Marine Department considers each anchorage to be closed to future development and, as such, can therefore be considered as an **Exclusion Constraint** to the siting of a LNG terminal in Hong Kong.

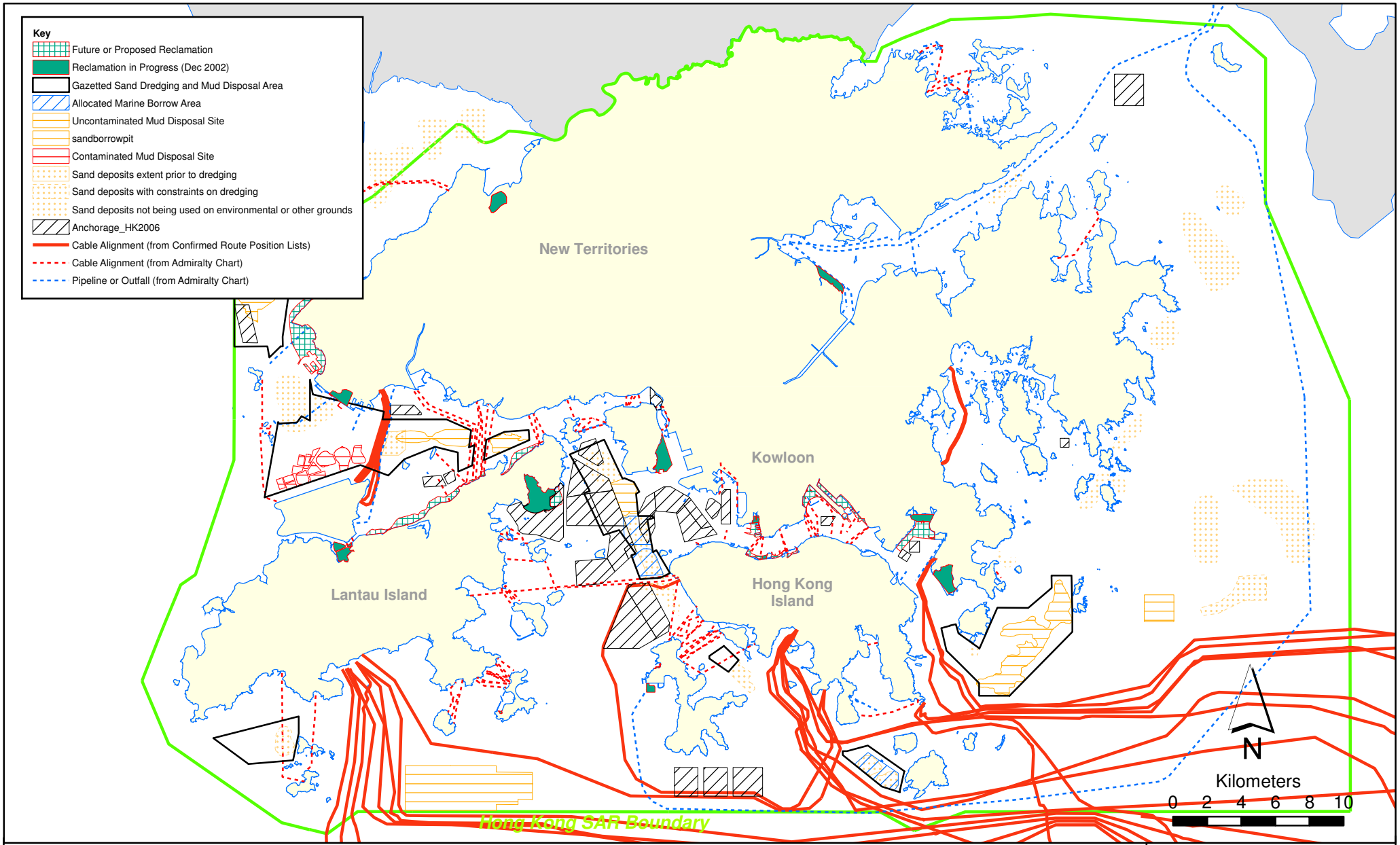

Figure 4.5

Key Seabed Features

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(Sources: Civil Engineering Department 2003; Marine Department, 2000; Environmental Resources Management, 1999 - 2003)

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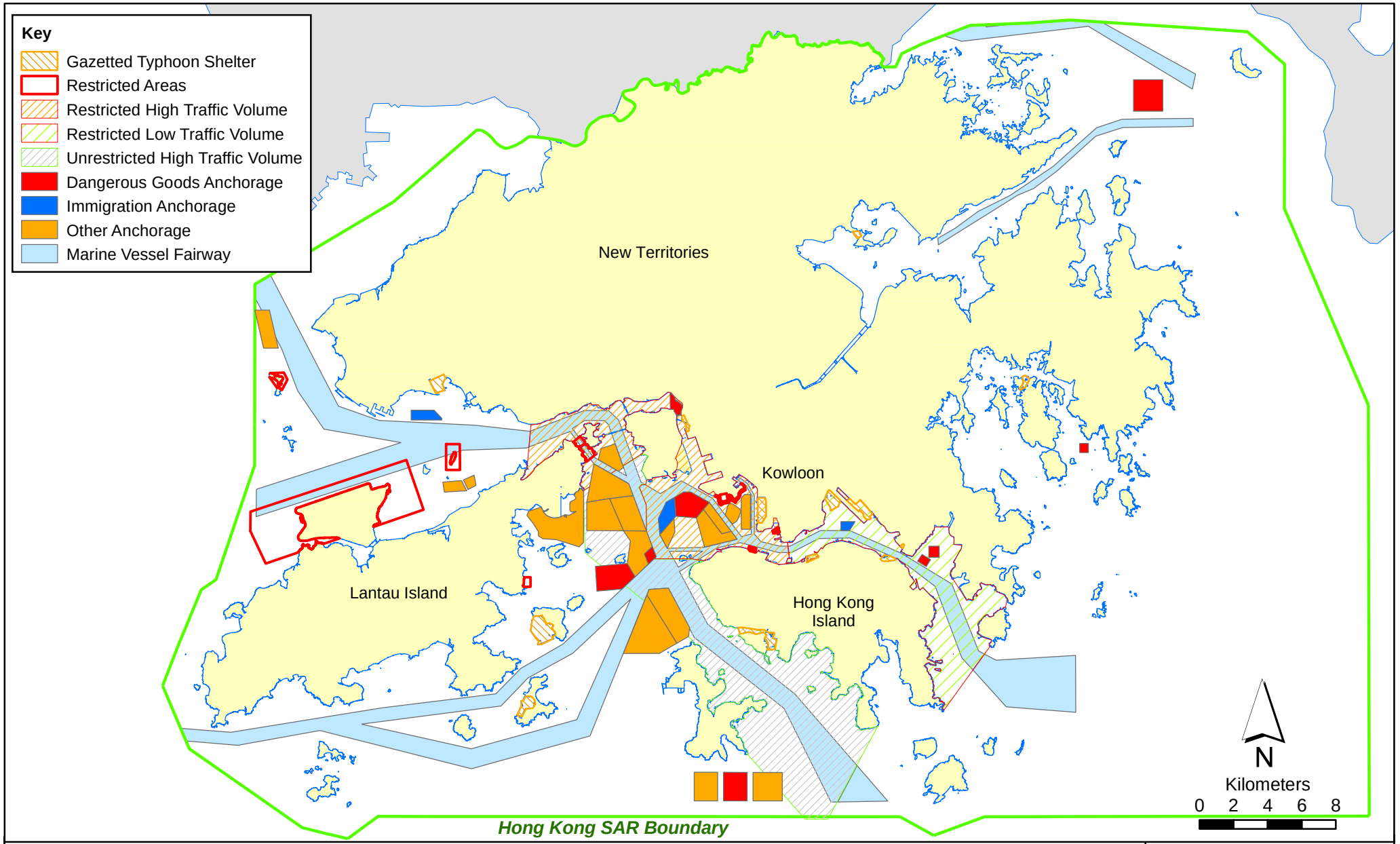

Figure 4.6

Key Port Operations

(Sources: Marine Department, 2006; Marad 1007)

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Date: 15/09/2006

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Feature	Review	Evaluation
Marine Vessel Fairways (*Figure 4.6*)	The LNG carrier must be provided with safe access to the LNG terminal. In doing so, the density and routes of other traffic within the same navigable waterway must be considered in order to mitigate against potential incidents. Control of transit speed, traffic control and reporting are important elements while within designated channel fairways for mitigating the incidence and consequences of either a collision or grounding. 'The LNG carrier is required to comply with the applicable rules-of-the-road as are other ship types while within HK waters A study of Hong Kong's marine traffic, based on a review of Marine Department casualty files between 1992 and 1994, has subsequently designated four different marine categories to signify risk (1) as follows: • Highly restricted water area with high traffic volumes; • Highly restricted water area with low traffic volumes; • Unrestricted water area with high traffic volumes; and, • Unrestricted water area with low traffic volumes. In addition to these areas, frequently used access channels to Hong Kong are as follows: • The *Tathong Channel*, which is the main access channel on the eastern side of Hong Kong and is mainly used by general cargo vessels and fishing vessels; • The *East Lamma Channel*, which is the major entry and exit route for Hong Kong. Whilst all types of vessels used this channel, the traffic is dominated by container ships. The channel also supports the tanker traffic for the Tsing Yi terminals; • The *West Lamma Channel*, which is mainly used by traffic to and from southerly destination and primarily by general cargo vessels. • The *Adamasta (South West Lantau) Channel*, which is used mainly by smaller cargo vessels to and from the southwest and the high speed ferries to and from Macau.	Highly restricted water areas and unrestricted water area with high traffic volumes are considered to be **Non-exclusion Constraints** to the siting of a LNG terminal due to the associated risk. Unrestricted water area with low traffic volume is considered not to be a constraint. Due to restrictions on use imposed by Marine Department, frequently used access channels are considered to be an **Exclusion Constraint** to the siting of a LNG terminal. It should be noted that the LNG pipeline would be able to pass through these channels as such use is allowed in Hong Kong (subject to engineering and protection requirements, and approval of Marine Department). There are also a number of other fairways in Hong Kong waters, such as the Yantian Fairway and Tolo Harbour Channel.. These fairways are not, however, considered to be a constraint due to their lower marine traffic.

(1) Au Posford Consultants Ltd (1997) Comprehensive study on marine activities, associated risk assessment and development of a future strategy for the optimum usage of Hong Kong waters (MARAD study). For Marine Department, Hong Kong SAR Government.

Feature	Review	Evaluation
Areas of Current, Future or Proposed Reclamation (*Figure 4.5*)	Civil Engineering and Development Department records (1) indicate several areas of current, future or proposed reclamation including at Tsing Yi, Pak Shek Kok, Victoria Harbour, North Lantau, Penny's Bay and Tseung Kwan O.	All reclamations currently in progress have been identified as **Exclusion Constraints** to the siting of a LNG terminal in Hong Kong. Although planning and development intentions may change over time, any reclamation sites that are currently under review or are proposed and are sufficiently likely to occur are considered to be **Non-exclusion Constraints**.
Restricted Areas (*Figure 4.5*).	There are three types of restricted areas in Hong Kong waters, based on restrictions in vessel air-draught (2). Each area either surrounds or is in the vicinity of the Chek Lap Kok International Airport platform Permission to pass through these areas must be obtained from the Marine Department and the Airport Authority.	Restricted Areas have been classified as an **Exclusion Constraint** to the siting of a LNG terminal in Hong Kong.
Gazetted Bathing Beaches (*Figure 4.1*)	There are currently forty-one gazetted beaches in Hong Kong, separated into five districts (3). The Environmental Protection Department (EPD) of the Hong Kong SAR Government monitors each of these beaches throughout the year. At present, only four beaches are considered to be open year-round, in terms of being actively managed by the Leisure and Cultural Services Department (LCSD) of the Hong Kong SAR Government. These are Deep Water Bay; Clear Water Bay Second; Golden Beach and Silverstrand Beach. The remaining thirty-seven beaches are only open during the LCSD designated bathing season, which lasts from the beginning of March to the end of October.	All gazetted beaches in Hong Kong would be considered to be **Exclusion Constraints** to the siting of a proposed LNG terminal in Hong Kong waters.
Typhoon Shelters (*Figure 4.6*).	There are fourteen public-use typhoon shelters located within Hong Kong waters. Vessels are limited to 50 m in length in each, however, vessels over 30.5 m long are allowed in only seven of the shelters. Although typhoon shelters are managed by the Marine Department and development is possible inside the shelter it is to be avoided where possible.	Hong Kong's typhoon shelters are considered to be an **Exclusion Constraint** to the siting of a LNG terminal in Hong Kong.

(1) Civil Engineering and Development Department (2005) Marine Fill Resources, Mud Disposal Areas and Major Reclamations. Marine Fill Committee. Government of the Hong Kong Special Administrative Region

(2) Marine Department (2004) The Port of Hong Kong: Handbook and Directory 2004. Information and Public Relations Section. Government of the Hong Kong Special Administrative Region.

(3) Environmental Protection Department (2005) Marine Water Quality in Hong Kong in 2004. Government Printer

Feature	Review	Evaluation
Utilities (Submarine Cables, Pipelines and Outfalls) (*Figure 4.5*)	There are numerous submarine cables, pipelines and outfalls in Hong Kong waters (1) . The majority of these approach Hong Kong from the southern waters, particularly fibre-optic cables.	Each submarine cable, pipeline and outfall is considered to be a **Non-exclusion Constraint** to the siting of a coastal LNG terminal in Hong Kong waters. These utilities would, however, be considered as **Exclusion Constraints** to the siting of an artificial island/gravity based LNG facility.
Water Depth (*Figure 4.7*).	One of the requirements for a safe transit and approach to the proposed LNG terminal is to have a seabed depth of around -15m PD and this would require some dredging.	Water depth of less than 10m is considered to be a **Non-exclusion Constraint** to the siting of a LNG terminal in Hong Kong due to the need for comparatively high amounts of dredging. Waters shallower than this would require the dredging of access channels and a turning basin for the LNG carrier.

(1) Environmental Resources Management (1999-2003) Internal database based on Admiralty and other charts.

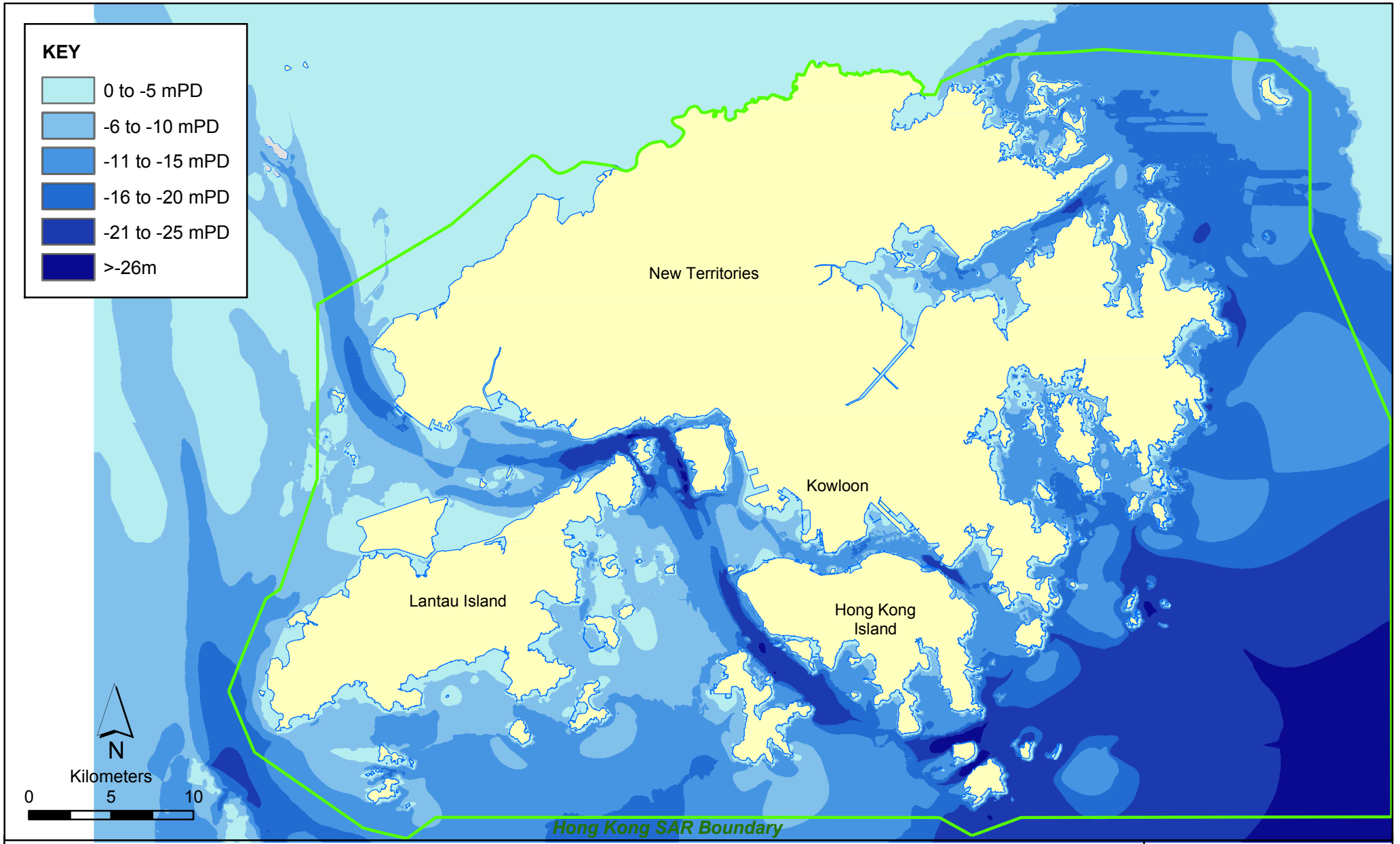

Figure 4.7

Water Depth within the
Hong Kong Special Administrative Region

(Civil Engineering Department, 1999)

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Date: 04/11/2005

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Table 4.5 Evaluation of Identified Social Features

Feature	Review	Evaluation
Areas of High Population Density (1) (*Figure 4.1*)	The construction and operation of a LNG terminal could be considered to provide an associated risk as well as having potentially adverse social implications.	Areas of high population density, which, based on best professional judgement, are taken as areas housing $\geq$ 100,000 people per km^2 are considered to be an **Exclusion Constraint** to the siting of a LNG terminal in Hong Kong.
Areas of Recreational Value (*Figure 4.1*)	Apart from the recreational value provided by Hong Kong's Country Parks, Marine Parks and Marine Reserve, a number of Hong Kong's coastlines and the surrounding waters have been categorised by the Environmental Protection Department (EPD) of the Government as Secondary Contact Recreation Zones (2) .	Whilst there are no regulations against development within these areas, they can be considered to be a **Non-exclusion Constraint** to the siting of a LNG terminal in Hong Kong due to their perceived recreational value. It is noted that these areas are also environmental in nature and are protected by the *Water Pollution Control Ordinance*.

(1) Census and Statistics Department (1996) Hong Kong population distribution data.
(2) Environmental Protection Department (2001, 2002) Annual Reports

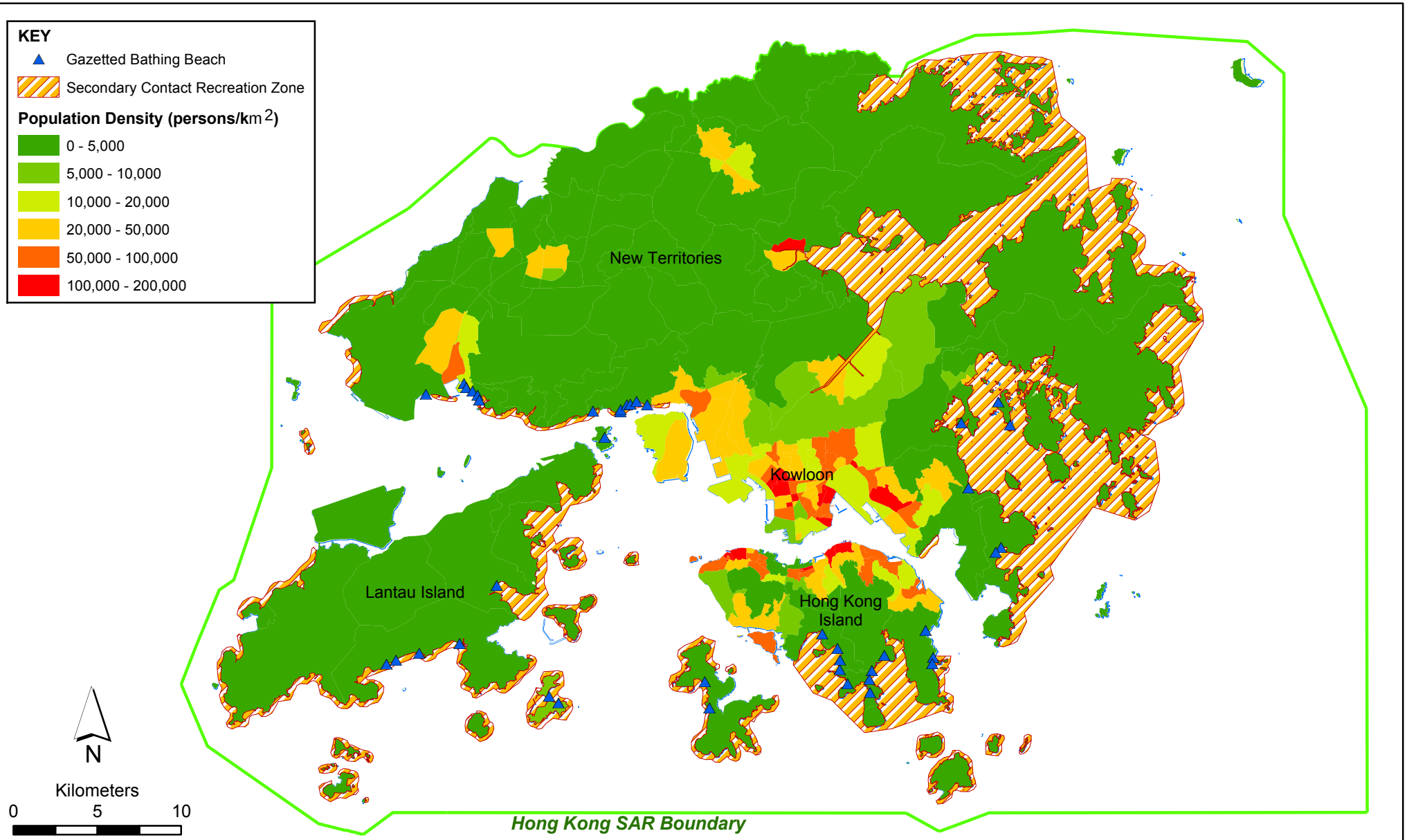

Figure 4.1

Population and Marine Recreation Issues

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Date: 04/11/2005

(Sources: Environmental Protection Department 2001, 2002; Census and Statistics Department, 1996)

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4.10.5 *Task 4 - Identification of Potentially Viable Longlisted Sites for a LNG Terminal*

The environmental and physical & social exclusion maps (*Figures 4.8* and *4.9* respectively) were combined to produce a composite constraint map which details all those constrained areas that would not be considered further for the siting of the LNG terminal. The comprehensive composite map is reported in *Figure 4.11*.

Based on the examination of the composite constraint map and taking into consideration the residential and commercial premises of HK SAR (*Figure 4.10*), a total of 27 unconstrained sites for the potential siting of the LNG terminal were identified and compiled into a longlist. In the Project Profile for this EIA Study it is mentioned that there were 29 sites. Two of the 29 (Fan Lau East and Fan Lau West) were revealed to be within the Country Park following revisions to digital Country Park boundary files and were consequently excluded. The names of the 27 sites are listed in *Table 4.6* and the locations of these are shown in *Figure 4.12*.

Table 4.6 ***Longlist of the 27 Potentially Viable Sites***

N.	*Site*	*N.*	*Site*
1	Black Point	15	Man Kok Peninsula
2	Lung Kwu Sheung Tan	16	Tsing Yi
3	Castle Peak North	17	Beaufort Island
4	West Brothers	18	Po Toi Island
5	Yam Tsai	19	Sung Kong - Fury Rocks
6	Brothers Point	20	Waglan Island
7	Sham Wat Wan	21	Stanley Peninsula
8	North Tai O	22	Cape Collinson
9	Yi O	23	Tung Lung Chau
10	Peaked Hill Island	24	Area 137
11	North Soko	25	Wang Chau
12	South Soko	26	Town Island
13	Shek Kwu Chau	27	Tap Mun
14	Sunshine Island		

4.11 *PHASE II - ANALYSIS AND IDENTIFICATION OF PREFERRED SITE(S)*

4.11.1 *Task 5 - Preliminary Screening of Longlisted Sites*

In order to proceed in the elimination of sites deemed unsuitable for the LNG terminal, the 27 longlisted sites were subjected to a social and technical feasibility review against three key site exclusion criteria:

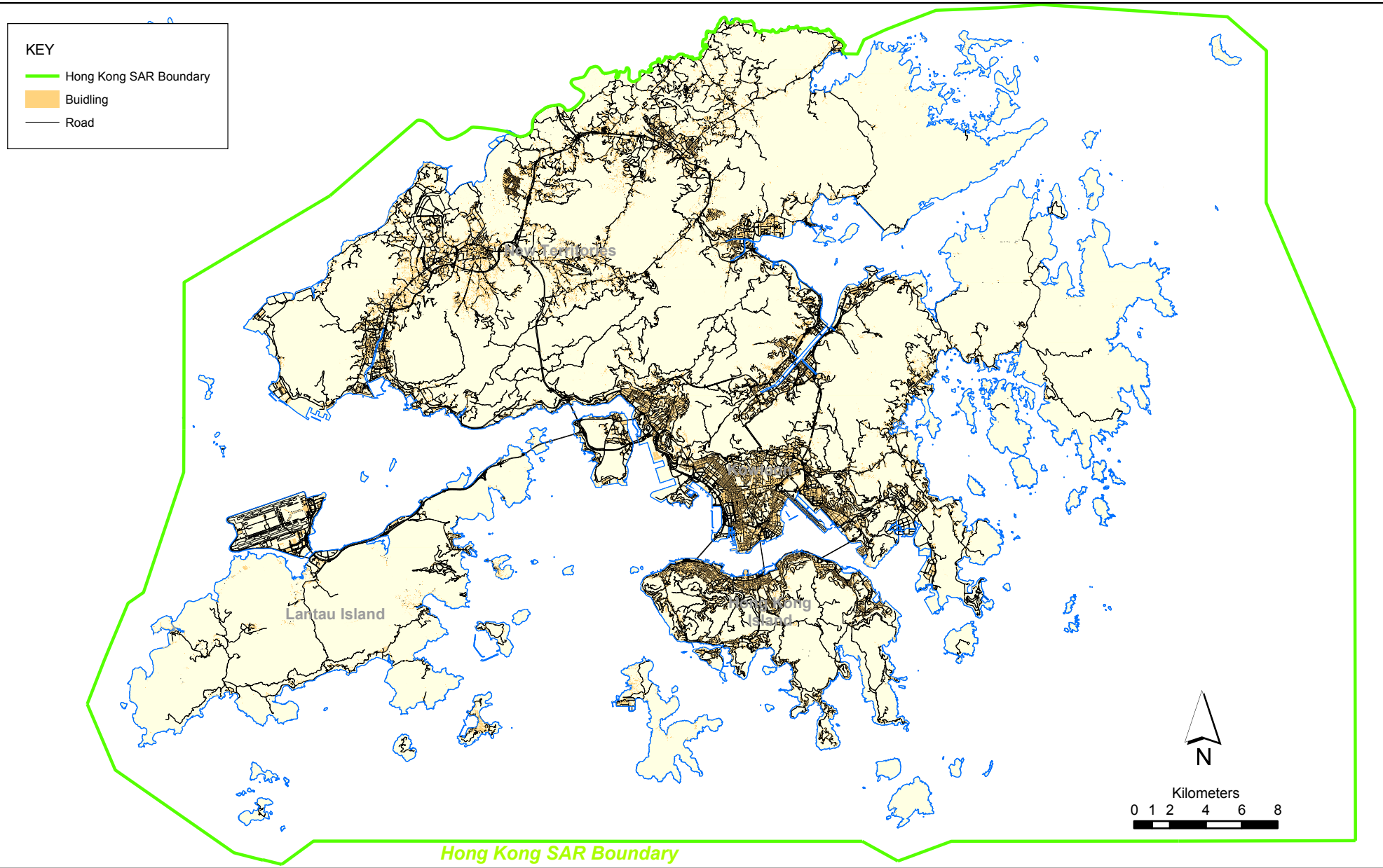

Figure 4.10

Residential and Commercial Premises
within the Hong Kong Special Adminsitrative Region (SAR)

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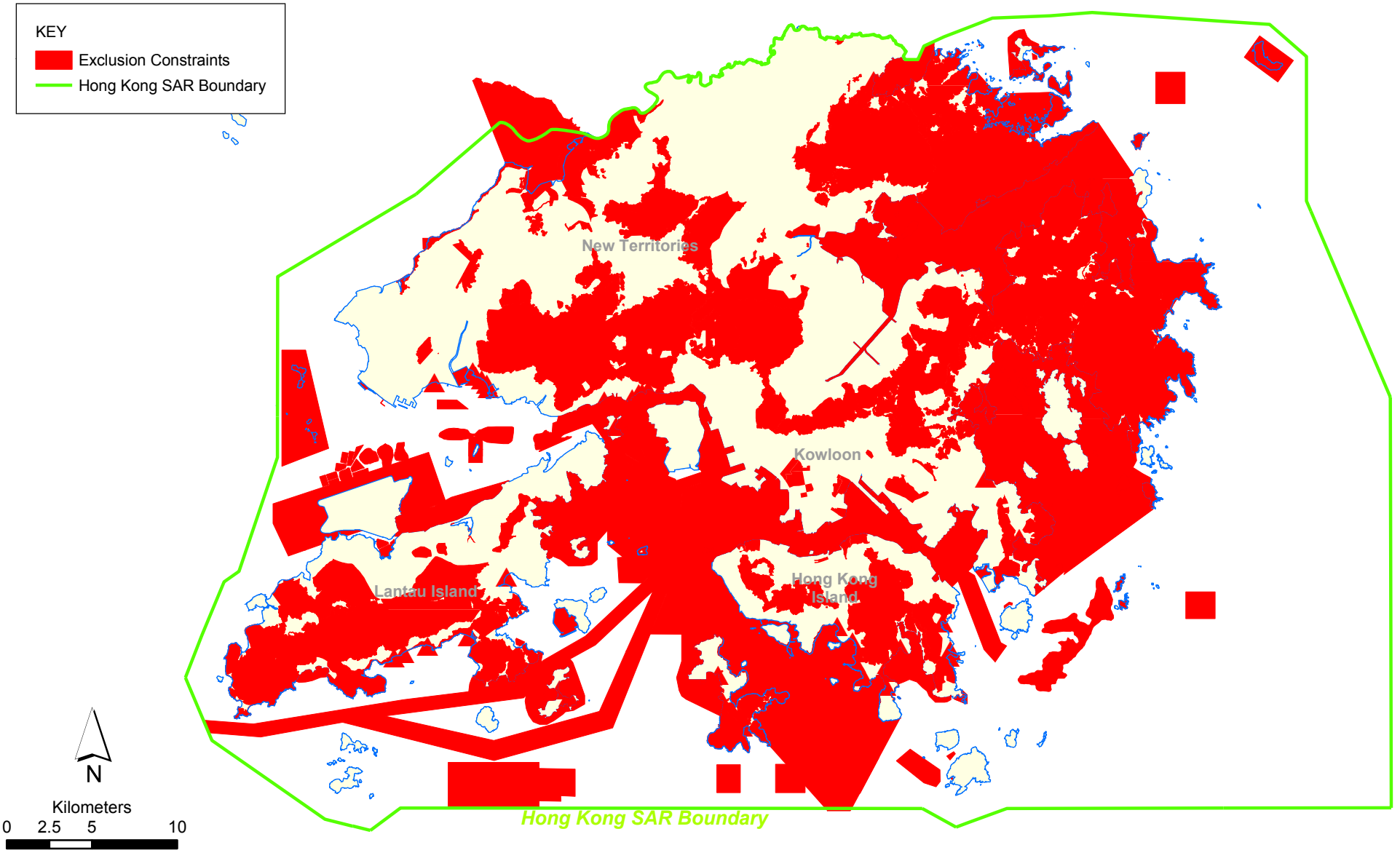

Figure 4.11

Areas excluded from consideration for the Siting of a LNG Terminal and its Associated Facilities within the Hong Kong Special Administrative Region (SAR)

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Date: 22/06/2006

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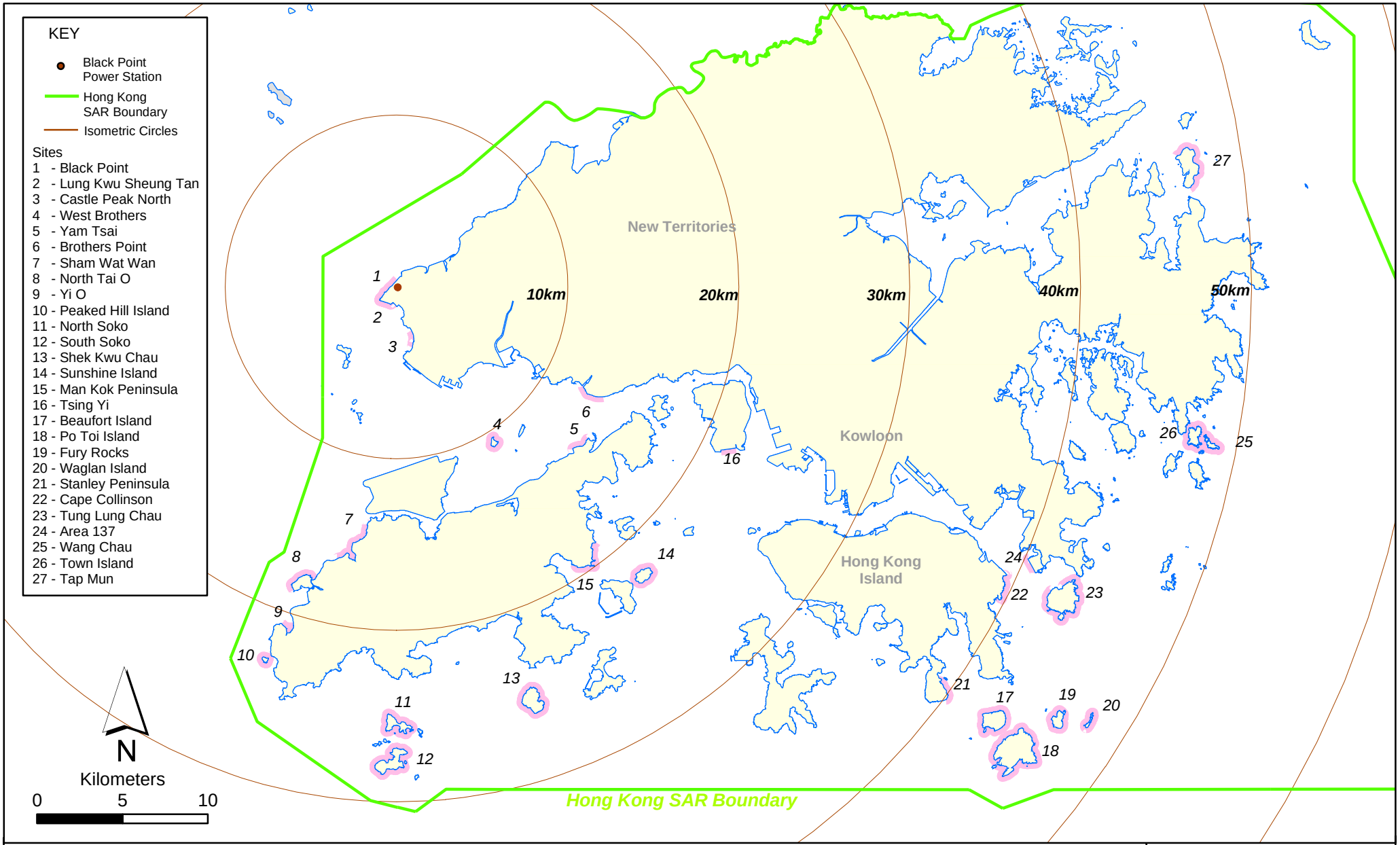

Figure 4.12

Longlisted Localities for Siting of an LNG Terminal and its Associated Facilities within the Hong Kong Special Administrative Region (SAR)

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- ***Criterion 1:*** *Proximity to existing residential/commercial population.* The presence of inhabited areas within a buffer zone of 500 m from the site's perimeter was selected as a safety-based exclusion criteria.

- ***Criterion 2:*** *Land availability and physical constraints.* The availability of at least 30 - 40 ha of unconstrained land (natural or reclaimed) is a necessary requirement for the siting of the LNG terminal. Failing to meet either of the parameters that make up this criterion will lead to the direct elimination of the site from the list of potentially viable sites.

- ***Criterion 3:*** *Exposure to metocean conditions.* The exposure of a site to significant metocean (mainly wave and currents) conditions has direct repercussions on the flexibility of site layout, and the extent of the marine works needed to provide adequate safety for marine operations. The extent of marine works introduces permitting risk as adverse environmental impacts may be incurred.

Criterion 1: Proximity to Existing Residential/Commercial Population

For the purpose of this site selection study, a distance of 500 m from the LNG terminal's boundary (including turning circle, jetty and terminal) has been adopted as safety-based exclusion criteria. The distance of 500 m has some relevance in Hong Kong as Potentially Hazardous Installations (PHIs) that involve hydrocarbon storage typically have a consultation zone of 500 m from the site boundary.

The application of this criterion allows to automatically exclude all sites which present residential or commercial population within the 500 m buffer zone from the site's perimeter. Based on this exclusion criterion, 10 sites were eliminated from the longlist of 27 sites. The eliminated sites are listed in *Table 4.7*.

Table 4.7 Criterion 1 – Eliminated Sites

N.	*Site*	*N.*	*Site*
3	Castle Peak North	13	Shek Kwu Chau
6	Brothers Point	14	Sunshine Island
7	Sham Wat Wan	15	Man Kok Peninsula
8	North Tai O	21	Stanley Peninsula
9	Yi O	22	Cape Collinson

Criterion 2: Land Availability and Physical Constraints

The site selection Criterion 2 is a combination of two strongly correlated parameters deemed essential for the location of the LNG terminal: Land availability and land constraint

- *Land Availability*: The suitability of a potential site for the LNG terminal is strongly dependent on the availability of least 30 - 40ha of land which may be natural or artificially reclaimed. The need for 30 - 40 ha is an essential

requirement based on technical and safety parameters determined by the LNG industry for a terminal of the capacity proposed in Hong Kong.

- *Physical Constraints*: From a construction feasibility point of view, certain areas/sites can automatically be eliminated on the basis of their physical characteristics (i.e. steep morphology/bathymetry).

On the basis of the above, the potential viable candidate for the siting of the LNG terminal will necessarily have to meet the physical characteristics/criteria listed in *Table 4.8*.

Table 4.8 Site's Physical Requirements

Requirement	*Technical Description of Requirement*
30 ha of land either on land or partially in the sea	The need for 30 ha is an essential requirement based on technical and safety parameters determined by the LNG industry for a terminal of this capacity.
Reclamation needs to be completed in water depth less than 10 m	This requirement is based on the practical limitations of the marine works.
Sufficient access for hill cutting activities	Where cuttings are required in steep land areas, there must be sufficient means of access from nearby areas without requiring the formation of additional reclaimed platforms within the sea.
50x50 area within 100m of the proposed site boundary	This area is essential for the initial stages of the construction of the LNG terminal. A platform will be created on this area to enable the initial mobilisation of the building material and will serve as a logistic/storage base for construction works
If metocean conditions necessitate a breakwater (see Criterion 3), then the water depths within 100 m of the seaward of the side of the jetty should be less than – 15m	This requirement is based on the practical limitations of the marine works.

Based on this exclusion criterion, 4 sites were eliminated from the longlist of 27 sites. The eliminated sites are listed in *Table 4.9,* together with a brief description of the rationale that led to their exclusion.

Table 4.9 Criterion 2 – Eliminated Sites

N.	*Site*	*Description*
4	West Brothers	Airport restrictions, shipping lanes, contaminated mud pits, dredging areas
16	Tsing Yi	Insufficient space on land, requires reclamation in an area where reclamation is heavily constrained
17	Beaufort Island	Technical and environmental difficulties in excavation and reclamation due to slope heights and surrounding water depths
18	Po Toi Island	Technical and environmental difficulties in excavation and reclamation due to slope heights and surrounding water depths

Criterion 3: Exposure to Metocean Conditions

Exposure of a site to adverse metocean conditions means that, in order to grant protection to the terminal structures and to the LNG carrier during unloading operations, a breakwater would need to be constructed. In such adverse/extreme metocean conditions the extensive marine works that arise from the construction of the breakwaters could in turn potentially have severe environmental and technical implications which could introduce a major permitting risk.

Two metocean parameters were considered in the evaluation of Criterion 3 as they are deemed directly correlated with potential interference or damage to the LNG terminal/LNG carriers and, therefore, with the siting of the LNG terminal:

- *Waves*: Wave action has the potential to affect the LNG carrier's berthing and mooring manoeuvres as well as causing potential damage to the LNG terminals structures (jetty, etc.). The wave climate in Hong Kong waters is mostly determined by the seasonal Monsoon winds, typhoon events and the coastal geomorphology which influences the wave trains as they propagate inshore. Wave energy from the eastern to south western sectors is developed from locally generated wind waves and more distant swell waves, or a combination of both. Wave energy across HKSAR waters is greater in the southeastern outer islands and reduces at sites to the west, and those sheltered within the island confines of Hong Kong harbour. This pronounced effect is due to the sheltering effect of the Lima islands 15km south of HK which act as a natural breakwater against storm waves generated from the southeast and south.

- *Currents*: Currents have the potential to affect the safety and efficiency of an LNG carrier's berthing and mooring manoeuvres. Current velocities are influenced by the semi diurnal tidal regime of the South China Sea and the fresh water flows of the Pearl River Delta during the wet season. In general proximity to narrow channels, which constrain flow and the key tidal streams within the Pearl River Estuary presents more adverse current environments.

Based on these parameters, sites directly exposed to long deepwater fetches extending towards the easterly and south-easterly sectors were deemed not viable for the siting of the LNG terminal as special measures would be required to mitigate the metocean conditions. The measures themselves have the potential to introduce insurmountable permitting risks as a result of potentially severe environmental implications. On the basis of this criterion 4 sites were eliminated from the longlist due to their exposure to metocean conditions. These sites and a brief description of the exclusion rationale are listed in *Table 4.10.*

Table 4.10 Criterion 3 – Eliminated Sites

N.	*Site*	*Description*
19	Sung Kong	Sung Kong Island (Fury Rocks) is a small island located in the south-eastern corner of Hong Kong SAR's waters. Its location and small size exposes the entire island to prevailing easterly/south easterly metocean conditions which would require the construction of a large breakwater to provide year round access for berthing and unloading of LNG because of water depth at the site and storm wave heights.. This would in turn may lead to potentially severe environmental, schedule and technical implications which could introduce a major permitting risk
20	Waglan Island	Waglan Island is a very small island located approximately 2 km east of Sung Kong. The metocean exposure and potential environmental drawbacks are the same as the ones listed for Sung Kong.
23	Tung Lung Chau	Tung Lung Chau Island is located approximately 500 m south of Fat Tong Mun and and Joss House Bay (Tai Miu Wan). With the exception of the north and north-eastern shore (where a village and Fish Culture Zone are located), the island is exposed to the prevailing easterly/south easterly metocean conditions. In order to provide year round access for berthing and unloading of LNG a large breakwater would be required along the island's exposed shores which in turn may lead to severe environmental and technical implications. Locating the LNG terminal on the more protected north and north eastern shores has not been considered feasible due to the presence of the village and gazetted fish culture zone..
25	Wang Chau	Wang Chau is a small island located approximately 1 km east of Town Island and approximately 2 km east of the southernmost tip of Sai Kung - High Island. The metocean exposure and potential environmental drawbacks are comparable to the ones identified for Sung Kong and Waglan Island.

Conclusions

The application of the three exclusion criteria discussed in this section led to the direct elimination of 20 sites and thus the identification of 7 sites on an interim shortlist (*Table 4.11*).

Table 4.11 Interim Shortlisted Sites

N.	*Site*
1	Black Point
2	Lung Kwu Sheung Tan
5	Yam Tsai
10	Peaked Hill
11	North Soko
12	South Soko
24	Area 137

4.11.2 *Task 6 - Detailed Review of Interim Shortlist of Sites*

The 7 shortlisted sites identified in *Task 5* were further assessed in a qualitative integrated manner whereby the environmental aspects of each of the sites, as well as their safety, social and marine transit considerations, were subject to a detailed review.

A qualitative narrative approach was adopted which identified the potential environmental advantages and disadvantages of each site. The screening process led to the direct elimination of the sites, based on objective assessment of the environmental drawbacks or advantages of each option.

The initial approach was to conduct a detailed review of the general site requirements that characterise the 7 selected sites with the aim to better identify and evaluate the potential environmental aspects of the LNG terminal's construction and operation. Once this first review was completed, a number of environmental, safety and social parameters were examined to assess the overall suitability of the sites.

In order to provide the qualitative approach with the consistency needed for the site selection exercise, the same list of both the general site requirements and the environmental, safety, social and marine transit aspects was used to review each site's suitability criteria. This list is presented below:

<u>General Site Requirements</u>

1. *Land Availability and Constraints*: Approximately 30 ha of unconstrained land to locate the terminal infrastructure. Further detailed assessment with respect to *Task 5* (*Criterion 2*) was completed with the aim of determining the site's potential issues related to land availability and associated constraints.

2. *Operational Depth*: Approach channel, turning basin and berth require a water depth of approximately –15 mPD to provide safe transit and manoeuvrability depths for the LNG carriers. In order to reduce extensive dredging and maintenance for the creation of a suitable turning basin and approach channel, a water depth of > -10m within 50m and > -15m within 500m from the site's coastline were adopted to determine the suitability of the sites.

3. *Pipeline*: Submarine gas pipeline to the Black Point Power Station. The primary aspects that were used to determine the suitability of a site were length of the pipeline and the level of physical/planning constraints along the proposed route. The level and extent of constraints is strongly correlated with construction time and potential environmental risks. Thus, in general terms, fewer constraints would mean fewer potential environmental impacts.

4. *Distance from Sensitive Receivers*: Distance from populated areas. Further detailed assessment with respect to *Task 5* (*Criterion 1*) was completed with the aim of determining the site's potential safety drawbacks concerning populations living in proximity to the LNG terminal's site.

Environmental, Social and Planning

5. *Terrestrial Environment*: An overview of the site's terrestrial environment, including its proximity to terrestrial habitats of high ecological value, was completed in order to determine the overall environmental sensitivity of the site. The primary objective of this review was to identify major terrestrial habitats that may suffer, directly or indirectly, from the construction and operation of the LNG terminal at the selected site. Loss of high ecological value habitat, loss of rare/protected/endemic species and interferences with sensitive terrestrial habitats found in close proximity of the site were considered as major environmental drawbacks. The ecological value of a habitat/species was determined in respect of its/their conservation value, spatial distribution and abundance within HK SAR based on available information.

6. *Marine Environment*: An overview of each location's marine environmental characteristics, including its proximity to marine habitats of high ecological value, was completed to determine the overall sensitivity of the site. The primary objective of this review was to identify major marine habitats that may be impacted directly or indirectly from the construction and operation of the LNG terminal at the selected site. Loss of high ecological value habitat, loss of rare/protected/endemic species and interference with sensitive marine habitats found in close proximity of the site were considered as environmental drawbacks. The ecological value of a habitat/species was determined by virtue of its/their conservation value, ecological importance, spatial distribution and abundance within HK SAR.

   Although not strictly of an ecological nature, data from AFCD's Port Survey 2001/2002 data was examined for each site, in order to determine the status of the fisheries resources/operations in and around their coastal waters. Proximity of the site to fish culture zones and gazetted artificial reefs were also addressed in the assessment.

7. *Social*: The potential social interferences to local/neighbouring communities caused by the LNG terminal's construction and operation were assessed. The primary objective was to determine the existing social conditions at and around the site and therefore identify potential direct and indirect impacts that could arise from the development of the LNG terminal.

8. *Planning*: The site's existing/established planning framework was determined in order to identify the potential for planning related conflicts as a consequence of the construction and operation of the LNG terminal.

9. *Permitting Risk*: The permitting risks and complexity with regard to the likelihood of objections that may result in significant schedule delays were determined.

Marine Transit

10. *Exposure*: The prevailing "metocean" conditions (waves and currents) at the site have the potential to affect the ability of the LNG carrier to berth and manoeuvre. Further detailed assessment with respect to *Task 5* (*Criterion 3*) was completed with the aim of determining the site's suitability with respect to its exposure to wave and currents.

11. *Interference with Shipping*: The terminal, jetty, turning circle and approach channel have the potential to interfere with passing ships and vice versa. The chosen determining factors for this marine transit aspect were the location and orientation of the site and its approach channel/turning basin with respect to major or minor vessel fairways.

12. *Volume of Marine Traffic*: The transit of the LNG carrier to the terminal will require passage through Hong Kong waters, and the approaches to its busy port areas. Sites with longer transits through busier harbour areas expose the LNG carrier to greater traffic activity, than sites in more secluded areas.

4.11.3 Black Point

Introduction

Black Point is a headland located in the western most part of the New Territories at the southern tip of the Deep Bay coast. The headland is extended on an east – west axis dividing the waters of Deep Bay and north western Hong Kong and presents a relatively steep morphology with a maximum height of approximately 135 m.

The site is located to the north western side of the headland, adjacent to BPPS. Due to its steep morphology, the site will need to be created through a combination of cutting into the hillside/headland and reclamation. The berth and jetty will be located towards the west end of the reclamation in order to be in water as deep as possible and yet to avoid the passage of vessels up and down the Urmston Road. A dredged turning basin will be required to provide access to the berth and a short dredged navigation channel extending southwest into waters that are approximately -15 m PD.

The coastline at Black Point has partially been modified in the past as a result of the works for the BPPS (*Figure 4.13*). The overall quality of the headland's surrounding marine waters is strongly affected by the discharges from the

Pearl River Delta and the Shenzhen River and, as a result, the marine ecology at Black Point is under the influence of the seasonal changes in freshwater fluxes between the summer and winter months which directly affects species diversity and abundance.

With the exception of the reported presence of the Indo-Pacific Humpback Dolphin (*Sousa chinensis*), recent information on marine ecological resources of Black Point has not identified any assemblages of high ecological value and the majority of marine habitats identified are considered to be of low ecological importance.

Although Humpback dolphins have been sighted in the area it must be noted that the waters around Blank Point's headland support a low number of sightings in comparison to other areas in Hong Kong and that marine waters around Black Point are regarded as of low importance to the Humpback Dolphins.

Figure 4.13 Aerial View of the Black Point Site

Terrestrial ecology at Black Point is mainly dominated by shrubland habitat interspersed with grassland which is typical of the granite hill slopes in Hong Kong. Similar vegetation, flora and fauna are well represented in the Hong Kong Country Parks and no rare or endangered species were recorded.

The site is located on the northern coast of the headland and it is relatively sheltered from prevailing metocean conditions. The proximity to the Urmston Road provides deepwater access to the area; however the final approach from the fairway towards the headland will require dredging due to the shallow bathymetry that characterises the coastal waters of the area.

The site is relatively remote from densely populated areas and the closest villages are located at Lung Kwu Tan (approximately 2 km from the potential site) where the population is approximately 1,800. The closest developments to the site, other than BPPS, are a mixture of small scale industrial uses at Lung Kwu Sheung Tan. No declared monuments or known sites of archaeology, graded buildings, graves or significant archaeological deposits have been reported at Black Point site.

Conceptual Layout

The main construction aspects of the site are outlined below. These are based on the preliminary conceptual layout reported in *Figure 4.14*:

- *Dredging*: In order to locate the LNG berth away from the marine traffic in Urmston Road significant dredging will be required (approximately 2.5 Mm^3) for the formation of the approach channel and turning basin. The dredging of the turning circle down to –15mPD, i.e. 9m deep in places, will require maintenance dredging once every 4 years.

- *Reclamation*: The area to be reclaimed is approximately 16 ha and the mud underneath the seawall and reclamation may reach 7 m in depth. The majority of material excavated from Black Point shall be used within the reclamation. However, due to the relative timing of the excavation and reclamation works and the limited space available on site it may be necessary to temporarily store the excavated material at a designated stockpile site.

- *Site Formation and Construction*: In order to minimise blasting and yet provide material for the reclamation only the LNG tanks have been located on the existing land at a level of +5 mPD. Marine access and in particular road access is already well established. There would be no requirement for gazettal of access roads. The heavy load berth in front of the power station could be used for marine access. For the most part tidal velocities at the reclamation are relatively low and are not likely to affect construction activities. Only at mid ebb tide on Spring Tides are velocities likely to be strong enough to affect some construction activities.

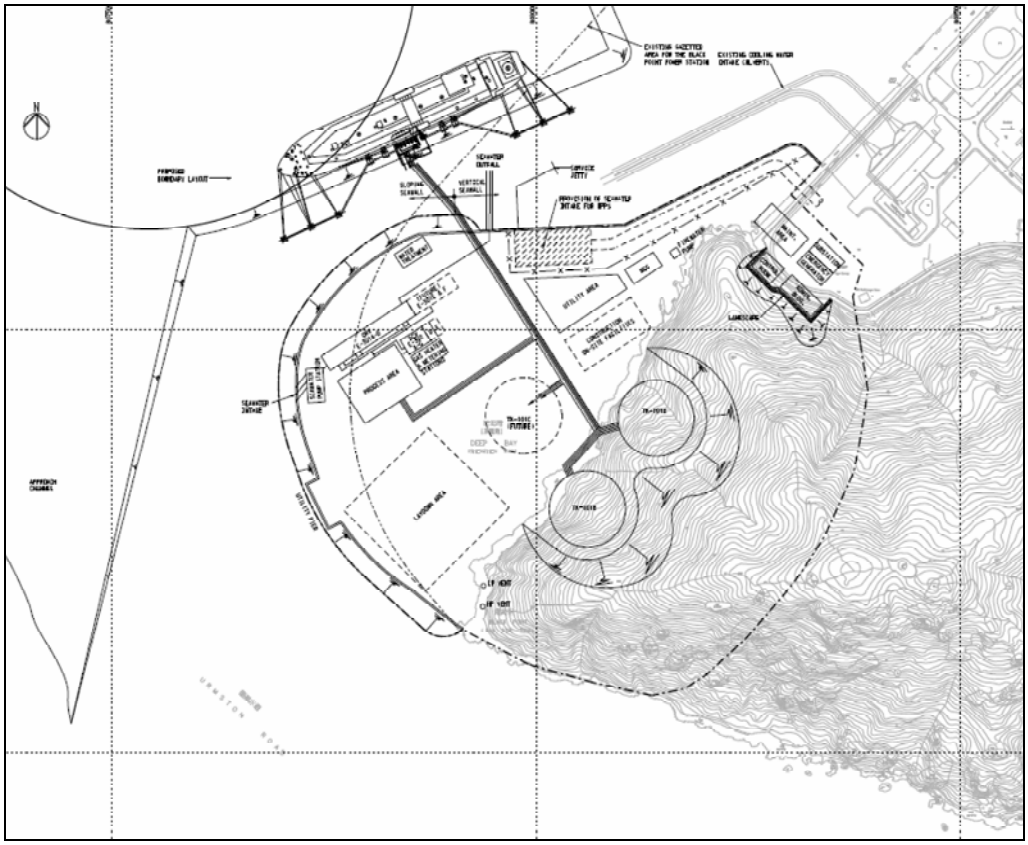


Figure 4.14 ***Conceptual Layout for Black Point Site***

Site Review

The general site requirements and the environmental, safety, social, planning and marine transit aspects of the Black Point site are summarised in *Table 4.12*.

Table 4.12 ***Site Review – Black Point***

General site requirements	
1	*Land Availability and Constraints:* The site will be created through a combination of cutting into the hillside/headland and reclamation. The land impacted by the reclamation is unconstrained. The Planning Department stated that Black Point has been identified as a potential second landing point for the proposed Ling Ding Yang Bridge.
2	*Operational Depth:* The waters bordering the headland are consistently shallow, often less than -5mPD. Considerable dredging will be required for turning circle and approach channel, dependant on the jetty location and the approach channel orientation.
3	*Pipeline*: No pipeline is required due to close proximity to BPPS.
4	*Distance from Sensitive Receivers*: The closest villages are located at Lung Kwu Sheung Tan (approximately 2 km from the potential site) where the population is approx. 1,800. The closest developments to the site, other than BPPS, are small scale industrial complexes at Lung Kwu Sheung Tan.

Environmental, Social and Planning

5 *Terrestrial Environment:*

- The headland is mainly composed of shrubland habitat interspersed with grassland. The northern slopes present the densest and tallest shrubland vegetation, whilst the southern side is mainly covered with grassland and scattered rocky boulders and outcrops.

6 *Marine Environment:*

- The site is located to the south of mudflats at Ha Pak Nai and is relatively distant from Mai Po Inner Deep Bay Ramsar Site.
- Approximately 4km to the south west of Black Point is the designated Sha Chau and Lung Kwu Chau Marine Park.
- Presence of the Indo-Pacific Humpback Dolphin (*Sousa chinensis*).
- The waters to the south of Black Point are reported as a spawning ground for commercial fisheries. The adult fish production is however relatively low in comparison to elsewhere in Hong Kong water and low numbers and size of fishing vessels, low fish catch value and production characterise the waters in the vicinity of Black Point.
- Water quality at Black Point is strongly influenced by the Pearl River, resulting in reduced salinity and relatively high turbidity levels during the summer.

7 *Social*: The area is presently uninhabited and the closest villages lie approximately 2 km from the site (Lung Kwu Sheung Tan).

8 *Planning:* The northern portion of the site is a Secondary Contact Recreation Zone. The coastline has been proposed for potential reclamation for Tuen Mun Port Development, which contains a recommendation for siting LPG facilities. Some government land landscaped by the BPPS will be affected. Black Point has been identified as a second landing point for the proposed Ling Ding Yang Bridge.

9 *Permitting Risk:* The northern portion of the site is a Secondary Contact Recreation Zone and some objections may arise due to perceived safety concerns and Fung Shui from local residents.

Marine Transit

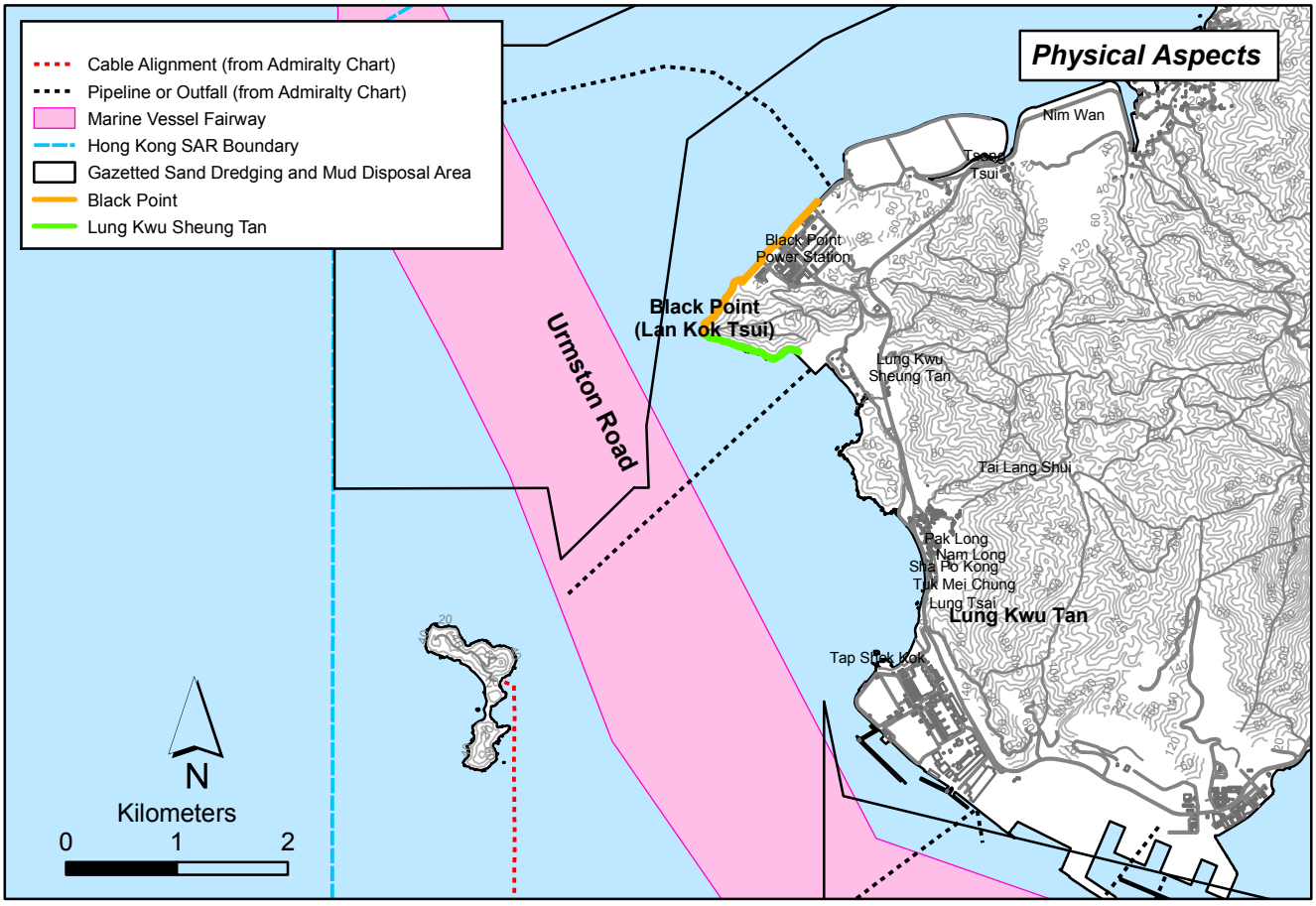
10 *Exposure:* The LNG terminal will be sited on the north western coast of the Black Point headland on the edge of Deep Bay and is relatively sheltered from prevailing metocean conditions. While the site is exposed to northerly winter monsoon winds, it is well sheltered from summer south-easterlies. The site is exposed to waves from the south west to the north west sectors; however, these are limited by the short fetch distance, shallow water and the low wind strengths from these quadrants. While currents in the Urmston Road channel to the west of the site may be strong, berthing at the terminal would occur in a basin away from these currents.

11 *Interference with Shipping:* Although the site is near the northern reaches of the busy Urmston Road, the approach channel and turning basins are located sufficiently far away from the vessel fairway and will not interfere with existing shipping activities.

12 *Volume of Marine Traffic*: Transit to the site is assumed to be via the East Lamma Channel, Western Fairway, Ma Wan Channel and the Urmston Rd Channel. This is a long passage through the "heart" of Hong Kong harbour. While this transit is now performed regularly and safely by some of the world's largest container ships which access the ports of the Shekou peninsular, it will expose the LNG carrier to significant marine traffic activity.

13 Need to conduct a Quantitative Risk Assessment of the transit of LNG via a LNG carrier to Black Point via the Ma Wan channel at the EIA stage to verify the acceptability of the transit route.

A summary of the environmental, social and planning characteristics of the Black Point site are reported in *Figure 4.15*.



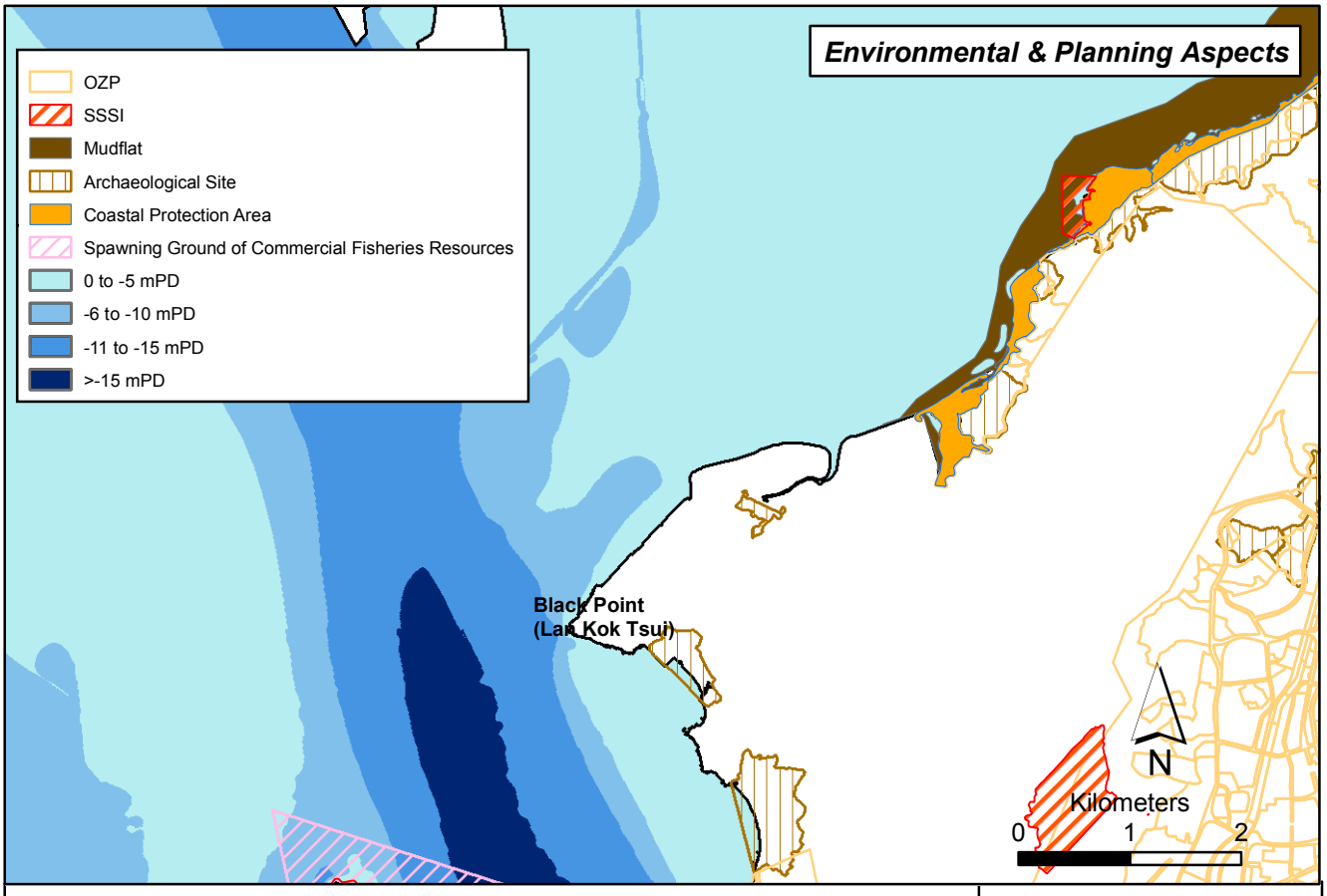


Figure 4.15

Physical, Environmental and Planning Aspects of Black Point and Lung Kwu Sheung Tan

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Date: 21/06/2006

Environmental Resources Management

ERM

Conclusions

From a review of Black Point's environmental, social, planning and marine transit characteristics it emerges that the site poses a series of advantages for the location of the LNG terminal, namely:

- The main advantage from an environmental perspective is Black Point's close proximity to BPPS meaning that the construction of the subsea import pipeline to the power station will not be needed. This allows the elimination of environmental impacts associated with the pipeline's construction.

- The area is presently uninhabited and the closest village is located at approximately 2 km from the site at Lung Kwu Tan. The nearest developments are small scale industrial complexes.

- The site is relatively sheltered from prevailing metocean conditions.

- Although the necessary land for the construction of the LNG terminal will need to be obtained from reclamation and excavation works, the coastal waters and the land potentially affected by the works are largely unconstrained.

- The approach channel and turning basins will be located sufficiently far away from the vessel fairway and will not interfere with existing shipping activities.

The location of the LNG terminal at Black Point does have some disadvantages, summarised below:

- Land for the construction of the LNG terminal will be obtained partly from reclamation and partly from the excavation of the hillside. This will lead to the loss of natural habitat (marine and terrestrial) and to the overall change in morphology of the coast and the hillside.

- Recorded presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*) in the coastal waters of Black Point.

- Considerable dredging will be required for turning circle and approach channel. The final volumes will be dependent on the jetty location and the approach channel orientation.

- Marine Transit of the LNG carrier will be via East Lamma Channel, West Harbour, Ma Wan and the Urmston Road. The shipping lanes are some of the busiest in Hong Kong and there are nearby populations along the transit route. A Marine Quantitative Risk Assessment would be required to verify the acceptability of the transit route.

The site's proximity to BPPS is considered to be the site's major environmental asset which, together with the site's remoteness form inhabited areas, its sheltered position with respect to prevailing metocean conditions and the unconstrained nature of the area to be reclaimed will strongly reduce the overall environmental impacts.

4.11.4 *Lung Kwu Sheung Tan*

Introduction

The site at Lung Kwu Sheung Tan lies on the south side of Black Point headland in close proximity to the BPPS (*Figure 4.16*). Due to the headland's relatively steep morphology, the Lung Kwu Sheung Tan site will be created through reclamation.

The southern coastline of the headland consists mostly of natural rocky shoreline with the exception of a relatively short artificial section (approximately 200 m) found corresponding to a government owned reclaimed land on the south eastern portion of the headland.

Figure 4.16 Aerial View of the Lung Kwu Sheung Tan Site

Due to the nature of the site's development, the construction of the LNG terminal will interfere with marine and coastal habitats only and will comprise little to no terrestrial works as it is assumed that the pipeline connecting this site with BPPS will run along the shoreline.

Recent data on marine ecological resources of Black Point has identified marine habitats of low ecological importance. Indo-Pacific Humpback Dolphin (*Sousa chinensis*) have been recorded in the area, however the marine waters within Lung Kwu Sheung Tan bay are regarded as of low importance to the humpback dolphins due to the relatively low abundance of sightings with comparison to other areas of Hong Kong Waters.

The site is in close proximity to the Urmston Road which provides deepwater access to the area; however the final approach from the fairway towards the headland will require dredging due to the shallow bathymetry that characterises the coastal waters of the headland.

The site is relatively remote from densely populated areas and the closest villages are located at Lung Kwu Tan (<2 km from the potential site) where the population is approximately 1,800. There appear to be no declared or deemed monuments, graded buildings, graves or archaeological sites within the site. However, in relatively close proximity to the site is the Lung Kwu Sheung Tan site of archaeological interest. Recent archaeological investigations at this site have found artefacts from the late Neolithic (2500 - 1500BC).

Conceptual Layout

The main construction aspects of the site are outlined below. These are based on the preliminary conceptual layout reported in *Figure 4.17*:

- *Dredging*: Dredge quantities will be significantly larger than for Black Point as it is assumed that that the site will be all reclamation with no cut into the hillside.

- *Reclamation*: The marine deposit thickness under the reclamations is up to 14 m thick and consequently will require longer and higher surcharges than Black Point if not dredged. As there is no excavation reclamation fill will have to be imported (marine sand or other suitable material). Additionally more seawall materials will be required for the embankment which skirts the headland and carries the LNG pipeline to BPPS and the access road.

- *Site Formation and Construction*: As all the land is formed by reclamation there is very little site formation from existing land. Access to the site from the main highway will have to be improved and a temporary jetty constructed for the import of materials. Access to BPPS is provided by extending the coastline embankment which runs between the terminal site and the jetty access trestle.

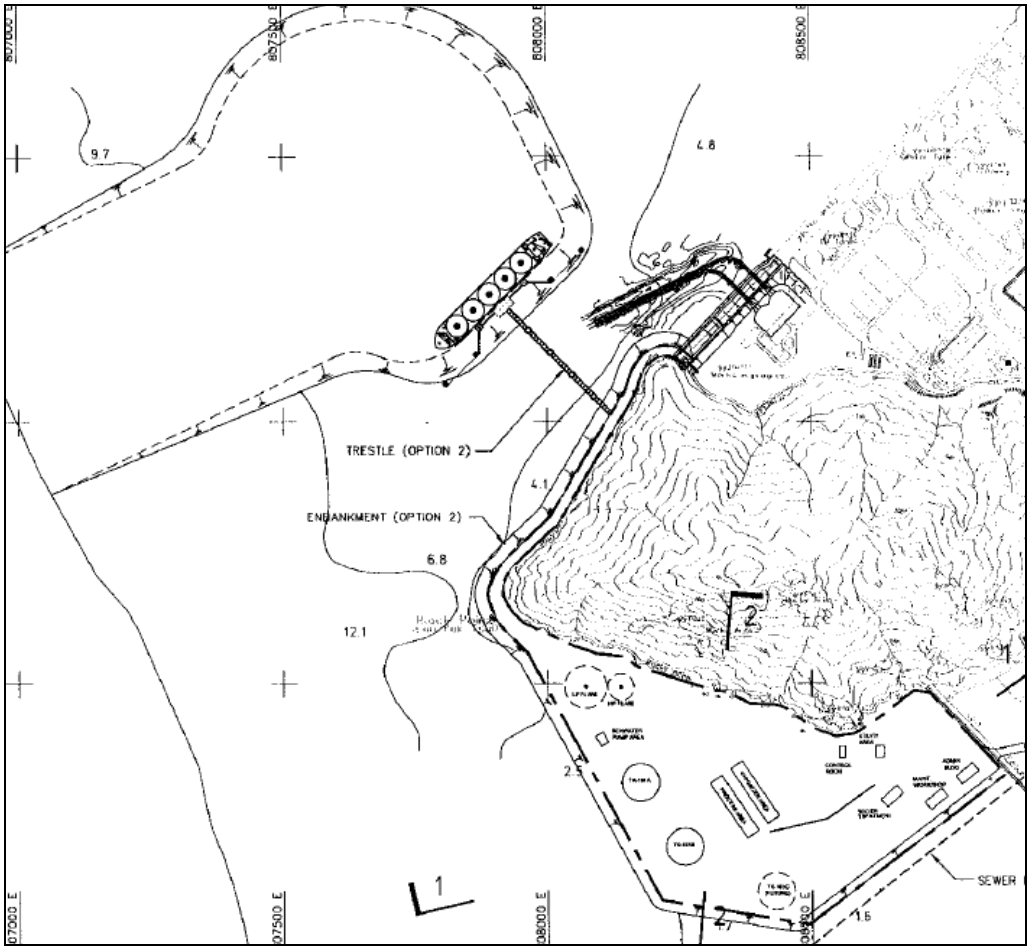


Figure 4.17 ***Conceptual Layout for Lung Kwu Sheung Tan Site***

Site Review

The general site requirements and the environmental, safety, social and marine transit aspects of the Lung Kwu Sheung Tan site are summarised in *Table 4.13*.

Table 4.13 ***Site Review - Lung Kwu Sheung Tan***

General site requirements	
1	*Land Availability and Constraints:* The site will need to be created through reclamation and the land impacted by the reclamation is unconstrained.
2	*Operational Depth:* The waters bordering the headland are consistently shallow, often less than -5mPD. Considerable dredging will be required for turning circle and approach channel, dependent on the jetty location and the approach channel orientation.
3	*Pipeline*: A short onshore pipeline will connect to BPPS
4	*Distance from Sensitive Receivers*: The berthing/unloading facilities will be located on the north western shore of the headland at < 2 km away from the closest village (Lung Kwu Tan). The LNG terminal will be located on the south shore of the headland at approximately 1 km from Lung Kwu Sheung Tan. The site is in close proximity to the BPPS.

Environmental, Social and Planning

5 *Terrestrial Environment:* The construction area will involve marine and coastal habitats only and does not comprise any terrestrial habitats. Impacts to wildlife are likely to be minor as those animals that may be disturbed by the construction activities will move away from the disturbed area to the similar habitats nearby.

6 *Marine Environment:*

- Presence of the Indo-Pacific Humpback Dolphin (*Sousa chinensis*).
- Approximately 4km to the south west of Black Point headland is the designated Sha Chau and Lung Kwu Chau Marine Park.
- The site is located to the south of mudflats at Ha Pak Nai and is relatively distant from Mai Po Inner Deep Bay Ramsar Site.
- The waters to the south of Black Point are reported as a spawning ground for commercial fisheries. The adult fish production is however relatively low in comparison to elsewhere in Hong Kong water and low numbers and size of fishing vessels, low fish catch value and production characterise the waters in the vicinity of Lung Kwu Sheung Tan.
- Water quality at Lung Kwu Sheung Tan is strongly influenced by the Pearl River, resulting in reduced salinity and relatively high turbidity levels during the summer.

7 *Social*: The site is presently uninhabited and the closest buildings lie approximately 1 km from the LNG terminal (Lung Kwu Sheung Tan). The site also abuts the boundary of the proposed Lung Kwu Tan archaeological site.

8 *Planning*: The site was identified in a 1992 Planning Study (TDD of HKSARG) for Special Industry (Bulk Chemical Storage, LPG or liquid hydrocarbon storage). There is Government Land Allocation in the northeast of Lung Kwu Sheung Tan Bay for the Water Supplies Department (WSD). Planning Department has also included Black Point as a second landing point for Ling Ding Yang Bridge. It is possible that the construction and operation of the LNG terminal may indirectly affect adjoining land uses.

9 *Permitting Risk*: Peninsula at Black Point is regarded to be of Fung Shui importance to Leung Kwu Sheung Tan villagers. Furthermore, as the proposed site is exposed to Lung Kwu Sheung Tan village and the Lung Kwu Sheung Tan beach, it is expected that local objections may be submitted during the public notification period of gazetting due to landscape and visual objections.

Marine Transit

10 *Exposure*: The LNG terminal will be sited on the southwestern coast of the Black Point headland on the edge of Deep Bay and is relatively sheltered from prevailing metocean conditions. The site is exposed to waves from the southern to the western sectors; however, theses are limited by the short fetch distance, the shallow water and the low wind strengths from these quadrants. While currents in the Urmston Road channel to the west of the site may be strong, berthing at the terminal would occur in a basin away from these currents.

11 *Interference with Shipping*: The approach channel and turning basins are located in closer proximity to the vessel fairway than those for the northern edge of the headland and while final berthing will not interfere with existing shipping activities the approach and slowing manoeuvres will occur close to the channel.

12 *Volume of Marine Traffic*: Transit to the site is assumed to be via the East Lamma Channel, Western Fairway, Ma Wan Channel and the Urmston Road Channel. This is a long passage through the "heart" of Hong Kong harbour. While this transit is now performed regularly and safely by some of the world's largest container ships which access the ports of the Shekou peninsular, it will expose the LNG carrier to significant marine traffic activity.

A summary of the environmental, social and planning characteristics of the Lung Kwu Sheung Tan site are reported in *Figure 4.15*.

Conclusions

From a review of Lung Kwu Sheung Tan's environmental, social, planning and marine transit characteristics it emerges that the site poses some of advantages for the location of the LNG terminal, namely:

- The main advantage from an environmental perspective is Lung Kwu Sheung Tan's close proximity to BPPS meaning that the construction of the subsea import pipeline to the power station will be limited to a short onshore pipeline. This will allow to strongly reduce the potential environmental impacts associated with the pipeline's construction.

- The area is presently uninhabited and the closest village is located at approximately 1 km from the LNG site and approximately 2 km from the jetty at Lung Kwu Sheung Tan. The nearest developments are small scale industrial complexes.

- The jetty is relatively sheltered from prevailing metocean conditions.

- The approach channel and turning basins will be located sufficiently far away from the vessel fairway and will not interfere with existing shipping activities.

The location of the LNG terminal at Lung Kwu Sheung Tan will however pose a number of potential environmental and marine traffic issues summarised below:

- Land for the construction of the LNG terminal will need to be obtained form extensive reclamation leading to the loss of natural habitat and coastline.

- Recorded presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*) in the coastal waters of Lung Kwu Sheung Tan.

- Considerable dredging will be required for the turning circle and approach channel and reclamation. The volume will be dependent on the jetty location and the approach channel orientation.

- Marine Transit of the LNG carrier will be via East Lamma Channel, West Harbour, Ma Wan and the Urmston Road. The shipping lanes are some of the busiest in Hong Kong and there are nearby populations along the transit route. A Marine Quantitative Risk Assessment would be required to verify the acceptability of the transit route.

Although several site selection advantages discussed above are comparable to the ones discussed for Black Point, it is deemed that the need for an onshore connecting pipeline to BPPS, the extensive dredging for the reclamation, the proximity to Lung Kwu Tan and the expected severe landscape and visual impacts makes the site less suitable from an environmental perspective. Based on the above, it is deemed that the disadvantages posed by siting the

LNG terminal at Lung Kwu Sheung Tan do not make the area a viable candidate site for further consideration.

4.11.5 *South Soko*

Introduction

South Soko Island (also called Tai A Chau) is the largest (120 ha) of a small group of islands located over 6 km to the south of southwest Lantau Island and about 2 km north of the boundary of HKSAR territorial waters. The most dominating feature of the island is the presence of a former Vietnamese detention centre which has now been demolished (*Figure 4.18*).

Figure 4.18 Aerial Photo of the South Soko Site

A large concrete platform now remains on the centre of the island, surrounded by modified landforms such as cut slopes, access road, reclaimed seawalls and a helicopter landing area. The topography of South Soko mainly consists of hills (Fei Kei Teng, Nam Shan and Tai Chau Mei Teng) with a maximum height of approximately 140 m. The coastline is mainly steeply sloped and rocky in nature. Notable coastal features include two bays located on the east and west side of the island (called Tung Wan and Sai Wan, respectively) with a shallow, gently sloping bathymetry ranging between 0 to -12 m in depth.

The Indo-Pacific Humpback Dolphin (*Sousa chinensis*) and Finless Porpoise (*Neophocaena phocaenoides*) have been recorded in the waters of Southern Lantau and South Soko, however sightings of the Humpback Dolphins are more concentrated in Western Lantau whilst the Finless Porpoises sightings are more concentrated in and around South Lamma.

The surrounding waters have been identified as both a spawning ground and a nursery area for commercial fisheries resources. The spawning ground extends east through to the Po Toi and Ninepin Islands whereas the nursery area extends from the Soko Islands to southern Lamma. Recent surveys have indicated that fish eggs and fry do not differ substantially between the Soko Islands and elsewhere in the Southern HKSAR waters.

Although the southern coast of the island has higher exposure to the prevailing ocean swells, the metocean conditions are reduced by the sheltering presence of the Lima islands approximately 15km to the south and south-east. The western shore (Sai Wan) is most sheltered. Waters on the northern side of South Soko are affected by fairly strong tidal currents causing some seabed scouring due to the narrow channel that exists between South Soko Island and North Soko Island.

Overall, South Soko is in a remote location, and the closest marine traffic fairway (the Adamasta Channel) passes about 2 km to the north of the island. This channel is predominantly used by fast ferries between Hong Kong and Macau. While it is busy, navigation is closely constrained in the channel and it is not crossed during transits to the terminal.

Seabed features surrounding South Soko Island include a submarine electricity cable and one water main, which connect to Lantau Island and were installed to service the former detention centre as well as a gazetted sand dredging and mud disposal area to the west.

Conceptual Layout

The main construction aspects of the site are outlined below. These are based on the preliminary conceptual layout reported in *Figure 4.19*:

- *Dredging*: In order allow access to the site dredging will be required (approximately 1.1 Mm^3) for the formation of the approach channel and turning basin. Maintenance dredging requirement is expected to be required once every ten years and will be restricted to specific small areas.

- *Reclamation*: An area of approx. 0.6 ha will be reclaimed. A relatively small proportion of the soil and rock material will be used within the reclamation and therefore most of the material will need to be exported off site. As there is no land access to the island the material will need to be transported by barge.

- *Site Formation and Construction*: The site formation works will be carried out from several berms formed at pre-determined levels to accommodate the necessary drainage works and landscaping works. The berms are typically provided at 10 m vertical intervals and will likely be used as a temporary working platform for the drilling and blasting works.

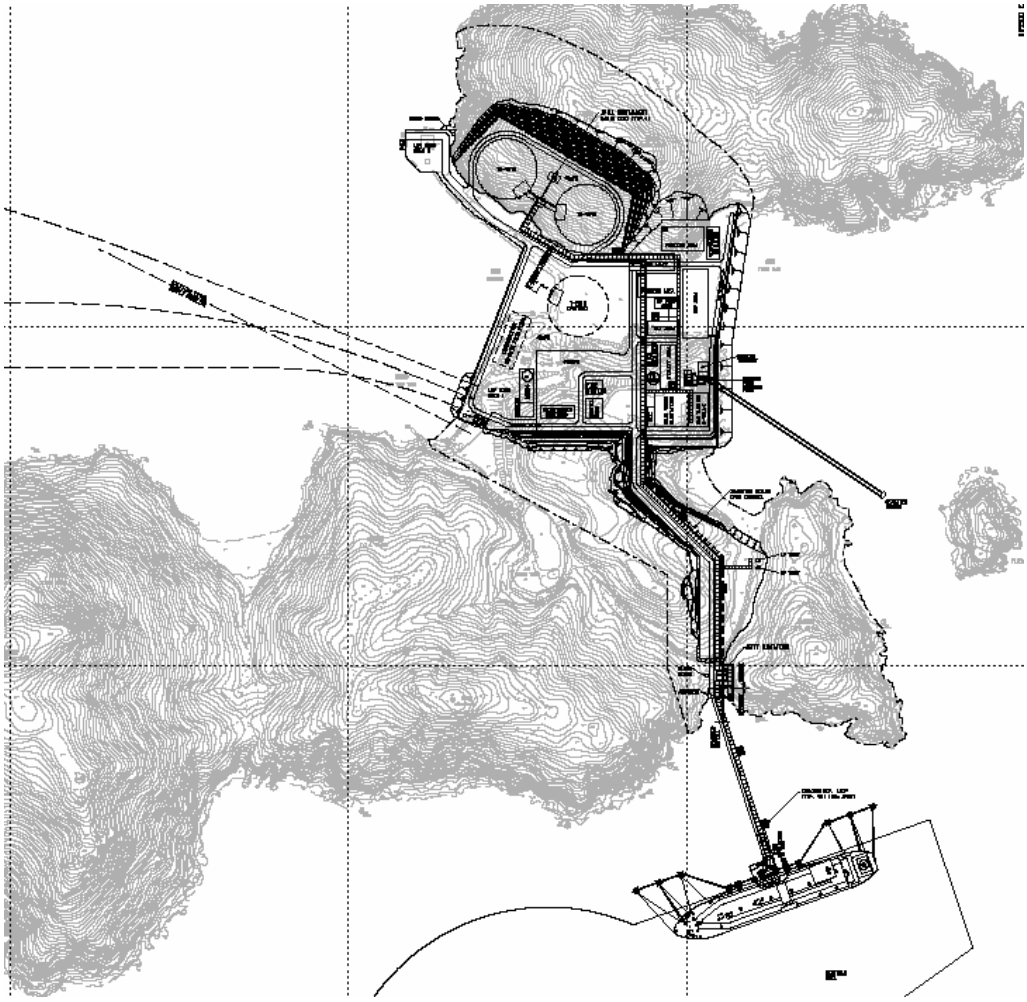


Figure 4.19 ***Conceptual Layout for South Soko Site***

Site Review

The general site requirements and the environmental, safety, social and marine transit aspects of the South Soko site are summarised in *Table 4.14*.

Table 4.14 Site Review - South Soko

General Site Requirements	
1	*Land Availability and Constraints:* Sufficient land is available for LNG site and associated facilities at South Soko, including land for potential expansion. Little reclamation will be needed to accommodate the terminal facilities and the land impacted by the reclamation is unconstrained.
2	*Operational Depth:* Approximate depth at potential approach channel/turning basin location: 12-14 mPD. Some dredging would be required and quantity would depend on the orientation of the approach channel/turning basin.
3	*Pipeline*: Pipeline route to BPPS will be approximately 40 km in length. The chosen route via Lantau's western waters is physically unconstrained, although the presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*) would require an ecological assessment to be undertaken.
4	*Distance from Sensitive Receivers*: South Soko is in a remote location from land based sensitive receivers. However there are marine sensitive receivers in the waters around South Soko such as Indo-Pacific Humpback Dolphin's (*Sousa chinensis)* and Finless Porpoises (*Neophocaena phocaenoides*).
Environmental, Social and Planning	
5	*Terrestrial Environment* • Terrace cultivation, two small abandoned settlements (Ha Tsuen and Sheung Tsuen) and a disused Vietnamese detention centre have in the years modified most of the island's terrestrial habitats which result partially altered and of low ecological value. Shrubland is the dominant habitat type and covers most of the hillsides. • The site of the ex-detention centre occupies the flat land between Tung Wan and Sai Wan where no habitat of ecological value can be found. The hill slopes to the south of the ex-detention centre were modified into cut slopes and all of the vegetation was removed. The changes in the island terrain are expected to have disturbed the soil strata containing the archaeological deposits of the Tai A Chau archaeological site present on the island.
6	*Marine Environment*: • Indo-Pacific Humpback Dolphin and Finless Porpoise have been recorded in the waters of Southern Lantau, including South Soko. However sightings of both species are more concentrated elsewhere in Western Lantau (Humpback Dolphin) and Po Toi (Finless Porpoise). • The surrounding waters have been identified as both a spawning ground and a nursery area for commercial fisheries resources. The spawning ground extends east through to the Po Toi and Ninepin Islands whereas the nursery area extends from the Soko Islands to southern Lamma. Recent surveys have indicated that fish eggs and fry do not differ substantially between the Soko Islands and elsewhere in the Southern HKSAR waters. • The scale of capture fisheries operations in and around the Soko Islands is considered to be moderate-high compared to other fishing grounds in Hong Kong. Adult fish production for these waters is considered moderate, whereas production of fish fry for these waters is low. There are no existing gazetted Fish Culture Zones in the vicinity of South Soko. • Surveys indicate that this coast supports sparse cover of isolated and scattered hard corals. Most species found are common in Hong Kong waters, with the exception of the False Pillow Coral, *Pseudosiderastrea tayami* found at the southern side of Tai A Chau. This False Pillow Coral is known to occur only at isolated locations of Lamma Island and South Soko. Soft corals and gorgonian seawhips were also recorded from this coast. • Wet and Dry season survey using grab samples recorded Amphioxus in low abundance in Tung Wan. • The shorelines of Tung Wan and Sai Wan bays have been partially reclaimed and are artificial. A rubble mound seawall was constructed in Tung Wan and piers were constructed on the northern and southern edges of Sai Wan bay. • Water quality of South Soko is influenced the Pearl River, resulting in reduced salinity and relatively high turbidity levels during the summer.

7 *Social*: The island was formerly a detention centre for Vietnamese illegal immigrants which is now disused and demolished. Tai A Chau is a Recognised Village however, although some private lots remain on the island, there are no permanent inhabitants. The island is regularly visited due to the presence of the Tai A Chau Tin Hau Temple and graves.

8 *Planning*: The island does not come under any statutory plans, however it has been identified as a potential Marine Park and Tourism/Recreation area by HKSARG SWNT Planning Study (not included in the Lantau Concept Plan). The waters are designated as secondary contact recreation zones (1). The site is of archaeological/historical interest as it includes several archaeological/historical resources including the Tai A Chau archaeological site and the Tai A Chau Tin Hau Temple.

9 *Permitting Risk*: Potential objections to the development of the site may come from NGOs. The island's coastal waters have also been identified as a potential marine park. There is a potential need to acquire land, however the permitting risks are considered to be relatively low as the land is all is owned by one company.

Marine Transit

10 *Exposure*: The southern coast of the Island is exposed to offshore conditions during the summer while the northern coast (facing Siu A Chau) is protected from ocean swells.

11 *Interference with Shipping:* The terminal and approach would be located away from main shipping routes

12 *Volume of Marine Traffic*: South Soko is located close to the boundary of the HKSAR waters and set away from the busy Adamasta Channel. The approach to the site would be from the southeast with transits along the proposed PRD Traffic Separation Schemes.

A summary of the environmental, social and planning characteristics of the South Soko site are reported in *Figure 4.20*.

Conclusions

From a review of South Soko's environmental, social, planning and marine transit characteristics it emerges that the site poses a series of advantages for the location of the LNG terminal, namely:

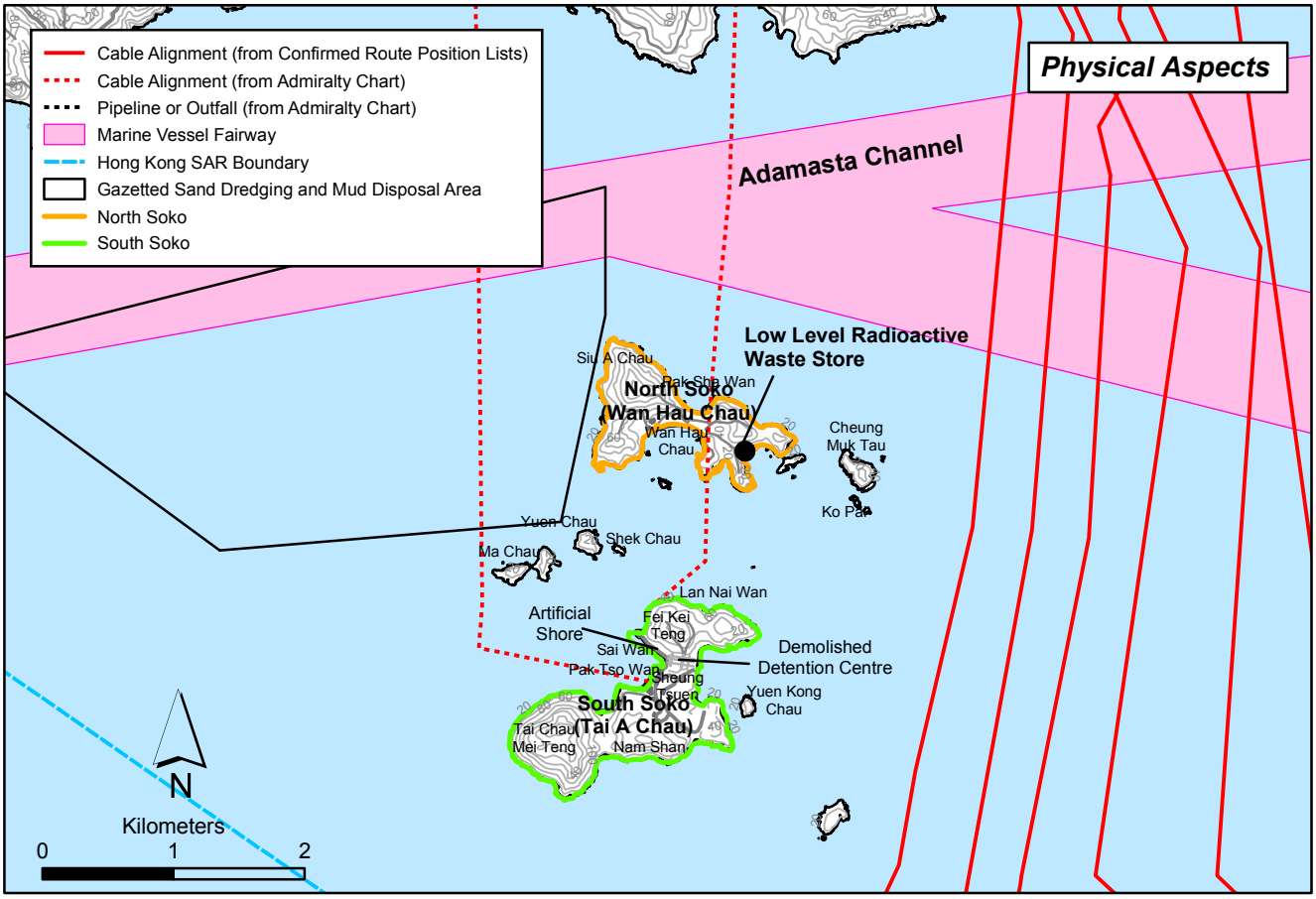
- Sufficient and unconstrained land is available for the construction and operation of the LNG terminal and associated facilities. Low severity environmental impacts are expected from the terrestrial works due to the generally disturbed nature of the habitats. Little reclamation will be needed strongly reducing potential environmental impacts to the marine environment.

- The site will provide unconstrained access to the LNG carriers avoiding major shipping lanes and populated areas. Little/no interference with existing shipping channels and marine traffic would be expected.

- South Soko is a very remote location, away from densely populated areas. The closest village is located approximately 6 km north (Shek Pik) and consequently there are few air, noise and landscape visual Sensitive Receivers.

- The unconstrained pipeline route to BPPS will reduce potential impacts on existing seabed features.

(1) EPD - Marine Water Quality in Hong Kong in 2004



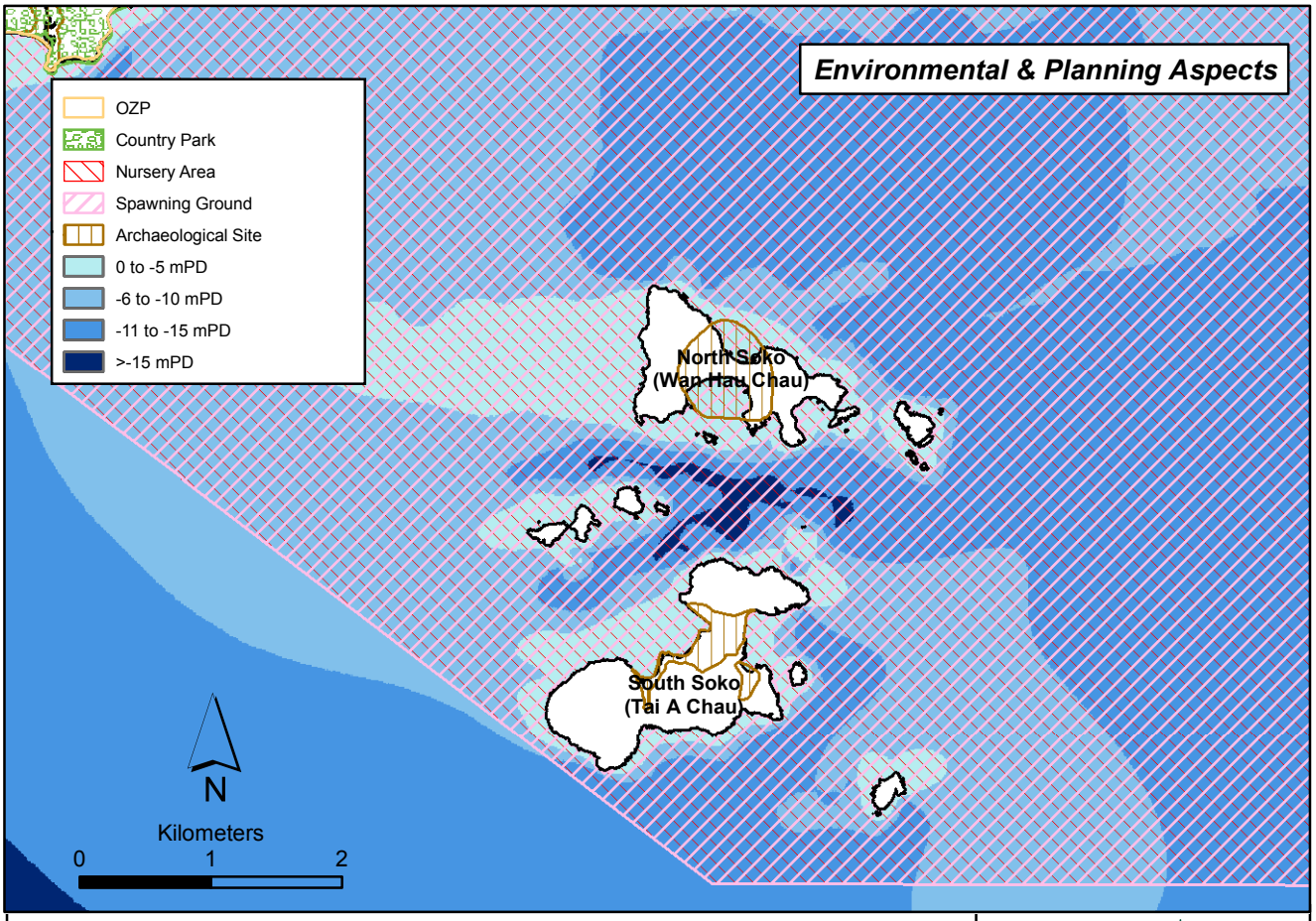


Figure 4.20

Physical, Environmental and Planning Aspects of North Soko and South Soko

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Date: 21/06/2006

Environmental Resources Management

ERM

- The absence of key sensitive terrestrial habitat due to the modified concrete platform, predominance of shrubland and the presence of vegetation/faunal assemblages of low ecological value.

Although South Soko presents several environmental and social advantages for the siting of the LNG terminal, a number of potential environmental and planning issues have been highlighted, namely:

- The Soko Islands have been identified as a potential Marine Park and Tourism/Recreation area by HKSARG SWNT Planning Study.
- Recorded presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*) and Finless Porpoise (*Neophocaena phocaenoides*).
- Although the pipeline route to BPPS is physically unconstrained, it will pass through acknowledged Indo-Pacific Humpback Dolphin habitat.
- The presence of the Tai A Chau archaeological site located on the isthmus between Tung Wan and Sai Wan, and the Tai A Chau Tin Hau Temple will require careful examination.
- Based on the above, it is deemed that the environmental advantages posed by siting the LNG terminal on the existing concrete platform on South Soko Island makes the area a viable candidate site for further consideration. Planning and environmental disadvantages will be further discussed in greater detail to determine their potential magnitude.

4.11.6 North Soko

Introduction

North Soko (Siu A Chau) is a small island located approximately 2 km south of Lantau Island. The coastline is mainly natural rocky shore with areas of boulders and sandy beaches. The island's morphology is characterised by two hills located to the east and west of the island, the highest of which reaches 120 m. They are joined by a strip of flat lowland on which the potential site is located *(Figure 4.21*).

To provide sufficient land for the construction a cut and fill reclamation will be required to expand the existing area. Due to the shallow water depth within Siu A Chau Wan, the preliminary layout positions the jetty in the channel between North Soko and South Soko. Minimal dredging will be required to allow the approach of the carriers to the jetty.

Indo-Pacific Humpback Dolphin (*Sousa chinensis*) and Finless Porpoise (*Neophocaena phocaenoides*) have been recorded in the waters of North Soko and throughout Southern Lantau. It must however be noted that sightings of these species are more concentrated in Western Lantau (Humpback Dolphins) and around South Lamma (Finless Porpoises).

The surrounding waters have been identified as both a spawning ground and a nursery area for commercial fisheries resources. Recent surveys have however indicated that fish eggs and fry do not differ substantially between the Soko Islands and elsewhere in the Southern HKSAR waters.

The vegetation of North Soko is typical of the outlying islands and well represented elsewhere in Hong Kong SAR. The east of North Soko is covered by low shrubs with a high percentage of grass cover, while the western part of the island is dominated by tall shrub.

Figure 4.21 ***Aerial Photo of the North Soko Site***

Of particular note for the North Soko site is the presence of the Siu A Chau Archaeological Site in which prehistoric coarse ware, polished stone and Tang dynasty limekiln debris have recently been identified.

The southern coast of the Island is exposed to offshore conditions while the northern coast (facing Lantau) is protected from ocean swells but bounded by the Adamasta shipping channel south of Lantau. There are no residential or commercial developments on the island; however the busy Adamasta channel is located approximately 1 km North of the site

Conceptual Layout

The main construction aspects of the site are outlined below. These are based on the preliminary conceptual layout reported in *Figure 4.22*:

- *Dredging:* Only nominal dredging is required for the turning circle. However, to achieve a navigation depth of –15 m PD, a 4 km navigation

channel is required to reach deeper water. Existing depths of about –13 m are recorded. The channel initially lies in an Easterly direction before turning South East, through the breakwaters to deep water.

- *Reclamation and Breakwaters*: A cut and fill reclamation will be required to expand the existing lowland area at the centre of the island. The materials for the reclamation will mostly be sourced from the excavation of the land site formation.

- *Site Formation and Construction*: The excavation required should be balanced with the reclamation fill quantities to provide the land needed.

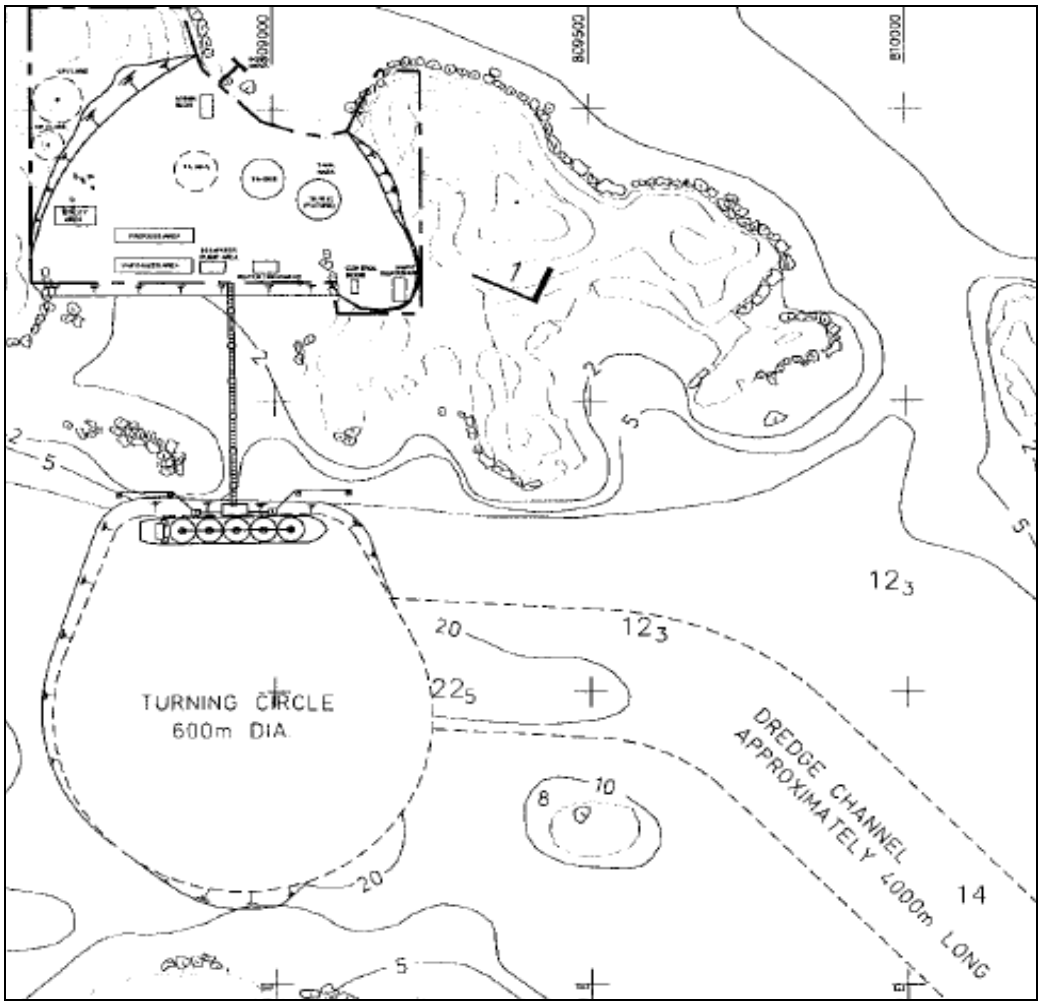


Figure 4.22 Conceptual Layout for North Soko Site

Site Review

The general site requirements and the environmental, safety, social and marine transit aspects of the North Soko site are summarised in *Table 4.15*.

Table 4.15 Site Review – North Soko

General site requirements	
1	*Land Availability and Constraints:* A cut and fill reclamation will be required to expand the existing lowland area at the centre of the island. The land impacted by the reclamation is unconstrained.
2	*Operational Depth:* Turning circle and approach channel will require significant dredging
3	*Pipeline*: The pipeline route to BPPS is approximately 38 km. The chosen route via Lantau's western waters is largely unconstrained, although the presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*) would require an ecological assessment to be undertaken. In addition, there are a number of submarine cables that have been laid between the island and Lantau island, as well as more to the east in between the island and the South Cheung Chau Disposal Ground.
4	*Distance from Sensitive Receivers*: The North Soko site lies in the southwestern waters of Hong Kong on the relatively undisturbed and remote location. Siu A Chau is a Recognised Village but it is not known if the structures are occupied, which are all within 500m of the site.
Environmental, Social and Planning	
5	*Terrestrial Environment:* • The area within the proposed construction site on North Soko Island is occupied by a variety of terrestrial habitats including shrubland, grassland, wetland, cultivation, bare rock/soil and plantation. • A small abandoned village, Siu A Chau Tsuen is located behind the sandy beach at Siu A Chau Wan. • With the exception of the tropical climber *Malaisia scandens* (not recorded in the Hong Kong SAR until 1996 when the species was first recorded in Lantau Island), most of the vegetation species recorded on North Soko Island are typical of outlying islands and well-represented elsewhere within the Hong Kong SAR. *Malaisia scandens* was found to be present in high abundance in the woodland and shrubland areas of the island.
6	*Marine Environment:* • Indo-Pacific Humpback Dolphin (*Sousa chinensis*) and Finless Porpoise (*Neophocaena phocaenoides*) have been recorded in the waters of Southern Lantau. However sightings of both species are more concentrated elsewhere in Western Lantau (Humpback Dolphin) and Po Toi (Finless Porpoise). • The surrounding waters have been identified as both a spawning ground and a nursery area for commercial fisheries resources. • The scale of capture fisheries operations in and around the Soko Islands is considered to be moderate-high compared to other fishing grounds in Hong Kong. Adult fish production for these waters is considered moderate, whereas production of fish fry for these waters is low. There are no Fish Culture Zones in the vicinity of North Soko. • Water quality at North Soko is influenced by the Pearl River, resulting in reduced salinity and relatively high turbidity levels during the summer.

7	*Social*: Siu A Chau is a Recognised Village, but it is not known if the structures are occupied, which are all within 500m of the site. More than 50 private lots are found on the island. There is a lighthouse at Pak Kok and a jetty in middle of Island
8	*Planning*: The site is identified as a Potential Marine Park and Tourism/Recreation area by HKSARG SWNT Planning Study, but not in the Lantau Concept Plan. The island is the site of a low level radioactive waste facility (Sum Wan). To the west of the site lies a gazetted area for sand dredging that is partially exhausted but currently considered constrained to continue such works.
9	*Permitting Risk*: The waters are designated as secondary contact recreation zones (1). The site is of archaeological/historical interest. There is a potential need to acquire land from approximately 70 private owners, which will require assistance from the Government and South Lantau Rural Committee
Marine Transit	
10	*Exposure*: The island is relatively sheltered from prevailing metocean conditions. The southern coast of the Island is more exposed to offshore conditions during the summer while the northern coast is relatively more protected from ocean swells.
11	*Interference with Shipping*: The jetty's extension into channel between North and South Soko will not result in issues to passing traffic.
12	*Volume of Marine Traffic*: Local traffic between the two Soko islands is comparatively light and the proposed location is well clear of fast ferry routes. The approach to the site would be from the southeast with transits along the proposed PRD Traffic Separation Schemes.

A summary of the environmental, social and planning characteristics of the North Soko site are reported in *Figure 4.20*.

Conclusions

From a review of North Soko's environmental, social, planning and marine transit characteristics it emerges that the site poses advantages for the location of the LNG terminal, namely:

- The site will provide easy access to the LNG carriers which will be approaching the site from the southern unconstrained waters of HK SAR avoiding major shipping lanes and populated areas. Little interference with existing shipping channels and marine traffic is also expected.
- North Soko is in a relatively remote location, away from densely populated areas. The closest village is located on the southern coast of Lantau Island, approximately 2 km north (Shek Pik).
- The unconstrained pipeline route to BPPS will reduce potential impacts on existing seabed features.
- The reclamation needed to provide sufficient land for the LNG terminal's construction and operation will affect unconstrained land.

Although North Soko presents several marine transit, environmental and social advantages for the siting of the LNG terminal, a number of potential environmental and planning issues have been highlighted, namely:

(1) EPD - Marine Water Quality in Hong Kong in 2004

- Land for the construction of the LNG terminal will need to be obtained from extensive cut and fill reclamation leading to the loss of natural terrestrial and marine habitat.

- The Soko Islands have been identified as a potential Marine Park and Tourism/Recreation area by HKSARG SWNT Planning Study.

- Recorded presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*), Finless Porpoise (*Neophocaena phocaenoides*) in the islands coastal waters.

- Although the pipeline route to BPPS is unconstrained, it will pass through acknowledged Indo-Pacific Humpback Dolphin habitat.

- The presence the Siu A Chau Archaeological Site will require careful examination.

- Significant dredging will be required for the approach of the LNG carrier. The quantities are related to the fact that a navigation channel approximately 4 km long will be required.

- There will be the need to acquire land from approximately 70 private owners and the removal of the Siu A Chau Recognised Village.

Although several site selection advantages discussed above are comparable to the ones discussed for South Soko, it is deemed that the need for an extensive dredging and cut/fill reclamation, as well as the need to acquire land from approximately 70 owners makes the site less suitable from environmental and planning perspectives.

Based on the above, it is deemed that the disadvantages posed by siting the LNG terminal at North Soko do not make the area a viable candidate site for further consideration.

4.11.7 Peaked Hill

Introduction

Peaked Hill is an isolated and uninhabited offshore island located west of Tsin Yue Wan on Lantau Island (*Figure 4.23*). It covers a land area of approximately 7 ha with a maximum elevation of about 69 m. The islands bathymetry is characterised by very shallow water to the east in the channel between Peaked Hill and Lantau Island whilst deeper water borders the island to the west.

Due to the small size of the island and its relatively steep morphology, the LNG terminal would be located on a cut and fill reclamation which will create the necessary land for the construction and operation of the LNG terminal. The jetty would extend westward to the –10 mPD contour where the turning basin will be dredged. The waters to the west of the turning basin are

sufficiently deep to require minimal to no dredging for the navigation channel.

The primary characteristic of Peaked Hill's marine ecology is the presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*). Abundance of humpback dolphins in Hong Kong waters is highest in the north and west Lantau areas. Peaked Hill Island is located within this major habitat for humpback dolphins and also within the boundaries of the proposed Southwest Lantau Marine Park which aims to protect the dolphin's habitat.

The island's terrestrial ecology is characterised by undisturbed habitats such as shrubland, grassland, plantation woodland and bare rock/soil. The community structure and vegetation species found on these islands are typical to other similar habitats in parts of Hong Kong where human disturbance is limited.

Figure 4.23 ***Aerial Photo of the Peaked Hill Island Site***

Offshore of Peaked Hill Island are the navigation entrances to the existing deep water channel to Nansha and Guangdong, the proposed Tonggu Waterway and any future Container Terminal 10, should the north west Lantau option for their development be chosen. The site is well protected by its proximity to Lantau Island from the prevailing easterly/south easterly metocean conditions, however it is more exposed to locally generated waves from the south west, albeit waves limited by the shallow waters of the PRD.

A review of the available literature indicates that there are no declared or deemed monuments, graded buildings, graves or archaeological sites within the site at Peaked Hill.

Conceptual Layout

The main construction aspects of the site are outlined below. These are based on the preliminary conceptual layout reported in *Figure 4.24*:

- *Dredging*: The berth and turning circle are located inshore of the 10 m contour so that dredging to –15 mPD will be required.

- *Reclamation*: The reclamation can be formed by excavation of Peaked Hill Island. The reclamation is assumed to be founded on soft marine deposits. Should the seabed be comprised of granular material, ground improvement techniques will not be required. Should the dredging be in granular material it can also be used in the reclamation.

- *Site Formation and Construction*: It is assumed the west side of the island is reduced to a level of about 10 mPD for location of the tanks. The material removed from the island can be used for reclamation and any surcharge loading required. There are no existing berthing facilities at the site and no access roads to the adjacent Lantau headland.

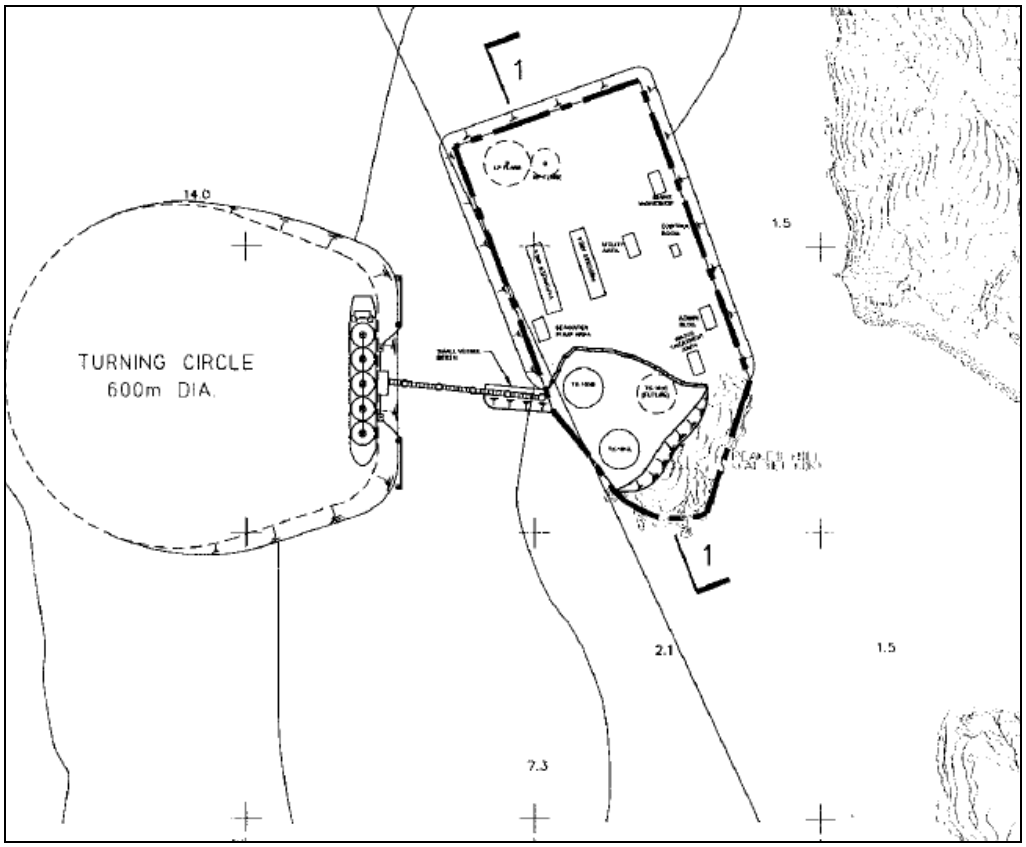


Figure 4.24 Conceptual Layout for Peaked Hill Site

Site Review

The general site requirements and the environmental, safety, social and marine transit aspects of the Peaked Hill site are summarised in *Table 4.16*.

Table 4.16 Site Review – Peaked Hill

General site requirements	
1	*Land Availability and Constraints:* The site would partially be formed by reclamation with no constraints on the extent of the reclamation.
2	*Operational Depth:* Minimal dredging would be required for the construction for the turning basin
3	*Pipeline*: The pipeline route to BPPS is ~ 25 km. The chosen route via Lantau's western waters is unconstrained, although the presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*) would require an ecological assessment to be undertaken.
4	*Distance from Sensitive Receivers*: The island is uninhabited and it is located in a remote and relatively undisturbed area on the western coast of Lantau Island characterised by a low population density. There are no sensitive receivers in close proximity of the site.
Environmental, Social and Planning	
5	*Terrestrial Environment:* • The island's terrestrial ecology is characterised by undisturbed habitats such as shrubland, grassland and bare rock/soil. • The surrounding terrestrial habitat on Lantau Island is a Country Park • In proximity to the island are sensitive habitats such as: mudflat and mangrove habitat, an SSSI, and a horseshoe crab breeding ground.
6	*Marine Environment:* • Peaked Hill's coastal waters are considered to be Hong Kong's major habitat for Indo-Pacific Humpback Dolphins (*Sousa chinensis*) • The island coastal waters are within the perimeter of the proposed Southwest Lantau Marine Park. • Information on the subtidal soft bottom assemblages indicates that the marine sediments in vicinity of the site support high species abundance and biomass in comparison to other areas in Hong Kong. • Capture fisheries operations in waters off Yam Tsai are reported to be of moderate-high magnitude compared to other Hong Kong waters. Catches of adult fish are moderate-high while production of fish fry in these waters was reported as moderate-low compared to other Hong Kong fishing grounds. • Water quality at Peaked Hill is influenced by the Pearl River, resulting in reduced salinity and relatively high turbidity levels during the summer.
7	*Social:* The island is uninhabited and there are no residential/commercial areas in close proximity of the site. However the island is in close proximity to the Lantau South Country Park at Tsing Yue Wan and along the South Lantau and Fan Lau Trails.
8	*Planning:* The site is part of the Potential Southwest Lantau Marine Park which was recommended in the Lantau Concept Plan.
9	*Permitting Risk:* The site is within a Secondary Contact Recreation Zone. Although the development of the Terminal is preferred on western side of Island this will have limited ability to shield the development from Country Park users.
Marine Transit	
10	*Exposure*: The site is well protected by its proximity to Lantau Island from the prevailing easterly/south easterly metocean conditions and from the persistent NE monsoon waves, however it is exposed to locally generated waves from the south west.
11	*Interference with Shipping*: The LNG terminal extension and the location of the jetty near the shipping channel has the potential to create passing vessel effects on moored LNG carriers.
12	*Volume of Marine Traffic*: The approach to the site would be from the southeast with transits along the proposed PRD Traffic Separation Schemes. While the LNG terminal is set away from the PRD Traffic Separation Scheme LNG carriers would be slowing to approach the terminal within the TSS, and close to its crossing within the Adamasta Channel.

A summary of the environmental, social and planning characteristics of the Peaked Hill site are reported in *Figure 4.25*.

Conclusions

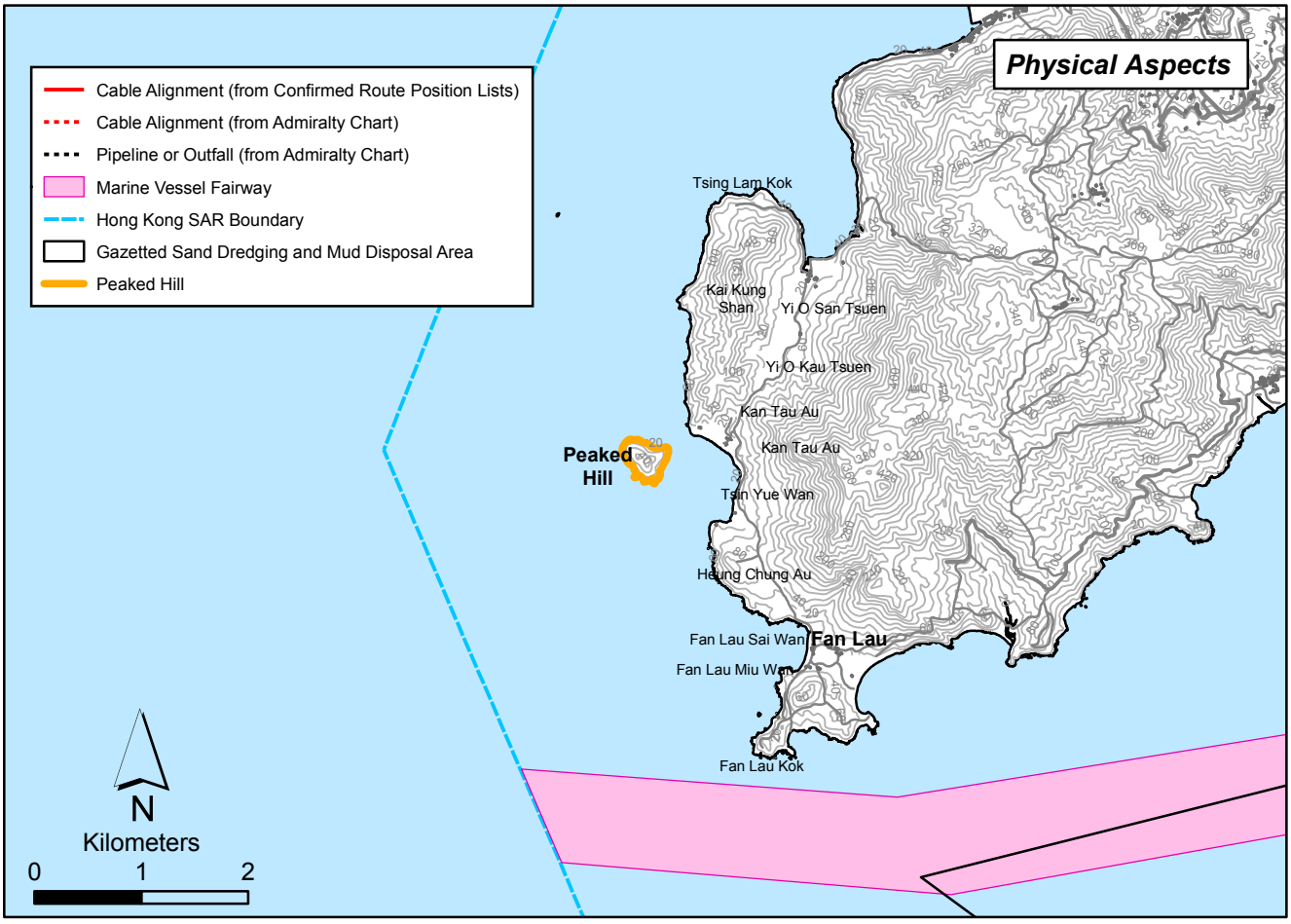
From a review of Peaked Hill's environmental, social, planning and marine transit characteristics it emerges that the site poses advantages for the location of the LNG terminal, namely:

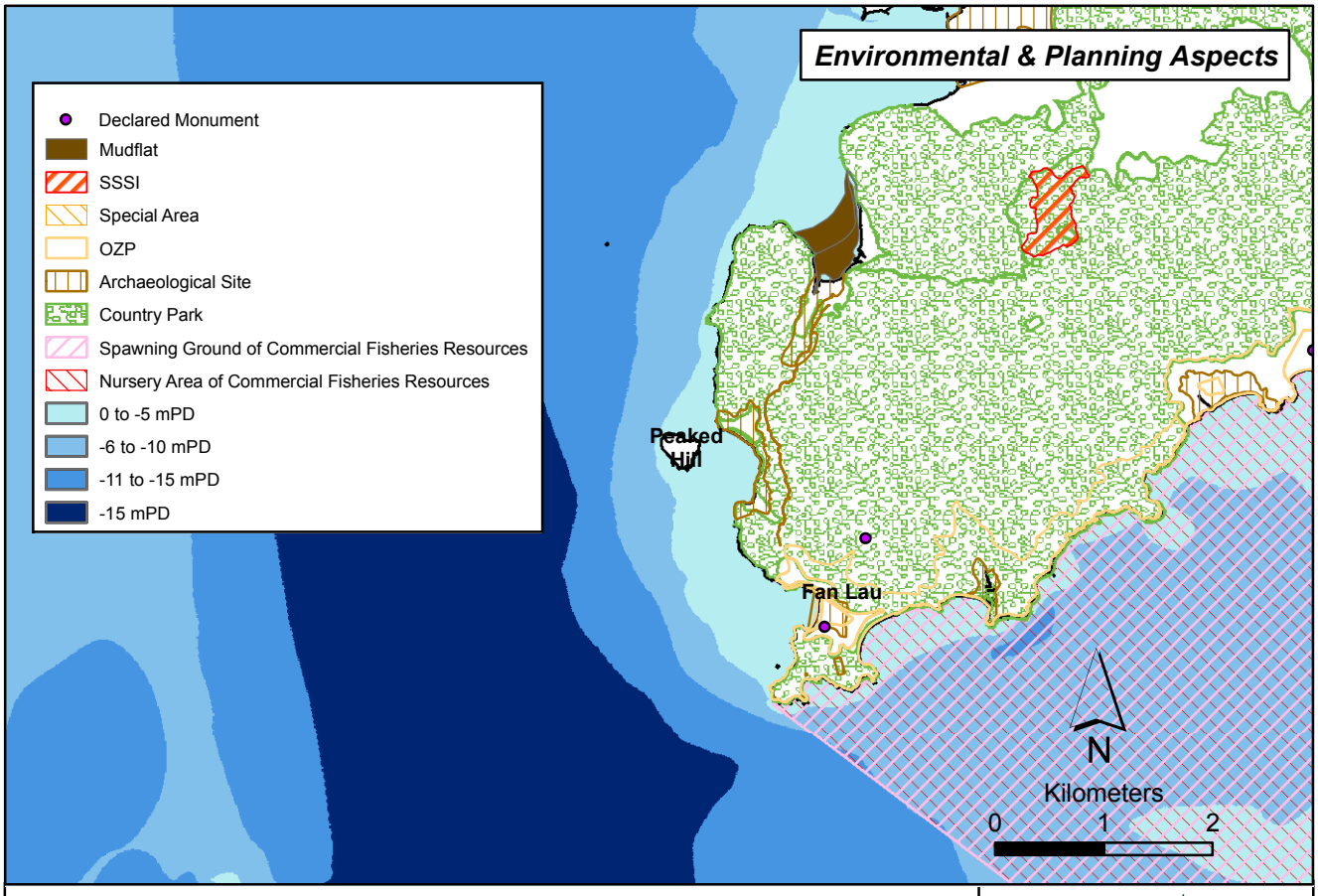
- Peaked Hill Island is in a remote location, away from densely populated areas. There are no sensitive receivers in close proximity to the site.
- The site will provide easy access to the LNG carriers which will be approaching the site from the Lema Channel, south of Lantau, causing no major impact on marine traffic.
- The unconstrained pipeline route to BPPS will reduce potential impacts on existing seabed features.

Although Peaked Hill Island presents several social, marine transit and planning advantages for the siting of the LNG terminal, a number of potential environmental and planning issues have been highlighted, namely:

- Peaked Hill Island is remote and located in relatively pristine surroundings. Development of the LNG terminal would introduce major changes to the landscape of SW Lantau. Visual impacts to users of Lantau Country Park would be expected to be severe.
- Peaked Hill Island's coastal waters are considered to be the major habitat for Indo-Pacific Humpback Dolphins in Hong Kong.
- Land for the construction of the LNG terminal will need to be obtained form extensive cut and fill reclamation leading to the loss of natural terrestrial and marine habitat, including major Indo-Pacific Humpback Dolphin habitat.
- Peaked Hill Island and its coastal waters have been identified as part of the Potential Southwest Lantau Marine Park which was recommended in the Lantau Concept Plan.
- Although the pipeline route to BPPS is unconstrained, it will pass through major Indo-Pacific Humpback Dolphin habitat.

The potentially severe landscape and visual impacts of the LNG terminal on the unspoilt natural landscape of SW Lantau, the presence of major Indo-Pacific Humpback Dolphins habitat and the need for an extensive cut and fill reclamation to provide sufficient land for the construction and operation of the LNG terminal makes the site undesirable from an environmental perspective and less suitable with respect to South Soko which is located approximately 8 km to the south east.





Fligure 4.25

Physical, Environmental and Planning Aspects of Peaked Hill

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Environmental Resources Management
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Based on the above it is deemed that the disadvantages posed by siting the LNG terminal at Peaked Hill do not make the area a viable candidate site for further consideration.

4.11.8 *Area 137*

Introduction

Area 137 (Fat Tong O) occupies an area of approximately 104 hectares and it is located on the southern side of the new town development of Tseung Kwan O (Junk Bay) on the opposite shore to Chai Wan (*Figure 4.26*).

Figure 4.26 Aerial Photo of the Area 137 Site

The area has recently been reclaimed for special industrial use and it is within close proximity to the Tathong Channel and a restricted area of low marine traffic volume.

Due to its artificial nature, the area's terrestrial and marine habitats are generally of low ecological value and complexity. Neither Indo-Pacific Humpback Dolphins (*Sousa chinensis*), nor Finless Porpoises (*Neophocaena phocaenoides*) have been recorded in the vicinity of the Tseung Kwan O and the nearest sighting of a Finless Porpoise was recorded 2km south of Tung Lung Chau. Important terrestrial habitats can be found in the neighbouring Clear Water Bay Country Park which borders the area to the north and south. Across the Tathong Channel are densely populated areas of Siu Sai Wan and Chai Wan.

Conceptual Layout

Area 137 is an existing industrial site intended for Deep Waterfront Industry. No dredging, reclamation or site formation will be needed. The preliminary conceptual layout reported in *Figure 4.27*.

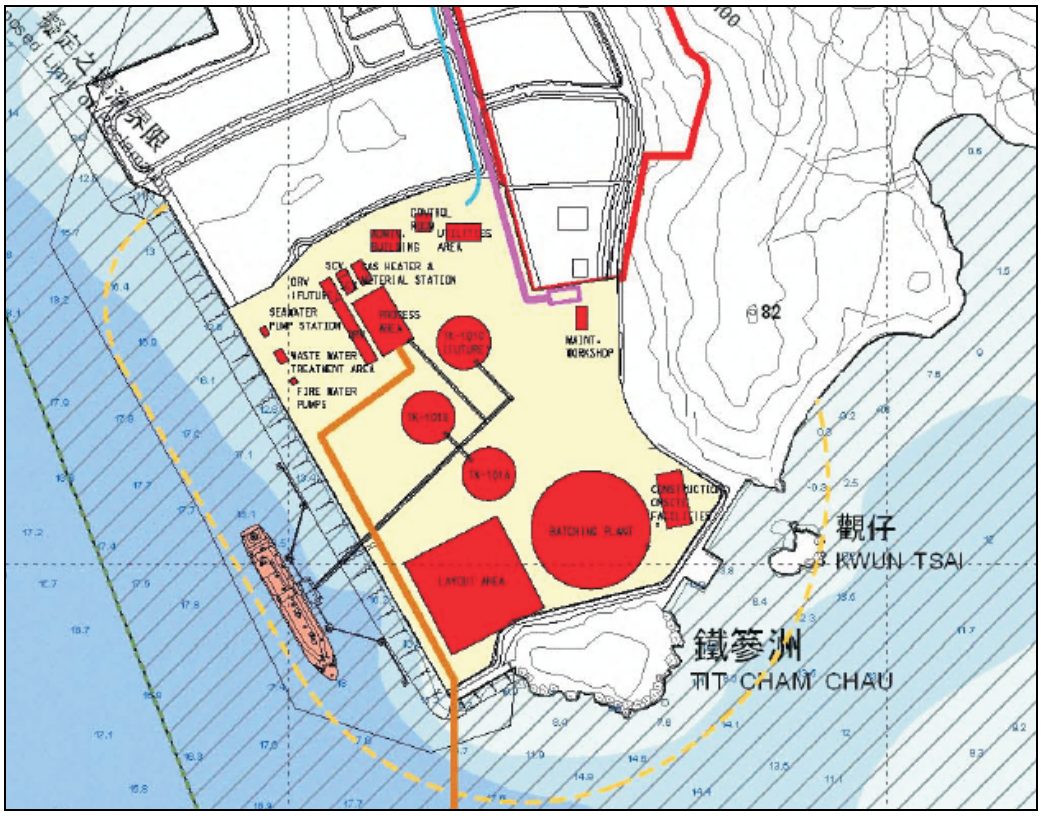


Figure 4.27 Conceptual Layout for Area 137 Site

Site Review

The general site requirements and the environmental, safety, social and marine transit aspects of the Area 137 site are summarised in *Table 4.17*.

Table 4.17 Site Review - Area 137

General Site Requirements	
1	*Land Availability and Constraints:* Sufficient land is available for LNG site and associated facilities at Area 137. No reclamation or site preparation works will be needed.
2	*Operational Depth:* Little or no dredging would be required to access the site.
3	*Pipeline*: The site is remote from BPPS and would require a pipeline of > 80 km. The route to the power station is highly constrained as a number of submarine cables are buried in the southern waters of Hong Kong Island and Lantau Island. Once passed the Soko Islands the pipeline route is largely unconstrained, although the presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*) would require an ecological assessment to be undertaken.
4	*Distance from Sensitive Receivers*: Siu Sai Wan is located less than 2 km from Area 137 with a population of 35,000 and Chai Wan at between 2 and 3 km from Area 137 has a population of 111,4000. In addition planned residential development in Area 85 (approx.10,000 people) and Area 86 (approx. 57,000 people) are located approximately 2 km to the North of Area 137. A number of seawater intake points are also located relatively close to the site and there is a Fish Culture Zone approx 1 km from the site at Tung Lung Chau.

	Environmental, Social and Planning
5	*Terrestrial Environment:* Area 137 is located on reclaimed land. The site is therefore characterised by vegetation/faunal assemblages of low ecological value. However it must be noted that the majority of the surrounding area is country park (Clear Water Bay Country Park).
6	*Marine Environment:* • The coastline around Area 137 is artificial and it is unlikely to have corals of particular ecological value. A recent study on Tseung Kwan O indicated low abundance and diversity of hard corals on the natural coast of the bay, including Junk Island, while moderate coral cover and low diversity of hard corals were recorded in East Joss House Bay and Tung Lung Chau. • Capture fisheries operations in waters off Area 137 are reported to be of moderate-high magnitude compared to other Hong Kong waters. Catches of adult fish are moderate while production of fish fry in these waters was reported as low compared to other Hong Kong fishing grounds. • There is a Fish Culture Zone at Tung Lung Chau, within approx. 1 km of the site.
7	*Visual:* Visual impacts at this site are a potential concern given the direct facing views of residents in Chai Wan, Siu Sai Wan, Yau Tong, users of beaches in Shek O and hikers in the Clear Water Bay Country Park.
8	*Social:* Planned residential development in Area 85 (approx.10,000 people) and Area 86 (approx. 57,000 people) are located approximately 2 km to the North of Area 137. Siu Sai Wan is located less than 2 km from Area 137 with a population of 35,000 and Chai Wan at between 2 and 3 km from Area 137 has a population of 111,4000.
9	*Planning:* • Area 137 has been zoned into two areas, the north as a Deep Waterfront Industry and the south (33 ha) for Open Use (OU). Area 137 is zoned "Other Specified Uses" annotated for "Deep Waterfront Industry" on the Approved Tseung Kwan O Outline Zoning Plan (OZP) No. S/TKO/15. According to the statutory planning intention, this zone is intended primarily for special industries which require marine access, access to deep water berths or water frontage. • According to the Definition of Terms Used in Statutory Plans, there is no provision within the existing land use zone for the LNG Terminal (either as of right or upon application to the Town Planning Board - TPB). A rezoning request to the TPB would be required. • At present, Area 137 is being used as a Public Fill Storage Area (Fill Bank) and the contract expires in 2008. There are no plans at present to extend it. • It is understood the Hong Kong and China Gas Planning Company has examined the site to use 15 ha of Area 137 and EPD is planning for extension of the SENT landfill which could potentially encroach the site. • No breakwater/ reclamation is allowed into the Tathong Channel gazetted limits. • The majority of the surrounding terrestrial habitat is a Country Park.
10	*Permitting Risk:* Although the area has been zoned for uses compatible for a LNG terminal, there is a history of local residents objecting to the use of Area 137 for such developments.
	Marine Transit
11	*Exposure*: The site is somewhat exposed to southeast monsoon storm conditions.
12	*Interference with Shipping:* The jetty has been located on the western limit of the site due to the environmental and marine transit issues (i.e. close proximity to Tung Lung Chau fish culture zone, presence of the foul area, potential hazards to the LNG manoeuvres within the turning circle) associated with the southern location within Joss House Bay (Tai Miu Wan). Any jetty extension required for clearance distances pushes the LNG berthing area closer to the Traffic Separation Scheme and increases the potential to create passing vessel effects on moored LNG carriers.
13	*Volume of Marine Traffic*: The site lies adjacent to the Tathong Channel, the principal access to HKSAR's central and eastern harbour areas. Traffic activity at this site is dominated by smaller craft, fishing vessels and rivertrade, with strong growth in feeder services between Yantian and Kwai Chung. Ocean-going vessel activity is limited, with the largest vessels comprising cruise liners accessing Kowloon Bay or Ocean Terminal.

A summary of the environmental, social and planning characteristics of Area 137 are reported in *Figure 4.28*.

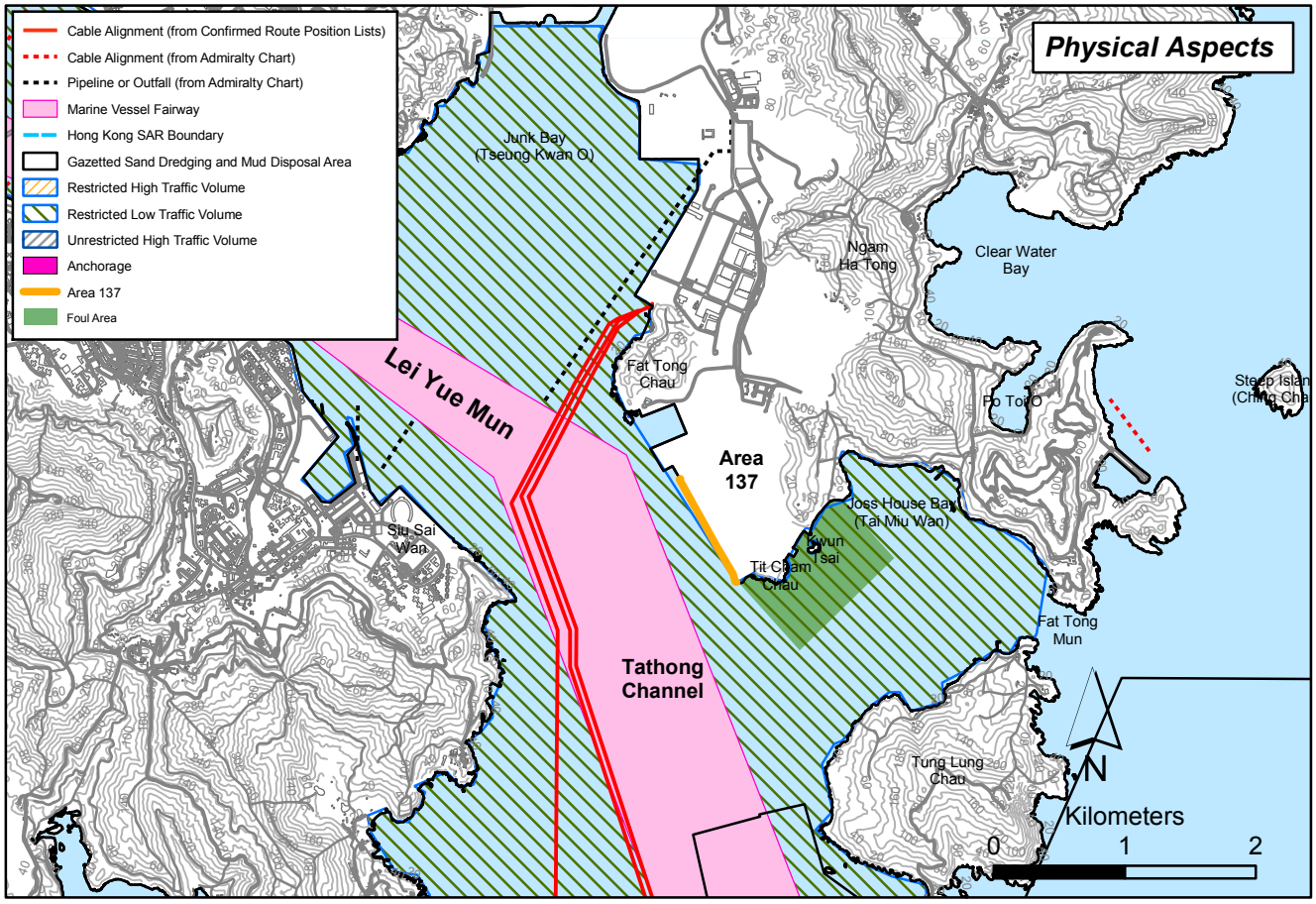
Conclusions

From a review of Area 137's environmental, social, planning and marine transit characteristics it emerges that the site presents environmental and planning advantages, namely:

- Area 137 has been zoned in the OZP for uses compatible with Deep Waterfront Industry.
- Little to no dredging would be required to access the site;
- The absence of key sensitive terrestrial, coastal and marine habitat due to the recent artificial nature of the site. The construction and operation of the site would not lead to the direct loss of important habitats. Furthermore, based on existing data sets on marine mammals distribution in HKSAR waters, neither Indo-Pacific Humpback dolphins (*Sousa chinensis*), nor Finless Porpoises (*Neophocaena phocaenoides*) have been recorded in the immediate vicinity of the site.

The site review has however highlighted several social, marine transit and planning drawbacks associated with Area 137, namely:

- Due to environmental and marine transit issues identified within Joss House Bay (Tai Miu Wan), the jetty will have to be located on the western limit of the site and in close proximity to the Tathong Shipping Channel. The location of the approach channel and turning basin in close proximity to the vessel fairway will potentially upset the LNG terminal's operations and ship transits. A safety zone to facilitate the LNG carrier's manoeuvres and off-loading operations would encroach on the vessel fairway and would thus not be permitted in Hong Kong. Furthermore the location of the jetty exposes the moored LNG carriers and the jetty itself to potential collisions with passing ships. A Marine Quantitative Risk Assessment (MQRA) will be required.
- The area is visually exposed to densely populated residential areas, the closest being Siu Sai Wan which is located less than 2 km away. The site's visibility to major urban districts will lead to a high level of public interests and impacts to perceived safety of the local population.
- The site is remote from BPPS and would require a pipeline of > 80 km. The route to BPPS is highly constrained as a number of submarine cables are buried in the southern waters of Hong Kong Island and Lantau Island. Once passed the Soko Islands to the west, the pipeline route is largely unconstrained, although the presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*) would require an ecological assessment to be undertaken.



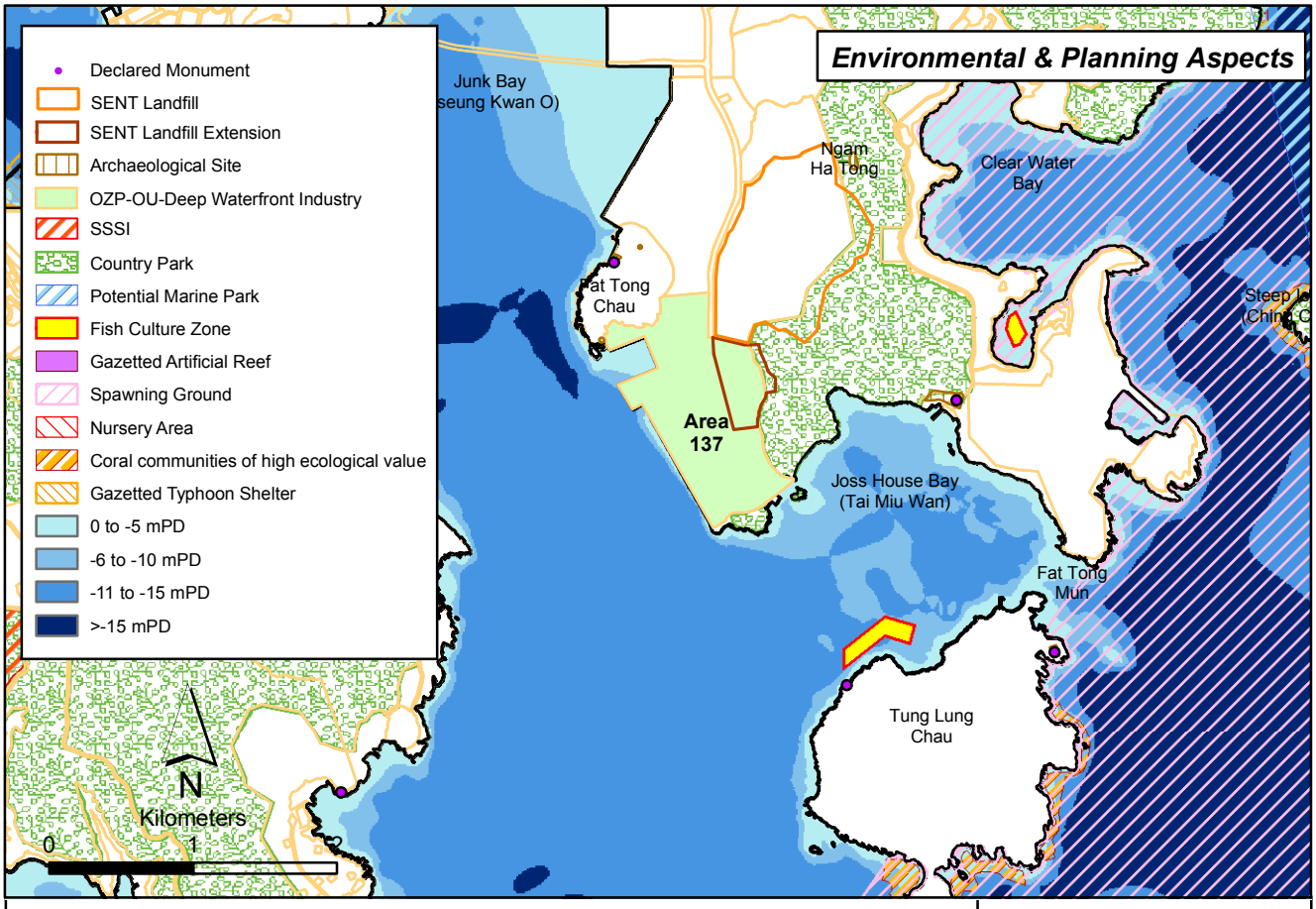


Figure 4.28

Physical, Environmental and Planning Aspects of Area 137

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Environmental Resources Management
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Based on the above, it is considered that the environmental advantages posed by siting the LNG terminal on the existing site at Area 137 with little to no associated environmental impacts and its potential compatibility with the OZP - Deep Waterfront Industry land use makes the area a viable candidate site for further consideration.

However, the potential marine traffic disadvantages highlighted will be further discussed in greater detail at a later stage of this site selection study to determine if the location of the jetty in close proximity to the Tathong Channel without a safety zone makes the site unacceptable for reliable LNG unloading operations. Planning and social issues will also be further examined.

4.11.9 Yam Tsai

Foreword

From a preliminary overview of the site's suitability criteria, it emerges that the site, although potentially viable from an environmental, social and technical perspective, presents numerous planning and permitting issues deemed sufficient for the site's "early" exclusion from the list of preferred sites. The rationale behind this exclusion is summarised below.

Statutory planning context:

- Yam Tsai is not covered by any existing OZP, however, it is located immediately adjacent to the Planning Scheme Boundary for the Approved North East Lantau Port OZP No S/I-NEL/12 and north of the Approved Discovery Bay OZP No. S/I-DB/4. The nearest land use zone is a "Green Belt" at Cheung Sok and Penny's Bay, the statutory planning intention of which is for conservation of the existing natural landscape, ecological and heritage areas, scenic areas and visual backdrops to the visitor attractions. An LNG terminal which would be highly visible from the Lantau Link, Airport Railway, the Tuen Mun Coastline and Ma Wan would be contrary to this planning intention. There is also an approx. 79ha of land next to Yam Tsai that is designated as the Sunny Bay Tourism and Entertainment Node a strip of land along the northern coast is intended as a reserve the proposed Road P1 extension.

Non-statutory planning context:

- In 1995 the Visitors and Tourism Study identified the potential for a tourism corridor along the northern coast of Lantau. This intention has since been reinforced by a number of Government studies and reports including the Territorial Development Strategy Review, the South West New Territories Development Strategy Review and the Northshore Lantau Development Feasibility Study. In the 2001 South West New Territories Development Strategy Review (SWNTDS), Yam Tsai is identified as a Conservation Area (Landscape Protection Area/Coastal Protection Area). An LNG Terminal is at direct odds with this intention.

The SWNTDS has also proposed a large area to the east of Yam Tsai for proposed additional development of Tourist/Recreational facilities.

- The Concept Plan for Lantau has recommended Yam Tsai as a Green Belt/Countryside area. In addition, there is a large proposed Country Park Extension to the south and large Leisure and Entertainment Node to the immediate east.

Introduction

Yam Tsai is located on the north eastern coast of Lantau Island just north of the North Lantau Expressway at Ta Pang Po (*Figure 4.29*). The site borders Yam Tsai Wan which extends on a south west-north east axis for approximately 1.5 km. Due to the morphology of the area, the site will have to be formed largely by reclamation.

The bathymetry of Yam Tsai headland's coastal waters are characterised by shallow waters to the east of the headland in Yam O Wan and steeper shelving waters to the north and the west of the site towards the Urmston Road vessel fairway.

With the exception of the presence of the Indo-Pacific Humpback Dolphin (*Sousa chinensis*), a review of existing information on the marine ecological resources of Yam Tsai coastal waters has not identified any assemblages of high ecological value. Although Humpback dolphins have been sighted in the area, it must be noted that the waters of north eastern Lantau do not support high number of sightings in comparison to other areas in Hong Kong (such as West and Northwest Lantau) and that marine waters around Yam Tsai are regarded as of low importance to the humpback dolphins.

The terrestrial ecology of Yam Tsai is of a little conservation importance and similar vegetation, flora and fauna are well represented on Lantau Island as well as the rest of Hong Kong SAR. The site is located on the northern coast of Lantau which provides shelter from prevailing metocean conditions. The proximity to the Urmston Road provides deepwater access to the area; however the final approach from the fairway towards the Yam Tsai will require extensive dredging due to the shallow bathymetry that characterises the near shore waters of the site.

Figure 4.29 *Aerial Photo of the Yam Tsai Site*

Site Review

The general site requirements and the environmental, safety, social and marine transit aspects of the Yam Tsai site are summarised in *Table 4.18*.

Table 4.18 *Site Review – Yam Tsai*

General site requirements	
1	*Land Availability and Constraints:* The site would have to be formed largely by reclamation. The land impacted by the expansion/reclamation is unconstrained.
2	*Operational Depth:* Minimal dredging would be required
3	*Pipeline*: The submarine pipeline route to BPPS is < 20 km. The submarine pipeline route to BPPS is severely constrained by the need for crossing submarine cables, pipelines and outfalls. There are a number of submarine cables traversing the channel to the west of the site.
4	*Distance from Sensitive Receivers*: Luk Keng Tsuen, a Recognised Village, lies within 1 km of the site.

Environmental, Social and Planning

5 *Terrestrial Environment:* The terrestrial habitats at Yam Tsai are of low conservation importance.

6 *Marine Environment:*

- Indo-Pacific Humpback Dolphin (*Sousa chinensis*) have been sighted in the vicinity of the site, however it must be noted that sightings in this area are less common than in the waters of western and northern Lantau.
- To the east of the site, in Yam O Wan, lies a small area of mudflat and mangrove habitat. .Seagrass has also been recorded in the bay.
- Capture fisheries operations in waters off Yam Tsai are reported to be of moderate-high magnitude compared to other Hong Kong waters. Catches of adult fish are moderate while production of fish fry in these waters was reported as low compared to other Hong Kong fishing grounds.
- Water quality at Yam Tsai is influenced by the Pearl River, resulting in reduced salinity and relatively high turbidity levels during the summer.

7 *Social*: Luk Keng Tsuen, a Recognised Village, lies within 1 km of the site. This site is located on a headland on the northeast of Lantau Island in the vicinity of Yam O, which is proposed for future reclamation.

8 *Planning*:

- Yam Tsai is not covered by any existing OZP; however it is located immediately adjacent to the Planning Scheme Boundary for the Approved North East Lantau Port OZP No S/I-NEL/12 and north of the Approved Discovery Bay OZP No. S/I-DB/4.
- The nearest land use zone is a "Green Belt" at Cheung Sok and Penny's Bay, the statutory planning intention of which is for conservation of the existing natural landscape, ecological and heritage areas, scenic areas and visual backdrops to the visitor attractions.
- The Concept Plan for Lantau has recommended Yam Tsai as a Green Belt/Countryside area. In addition, there is a large proposed Country Park Extension to the south and large Leisure and Entertainment Node to the immediate east.
- The 2001 South West New Territories Development Strategy Review (SWNTDS) identifies Yam Tsai as a Conservation Area (Landscape Protection Area/Coastal Protection Area).
- There is an approx. 79ha "Undetermined" zone next to Yam Tsai which is intended as a reserve the proposed Road P1 extension.
- The waters to the north of Yam Tsai are an exhausted sand borrow area which, until late 2001, was used for the disposal of uncontaminated mud. The waters remain, however, gazetted for such a purpose.

9 *Permitting Risk*: please refer to the foreword of this section

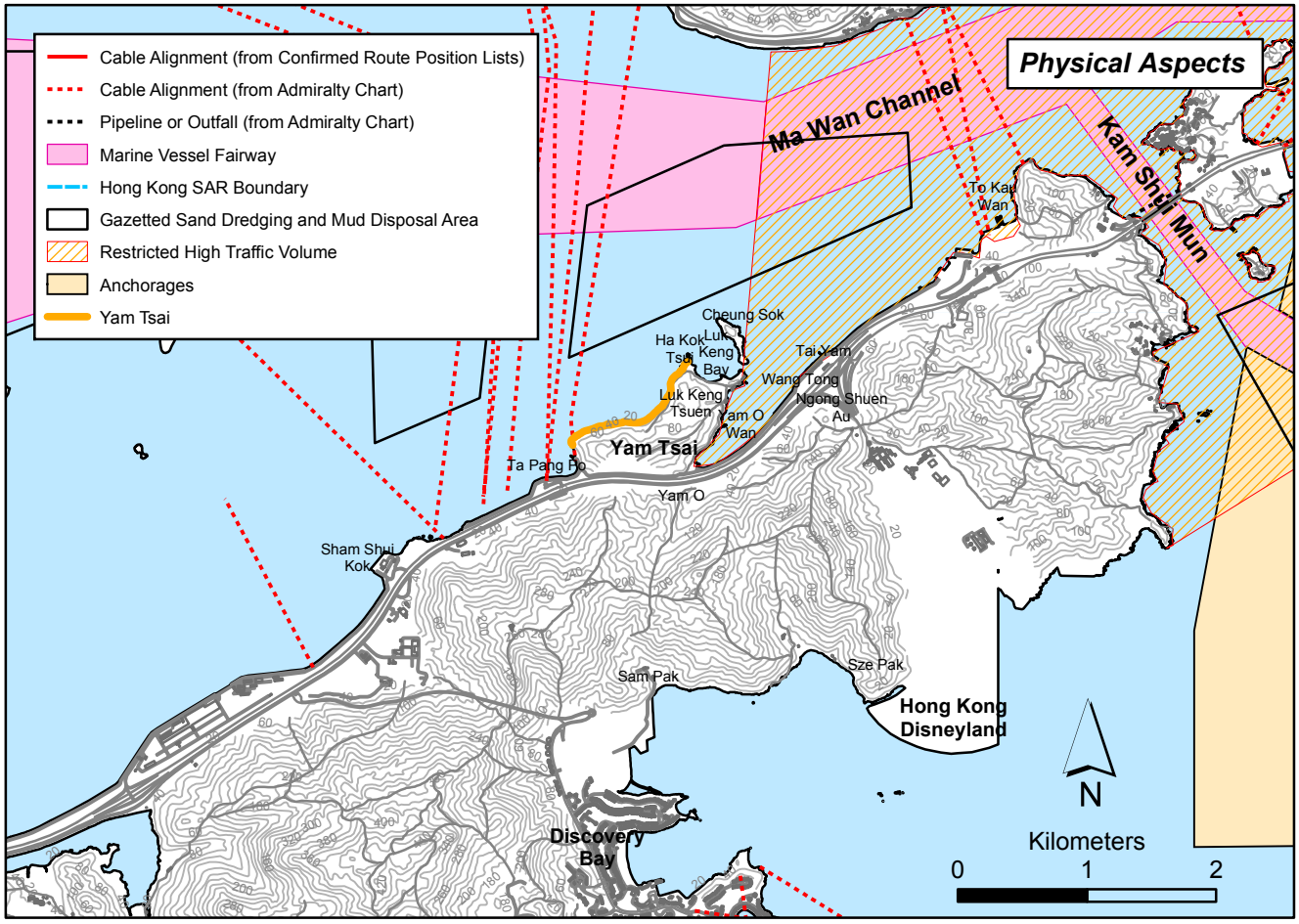
Marine Transit

10 *Exposure*: The site is located on the northern coast of Lantau which provides shelter from prevailing metocean conditions. While the site is exposed to northerly winter monsoon winds, the fetches over which waves are generated are limited. While currents in the Urmston Road channel to the north of the site may be strong, berthing at the terminal would occur in a basin away from these currents.

11 *Interference with Shipping*: Access to the site will be via the East Lamma Channel, West Harbour and Ma Wan. The site is sufficiently far from the main channel area, but would be close to the approach of the recently designated anchorages at Shan Shui Kok.

12 *Volume of Marine Traffic*: Transit to the site is assumed to be via the East Lamma Channel, Western Fairway, Ma Wan Channel. This is a long passage through the "heart" of Hong Kong harbour. While this transit is now performed regularly and safely by some of the world's largest container ships which access the ports of the Shekou peninsular, it will expose the LNG carrier to significant marine traffic activity.

A summary of the environmental, social and planning characteristics of Yam Tsai are reported in *Figure 4.30*.



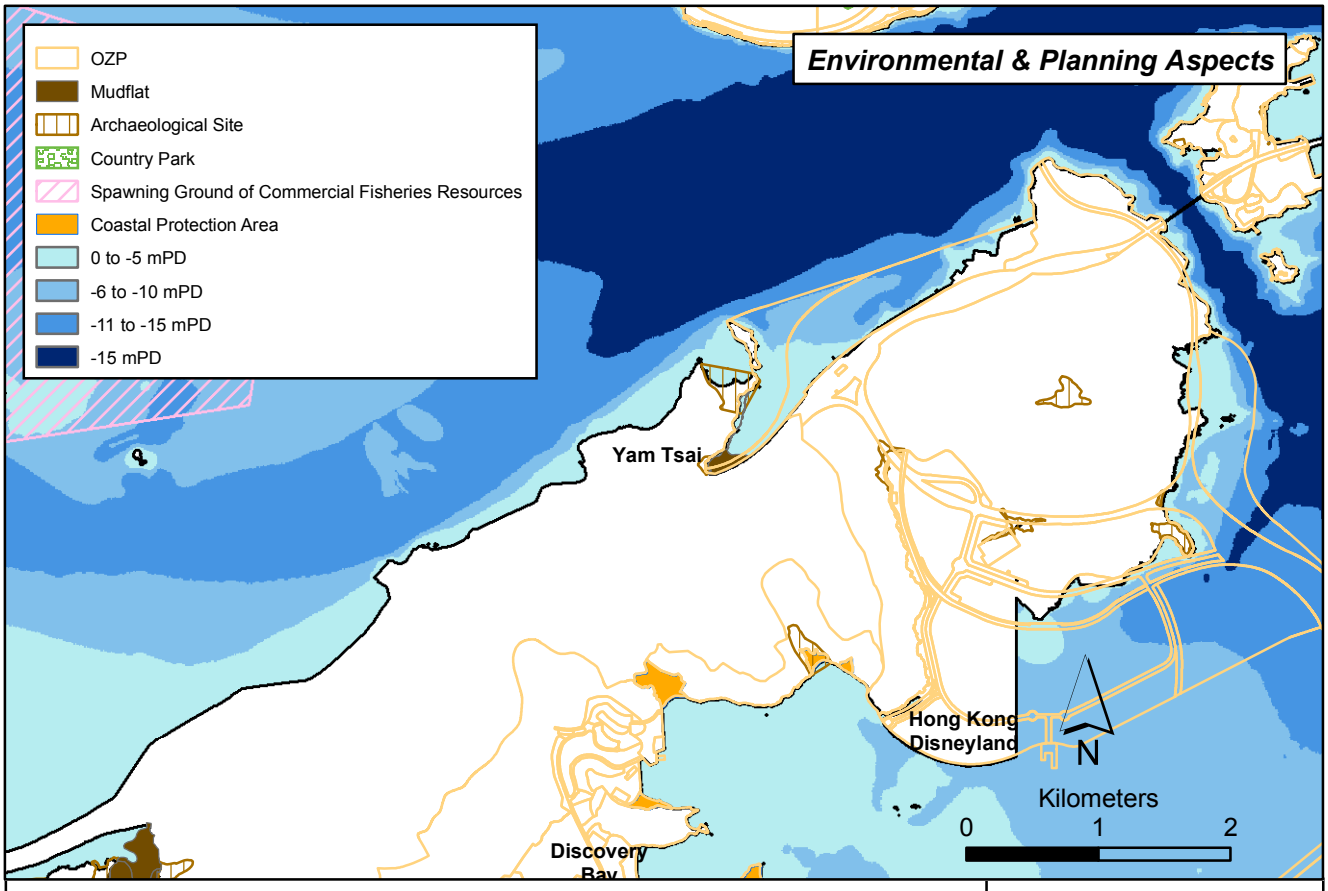


Figure 4.30

Physical, Environmental and Planning Aspects of Yam Tsai

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Conclusions

From a review of Yam Tsai's environmental, social, planning and marine transit characteristics it emerges that the site poses limited advantages for the location of the LNG terminal, namely:

- The site is relatively sheltered from prevailing metocean conditions; hence breakwaters will not be needed reducing potential environmental impacts form the marine works.

- Although the necessary land for the construction of the LNG terminal will need to be obtained form reclamation and excavation works, the coastal waters and the land potentially affected by the works are unconstrained.

In addition to the planning and permitting drawbacks identified in the Foreword of this section, the location of the LNG terminal at Yam Tsai will pose a number of potential environmental and marine transit issues, namely:

- The submarine pipeline route to BPPS will be severely constrained by the need for crossing submarine cables, pipelines and outfalls.

- Recorded presence of Indo-Pacific Humpback Dolphin (*Sousa chinensis*) in the coastal waters of Yam Tsai. It must be noted that marine waters around Yam Tsai are regarded as of low importance to the humpback dolphins.

- Land for the construction of the LNG terminal will be obtained partly from reclamation and partly from the excavation of the hillside. This will lead to the loss of natural habitat (marine and terrestrial) and to the overall change in morphology of the coast and the hillside.

- Marine Transit of the LNG carrier will be via East Lamma Channel, West Harbour, and Ma Wan.. The shipping lanes are some of the busiest in Hong Kong and there are nearby populations along the transit route. A Marine Quantitative Risk Assessment would be required to verify the acceptability of the transit route.

- The LNG terminal will be in close proximity to the Sunny Bay Disney MTR station.

Based on the above, it is deemed that the disadvantages posed by the numerous planning issues of the Yam Tsai site and its few environmental advantages do not make suitable area for the siting of the LNG terminal and will therefore not be considered as a viable candidate for further examination.

4.11.10 Conclusion

A summary of the site characteristics of the 7 sites is provided in *Table 4.19*.

Table 4.19 Summary of Site Characteristics

Location	Marine Works	Onshore works	Pipeline to Black Point	Marine Transit	Permitting Risks	Remarks
Black Point	• Extensive reclamation would be required (approx. 16 ha). • Dredging of approach channel and turning basin would require extensive dredging (approximately 2.5 x 10^6 m^3).	• Extensive onshore works would be required. The headland would be excavated and graded.	• No pipeline would be required	• Although the site is near the northern reaches of the busy Urmston Road, the approach channel and turning basins would be located sufficiently far away from the vessel fairway and would not interfere with existing shipping activities.	• The site presents no significant planning or, social issues. There are no visually sensitive receivers and thus no major objections are expected during the public notification period.	• The site is SUITABLE and will be further assessed
Lung Kwu Shung Tan	• Extensive reclamation would be required. • Rock armour would be required for the onshore coastal pipeline route to BPPS. • Dredging of approach channel and turning basin would require extensive dredging.	• Minor onshore works would be required. The site would be located on reclaimed land	• Very short onshore coastal pipeline would connect the LNG terminal to BPPS.	• As above	• The site presents no significant planning or, social issues; however the area is exposed to visually sensitive receivers: Lung Kwu Sheung Tan village and the Lung Kwu Sheung Tan beach. It is expected that local objections may be submitted during the public notification period of gazetting due to landscape and visual objections.	• The site is NOT A PREFERRED SITE and will thus not be assessed further.

Location	Marine Works	Onshore works	Pipeline to Black Point	Marine Transit	Permitting Risks	Remarks
South Soko	• Little reclamation is required (approx. 0.6 ha) • Dredging of approach channel and turning basin would require extensive dredging (approximately 1.1 x 10^5 m^3).	• Onshore works would be limited as the LNG site would be constructed on an existing concrete platform of a disused detention centre. Onshore excavation works would be needed to accommodate the tanks.	• Pipeline of approx. 40 km in length. The route presents no significant physical constraints however it would potentially interfere with *Sousa chinensis* habitat and would thus need further assessment.	• The terminal and approach channel would be located away from main shipping routes. • The approach to the site would be from the southeast away from the busy Adamasta Channel or other busy vessel fairways.	• The site presents no insurmountable planning or, social issues. There are no visually sensitive receivers.	• The site is SUITABLE and will be further assessed in Task 7
North Soko	• A cut and fill reclamation would be required to expand the existing lowland area at the centre of the island • Dredging of approach channel and turning basin would require extensive dredging. A 4 km navigation channel is required to reach deeper water.	• Extensive onshore works would be required.	• Pipeline of approx. 40 km in length and presents no significant physical constraints. However it would potentially interfere with *Sousa chinensis* habitat and would thus need further assessment.	• No significant marine transit impacts. The jetty's extension into channel between North and South Soko would not result in issues to passing traffic.	• The site presents no significant planning or, social issues. There are no visually sensitive receivers. However there is a potential need to acquire land from approximately 70 private owners, which will require assistance from the Government and South Lantau Rural Committee which will cause potential permitting delays.	• The site is NOT A PREFERRED SITE and will thus not be assessed further.

Location	Marine Works	Onshore works	Pipeline to Black Point	Marine Transit	Permitting Risks	Remarks
Peaked Hill	• Due to the small size of the island, extensive marine works and reclamation would be required to provide the 30 ha required for the site construction. • Minimal dredging would be required for the construction for the turning basin	• Extensive onshore works would be required.	• The pipeline route to BPPS is ~ 25 km and presents no significant physical. However it would potentially interfere with *Sousa chinensis* habitat and would thus need further assessment.	• Access to the site would be via Lema Channel.. The site is sufficiently far from the main channel area and the recently designated anchorages at Shan Shui Kok.	• The site presents no significant planning or, social issues. However, it would be exposed to Country Park users which may object to the development and cause permitting delays.	• The site is NOT A PREFERRED SITE and will thus not be assessed further.

Location	Marine Works	Onshore works	Pipeline to Black Point	Marine Transit	Permitting Risks	Remarks
Area 137	• No marine works are required. The site is an existing industrial site	• No onshore works are required. The site is an existing industrial site	• The pipeline route to BPPS is ~ 80 km. The route to the power station is highly constrained as a number of submarine cables are buried in the southern waters of Hong Kong Island and Lantau Island. Once passed the Soko Islands the pipeline route is largely unconstrained however it would potentially interfere with *Sousa chinensis* habitat and would thus need further assessment.	• The jetty would be in close proximity to the Tathong Shipping Channel. • LNG terminal's operations and ship transits would potentially be impacted. • A safety zone to facilitate the LNG carrier's manoeuvres and off-loading operations would encroach on the vessel fairway and would thus not be permitted in Hong Kong. • The location of the jetty exposes the moored LNG carriers and the jetty itself to potential collisions with passing ships. • A Marine Quantitative Risk Assessment (MQRA) would be required.	• Although the area has been zoned in the OZP for uses compatible with Deep Waterfront Industry, the area is visually exposed to densely populated residential areas, the closest being Siu Sai Wan which is located less than 2 km away. The site's visibility to major urban districts will lead to a high level of public interests and impacts to perceived safety of the local population. This may ultimately cause permitting delays.	• The site is SUITABLE and will be further assessed in Task 7

Location	Marine Works	Onshore works	Pipeline to Black Point	Marine Transit	Permitting Risks	Remarks
Yam Tsai	• The site would have to be formed largely by reclamation. Extensive reclamation would be required. • Minimal dredging would be required	• Extensive onshore works would be required.	• The submarine pipeline route to BPPS is < 20 km. The submarine pipeline route to BPPS is severely constrained by the need for crossing submarine cables, pipelines and outfalls. There are a number of submarine cables traversing the channel to the west of the site.	• Access to the site would be via the East Lamma Channel, West Harboure and Ma Wan. The site is sufficiently far from the main channel area, but would be close to the approach of the recently designated anchorages at Shan Shui Kok.	• Numerous planning issues have been identified (see *Section 4.9.9*)	• The site is NOT A PREFERRED SITE and will thus not be assessed further.

This initial shortlisting assessment provided the necessary support for the elimination of 4 sites. The preferred suitable sites identified for further examination were:

- South Soko,
- Black Point, and
- Area 137.

4.11.11 *Task 7 - Final Selection*

The 3 sites identified in the previous task were subjected to further detailed qualitative narrative assessment based on a suite of pre-defined environmental and technical criteria:

1. Planning and Land Use Features
2. Potential Hazard to Life Impacts (including transit route and terminal)
3. Potential Water Quality Impacts
4. Potential Terrestrial Ecological Impacts
5. Potential Marine Ecological Impacts
6. Potential Impacts to Fisheries Resources and Operations
7. Potential Impacts to Cultural Heritage Resources
8. Potential Impacts to Landscape and Visual Environment
9. Potential Impacts from Waste Disposal
10. Other potential impacts (e.g. air, noise that may be site specific)

The assessment against the above criteria was based upon the engineering items listed in the *EIAO* Study Brief (*Clauses 3.3.3* and *3.6.6*) around which the CAPCO team has sufficient conceptual detail available:

- Size and location of the facility;
- The size of reclamation;
- The extent of dredging for the navigation channel;
- The extent of natural slope cutting;
- Submarine pipeline alignment;
- Submarine power cable;
- Submarine water main;
- Construction method;
- Number and size of the fuel tanks and piers.

The potential conceptual layouts for South Soko, Black Point and Area 137, together with their main engineering parameters, are presented *Figures 4.31*, *4.36* and *4.39* respectively. It must be noted that these layouts are intended for indicative illustration purposes only and are not to be considered as the final layout that will be assessed in the EIA.

This final assessment will provide the necessary support for the election of the final 2 preferred sites, Black Point and South Soko, placing an emphasis on their determining environmental, planning and social advantages.

4.11.12 South Soko

General Layout

South Soko Island (also called Tai A Chau) is the largest (120 ha) of a small group of islands located over 4 km to the south of southwest Lantau Island and about 2 km north of the boundary of HKSAR territorial waters.

The coastline is mainly steeply sloped and rocky in nature. Notable coastal features include two bays located on the east and west side of the island (called Tung Wan and Sai Wan, respectively). The southern coast of the island has higher exposure to the prevailing ocean swells, while the northern shores (facing the neighbouring island of Siu A Chau) are more sheltered. Waters on the northern side of South Soko are affected by fairly strong tidal currents causing some seabed scouring due to the narrow channel that exists between South Soko Island and North Soko Island.

Overall, South Soko is in a remote location, although a marine traffic fairway called the Adamasta Channel passes about 2 km to the north of the island. Seabed features surrounding South Soko Island include a submarine electricity cable and one water main, which connect to Lantau Island and were installed to service the former detention centre.

The potential conceptual site layout (1) for South Soko, together with its main engineering parameters (as listed in the EIAO Study Brief), are reported in *Figure 4.31*. The layout positions the approach channel, turning basin and jetty on the southern coast of South Soko Island, away from main shipping routes and closer to the southern boundary of the HKSAR waters. This location will allow the LNG carriers to approach the LNG terminal's jetty from a relatively unconstrained route, reducing the risks of collisions of existing shipping activities with the jetty and strongly reducing potential interferences with the LNG carriers operations.

Planning and Land Use Features

South Soko is currently abandoned and although there remain some private lots on the island, there are no inhabitants. The island does not come under

(1) The potential conceptual layout presented in this report is intended for indicative illustration purposes only and is not to be considered as a the final layout that will be assessed in the EIA.

Figure 4.31

Potential Site Layout at South Soko (Indicative for Illustration only)

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any statutory plans. The island and its adjacent marine waters have been the subject of several earlier studies which have examined its potential for a variety of uses, including a Marine Park, an LNG terminal, a spa resort, a gas or coal-fired power station and as a new landfill.

Historically, Soko Island supported two small settlements of Ha Tsuen and Sheung Tsuen on the west and south sides of island. These settlements which were established in the early 20th century, consisted of about 50 dwellings according to aerial photographs available from the 1960s (aerial photograph 1963 *Figure 4.32*). During this period, terrace cultivation was evident and extensive on South Soko so that most of the lowland and some of the hillsides had been modified by agriculture and related activity. Inhabitants of these villages left the island in the 1980s due to government land resumption and construction of a Detention Centre for Vietnamese refugees.

The construction of the Detention Centre started in 1989 (aerial photograph 1989 *Figure 4.33*) and was completed in 1991. The Detention Centre occupied the flat land between Tung Wan and Sai Wan and reclaimed some of the shoreline in both of these bays. The hill slopes to the south of the Detention Centre were modified into cut slopes and all the vegetation removed. The natural shoreline of Sai Wan was modified into artificial shore with piers constructed on the northern and southern edges of this bay. The natural shore of Tung Wan was also modified into artificial shore consisting rubble mound seawall. Prior to 1997, the Detention Centre was cleared and all the building structures were demolished and abandoned.

Water Quality Conditions

The location of South Soko Island in the western waters of Hong Kong means that this site is influenced by freshwater plumes from the Pearl River, with this effect most pronounced during the summer (wet season) months. Coastal waters surrounding the South Soko can generally be characterised as having reduced salinity and relatively high turbidity levels.

South Soko Island is located in the Southern Water Control Zone (WCZ) and is also designated as a Secondary Contact Recreational Zone. Routine monitoring of waters close to the Soko is conducted by the Environmental Protection Department (1). Based on the latest available monitoring data (i.e., 2003), waters in this WCZ showed full compliance with Water Quality Objectives (WQOs) for dissolved oxygen and partial compliance for unionised ammonia, *E. coli* and total inorganic nitrogen levels. Monitoring of water quality at EPD station SM17 which is considered broadly representative of waters surrounding South Soko, has shown that between 1989 and 2003, the trend has been for increases in dissolved oxygen and lower total inorganic nitrogen levels. *E. coli* levels are considered to be low in comparison to other stations in Hong Kong.

(1) Data from EPD's water quality monitoring programme for stations in the Southern WCZ are available at: http:// www.epd.gov.hk/epd/english/environmentinhk/water/marine_quality/mwq_report.html

Not to Scale

Figure 4.32

Aerial Photograph of South Soko in 1963 - A number of inhabitants were living at South Soko and most of the lowland areas were modified as agricultural land (source : Lands Department)

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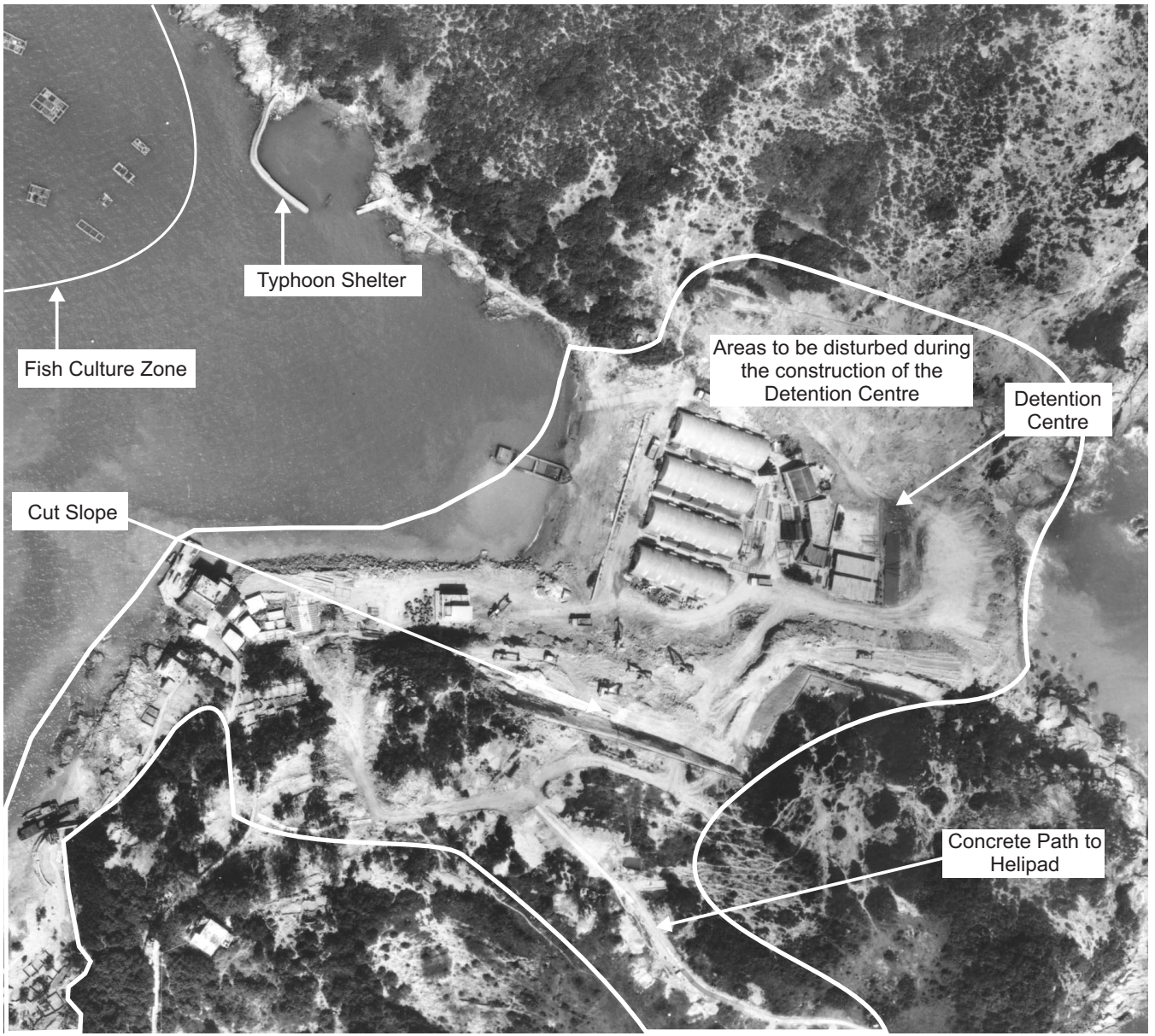

Not to Scale

Figure 4.33

Aerial Photograph of South Soko at 1989 - Detention Centre was under construction

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The marine works foreseen for the construction of the LNG terminal have the potential to impact the water quality parameters of South Soko. At this early stage of the assessment it is deemed that, the dredging of the approach channel and turning basin, as well as the offshore construction of the subsea pipeline, will have a localised detrimental effect on the water quality of South Soko and the proposed pipeline route. Further assessment is at this stage needed to confirm the magnitude and level of significance of such impacts.

Sediment Quality Conditions

Sediment quality monitoring data (1) collected at Station SS6 approximately 10km to the northeast of the Soko Islands would suggest that the site would be considered uncontaminated (Category L) as there were no exceedances of the Lower Chemical Exceedance Level (LCEL).

Terrestrial Ecological Resources

Ecology surveys previously conducted in 2004 on South Soko Island have indicated that terrestrial habitats are highly modified/disturbed due to previous developments on the island (as described above). Terrestrial habitats on the island are generally considered to have low ecological value. Shrubland was the dominant habitat type and covered most of the hillsides. Other habitats present included young woodland (derived from the plantation of exotic tree species), grassland, abandoned wet and dry agricultural land, disused reservoir, stream and disturbed area derived from the abandoned former Detention Centre and associated facilities. One of the plant species recorded during survey on the island was considered rare or protected, ie Golden Eulophia.

All faunal species recorded on the island were considered common and widespread with the exception of small number (11) of bird species of conservation interest, 8 uncommon butterflies, and one protected snake. The majority of the species were recorded in habitats that would not be directly impacted by the proposed terminal footprint. Terrestrial ecology issues associated with proposed LNG terminal and associated facilities at the South Soko site were considered to be of relatively low concern owing to the fact that much of the proposed project could be accommodated on the existing abandoned concrete platform and disturbed land.

The LNG terminal will be constructed on an existing concrete platform, thus significant direct and indirect impacts on terrestrial habitats present on South Soko are, at this early stage of the assessment, not expected to be significant.

Marine Ecological Resources

The waters and coastal areas of Southwest Lantau including the Soko Island group, which are located away from the major population centres of Hong

(1) Environmental Protection Department (2004) Marine Water Quality in Hong Kong in 2003

Kong, have been considered by some academics, government and green groups to be a general area of high ecological value including from a marine perspective. Both dolphins and porpoises are sighted in the waters of Southwest Lantau, although typically at different times of the year.

There have been a variety of studies, which have investigated the marine ecology of Southwest Lantau waters and as a result of these, in particular the AFCD-commissioned Marine Park feasibility study (1), both the coastal waters off Southwest Lantau Island and the waters around the Soko Island Group have been proposed for designation as Marine Parks. Recently gathered information on the West Lantau area would also indicate high ecological value. It is important to note that there are significant spatial variations in the ecological characteristics within this large area.

Of the two marine cetacean species (Indo-Pacific Humpback Dolphin, *Sousa chinensis;* and Finless Porpoise, *Neophocaena phocaenoides*) that are resident in Hong Kong waters, both are recorded in South Lantau waters, although their distribution and abundance in these waters varies by season over the year.

Based on Agriculture, Fisheries and Conservation Department (AFCD) monitoring data (1995-2006), dolphin numbers in South Lantau waters peak in summer and are lowest in spring. Although dolphins have been sighted in waters close to South Soko, monitoring records indicate this area is not highly utilised. In comparison to neighbouring waters, dolphin usage of waters around South Soko is low.

Finless Porpoise are also recorded in South Lantau waters, including in waters close to South Soko. AFCD monitoring data indicate that utilisation of these waters by Finless Porpoises is highly seasonal. Sightings of Finless Porpoises are recorded in South Lantau waters in winter and spring. In contrast, these animals are largely absent from these waters in summer and autumn. While South Lantau waters are frequented by Finless Porpoises on a seasonal basis, sightings are most concentrated in the neighbouring waters around the Po Toi Islands. Although waters close to South Soko may be frequented by Finless Porpoises, these waters are of lower use in comparison to neighbouring Hong Kong waters to the east.

In addition to the AFCD data set (1995 – 2006), a recent extensive programme of vessel-based surveys has been conducted. These surveys have provided a detailed overview of dolphin utilisation of Hong Kong western waters spanning South West Lantau, West Lantau, North West Lantau and Deep Bay areas. During field surveys, dolphins were observed throughout all the surveyed areas except directly south of the Sha Chau/ Lung Kwu Chau Marine Park and the very northern end of the Deep Bay survey area.

Deep Bay has relatively low densities (0.08 - 0.23 dolphins km^{-2}) and low estimates of abundance (<10 dolphins). As such it appears that dolphins use

(1) HKIEd 1999. Study on the Suitability of South West Lantau to be Established as Marine Park. Submitted to AFCD.

the mouth of Deep Bay at a low level throughout the year. In contrast, West Lantau had highest dolphin densities (1.71 – 2.81 dolphins km^{-2}) and comparatively higher abundance (47 - 78) of dolphins. It was evident that dolphins use this area as part of their habitat in all seasons. Southwest Lantau had lower levels of dolphin density (0.10 - 0.44 dolphins km^{-2}) and abundance (26 - 29 dolphins) than West Lantau but higher than Deep Bay.

Finless Porpoises were only seen in Southwest Lantau and estimates of abundance (0 - 15 porpoises) and density (<0.01 - 0.17 porpoises km^{-2}) were low for all seasons.

Surveys (1) conducted at the Soko Islands indicate that this coast supports sparse cover of isolated and scattered hard corals. Most species found are common in Hong Kong waters, with the exception of the False Pillow Coral, *Pseudosiderastrea tayami* found in an isolated location at the southern side of Tai A Chau. This False Pillow Coral is known to occur only at isolated locations of Lamma Island and South Soko. Soft corals and gorgonian seawhips were also recorded from this coast.

The marine works foreseen for the construction of the LNG terminal have the potential to impact the marine ecology of South Soko. At this early stage of the assessment, it is deemed that, due to the reduced extent of nearshore marine works, the sensitive nearshore habitat will not be significantly impacted by construction activities. However, as a result of the dredging of the approach channel and turning basin, as well as the offshore construction of the subsea pipeline, potential impacts may arise. Further assessment is at this stage needed to determine the magnitude and level of significance of such impacts.

Fisheries Resources and Operations

The South Soko Island is at the western part of both a spawning and nursery area for commercial fisheries resources (2). The spawning ground extends east through to the Po Toi and Ninepin Islands whereas the nursery area extends from the boundary of HKSAR waters by the Soko Islands to southern Lamma.

It must be noted that a recent fisheries survey (*Part 2 of the EIA - Annex 10*) shows an overall low density of fish larvae for the waters of South Soko and a family composition dominated by non-commercially important fish (i.e., Clupeiform, Engraulidae, and Ambassidae). Furthermore the survey concludes that there is no statistically significant difference in fish density and eggs density between the non-spawning/non-nursing grounds of western Lantau and the spawning/nursing grounds of southern Lantau and South

(1) Binnie Consultants Ltd (1995) Report on Underwater Dive Surveys (October 1991 – November 1994) Volumes I & II. Report commissioned by Civil Engineering Department.
(2) ERM (1998) Fisheries Resources and Operations in Hong Kong Waters. Report commissioned by AFCD.

Soko allowing for a potential reinterpretation of the sensitivity and extent of the identified nursery and spawning grounds.

The scale of capture fisheries operations in around the Soko Islands is considered to be moderate-high compared to other fishing grounds in Hong Kong (1). Adult fish production for these waters is considered moderate, whereas production of fish fry (*i.e.*, collection of fish fry for grow out in FCZs) for these waters is low. There are no Fish Culture Zones in the vicinity of South Soko.

In view of the overall moderate level of importance of the commercial fisheries activities at South Soko, it is expected that the potential construction and operation impacts of the LNG terminal on the local fisheries will not be significant.

Cultural Heritage Resources

South Soko is the location of the Tai A Chau Archaeological Site. This archaeological site has been impacted significantly in the past by the construction and later demolition of the Detention Centre. The resultant changes in the islands' terrain are expected to have disturbed the soil strata containing archaeological deposits that were previously identified on the isthmus between Tung Wan and Sai Wan. This area is also the location for Tai A Chau Tin Hau Temple (approximately 5m wide by 3m high). Built in 1828 the temple was renovated in 2000 and is well maintained and regularly visited. The temple is not managed by the Chinese Temples Committee and is likely to be maintained by private individuals from the fishing community.

At this early stage of the assessment it is expected that the construction of the LNG terminal at South Soko may have potential detrimental effects on the Tai A Chau Archaeological Site. However, it must be noted that, due to the altered and disturbed nature of the archaeological site, the additional impacts associated with the development of the LNG terminal will be potentially not significant.

Landscape and Visual Conditions

In terms of landscape, South Soko has a varied form and shape and its terrain is moderate with broad convex hillcrests and a few rugged and steep hill slopes with rocky outcrops. There are four main rises, two on the northern headland and two on the south mainland. The flat low land area of the island is a concrete platform surrounded by engineered slopes. Despite previous disturbance on the island, landscape quality is relatively high due to varied island landscape character and the relatively natural appearance of the majority of the island.

(1) Agriculture, Fisheries and Conservation Department (2003) Port Surveys 2001/2002

The siting of the LNG terminal on the island will potentially have a significant negative impact on the existing Landscape Character of South Soko island, and to a lesser extent, the Soko Islands as a whole. However, this impact will only be apparent when the islands are viewed from relatively close proximity (<1,260m).

As the Visually Sensitive Receivers (VSRs) within this distance are located in ocean areas, or from other islands in the Soko chain, the impact is greatly reduced as all visitors will experience this impact from marine vessels, or when visiting the Soko Islands. No VSRs located in residential areas, on public roads, or in publicly accessible lookouts or Country Parks will experience this impact on the Landscape Character (*Figure 4.34)*.

4.11.13 Black Point

General Layout

The Black Point site is adjacent to BPPS and borders the northern reaches of the Urmston Road which provides deepwater access to the site. To the northeast of the site lies Deep Bay where the waters are consistently shallow, often less than –5 mPD. To the west of the site, across Urmston Road, lies the route of the Tonggu Waterway Project, which is a proposed shipping channel, intended to be dredged to a depth of –15 mPD. The site is in a relatively sheltered location in terms of wave exposure (*Figure 4.35*).

The major development that has occurred at Black Point is the construction of the Black Point Power Station (the first natural gas-fired plant in Hong Kong), which is located on the northern side of the headland.

The potential conceptual site layout (1) for Black Point, together with its main engineering parameters (as listed in the EIAO Study Brief), are reported in *Figure 4.36*. The layout positions the approach channel, turning basin and jetty near the northern reaches of the Urmston Road. The distance that separates these from the vessel fairway is however deemed sufficient to avoid potential interferences of the existing shipping activities with the LNG carriers operations. No significant risks of collision of vessels with the jetty or the LNG carriers during approach/berthing and off-loading activities is foreseen.

It must however be noted that the transit route of the LNG carriers to the site is assumed to be via the East Lamma Channel, Western Fairway, Ma Wan Channel and the Urmston Rd Channel which will expose the LNG carrier to significant marine traffic activity and thus potential collision risks.

(1) The potential conceptual layout presented in this report is intended for indicative illustration purposes only and is not to be considered as a the final layout that will be assessed in the EIA.

EXISTING VIEW LOOKING SOUTH EAST TOWARDS THE DEVELOPMENT FROM CHEUNG SHA BEACH LOWER

WIREFRAME OF THE PROPOSED DEVELOPMENT AND THE DIGITAL TERRAIN MODEL COMPOSITED ONTO THE PHOTOGRAPH

VIEW DISPLAYING THE 3D MODEL OF THE PROPOSED DEVELOPMENT

Figure 4.34

Landscape Visual Assessment - South Soko
View from Cheung Sha Beach

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DATE: 23/06/2006

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Figure 4.35

Aerial Photo of Black Point Headland

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Date: 22/06/2006

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BD REF. NO.

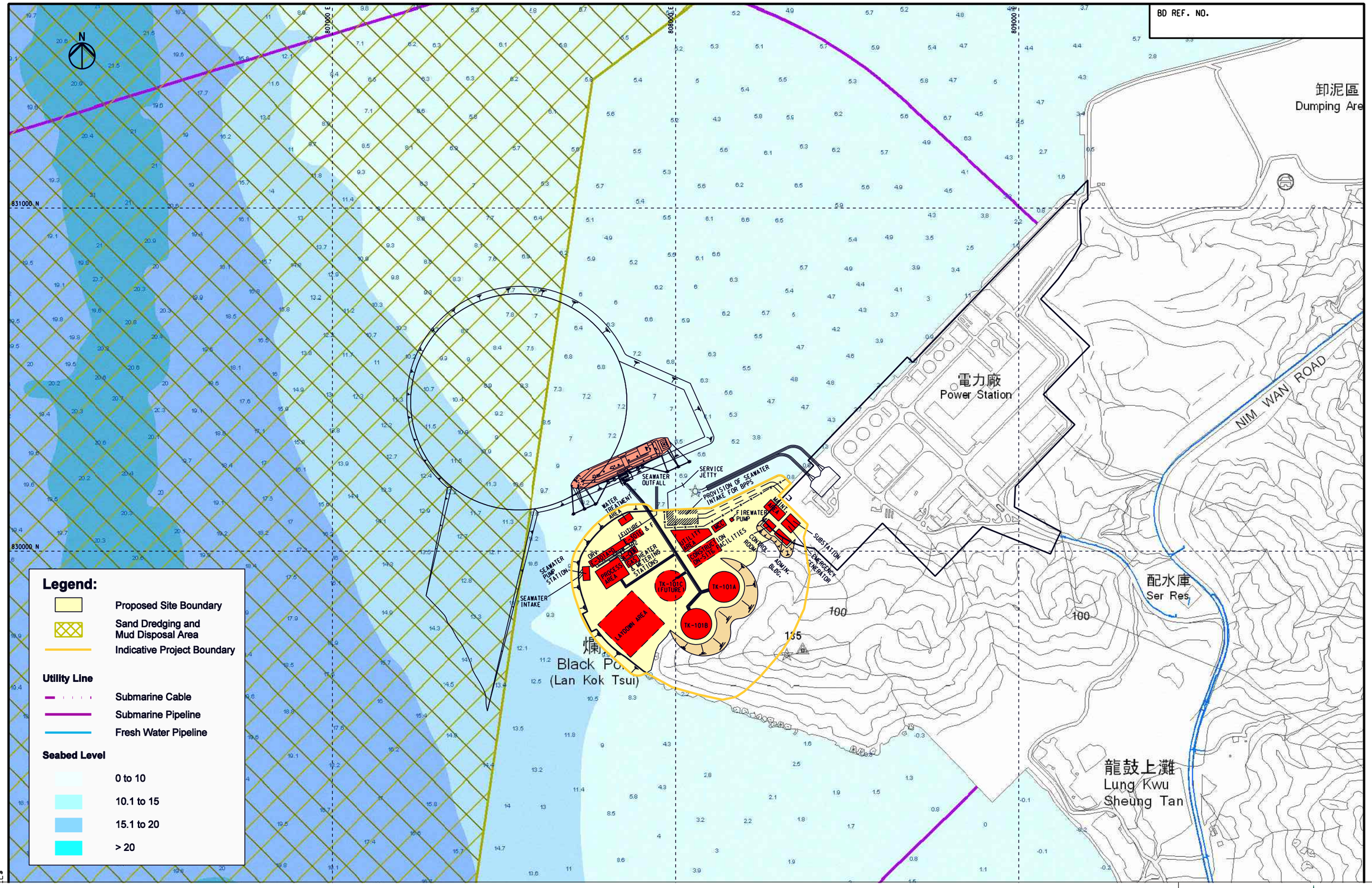

Figure 4.36

Potential Site Layout at Black Point (Indicative for Illustration only)

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(24443/BP/SK/001_c1)
DATE: 29/09/2006

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Planning and Landuse

Black Point does not fall under any statutory plans. The site has been studied in the past for the development of the Tuen Mun Port. As part of this study, a recommended plan was prepared including locations for PHIs. The plan included provisions for LPG and other hydrocarbon storage. There are no private lots within the area proposed for locating the LNG terminal. The closest developments to the site, other than the BPPS, are a mixture of small scale industrial uses at Lung Kwu Sheung Tan (0.8 km from site) and the closest villages are located at Lung Kwu Tan (> 2 km from site) where the population is around 1,800.

As mentioned above, studies have been conducted to assess the future development of the area for a port. Additional studies on other uses include the potential siting of a Waste-to-Energy Facility, Sludge Treatment Facility and Animal Carcass Treatment Facility.

Water Quality Conditions

The quality of the surrounding marine waters is dominated by the influence of discharges from the Pearl River. High fluctuations in the background levels of suspended solids (1 – 100 mg L^{-1}) are known to occur throughout both seasons and tidal cycles.

Black Point waters are located in the Deep Bay Water Quality Control Zone. Waters in the northern portion of the site are also part of a Secondary Contact Recreation Zone that extends into the western reaches of Deep Bay. Based on the latest water quality monitoring data (1), inner Deep Bay was highly polluted and had the highest levels of nitrogen of any marine waters in Hong Kong and low dissolved oxygen and did not comply with Water Quality Objectives. At the outer Deep Bay where Black Point is located, waters are further from pollution sources. Water quality in these waters as indicated by monitoring station DM5, comply with Water Quality Objectives for ammonia nitrogen, total inorganic nitrogen and were generally compliant for Dissolved Oxygen.

From a review of the engineering parameters listed in *Figure 4.36*, it emerges that the marine works necessary for the construction of the LNG terminal at Black Point would entail a large reclamation area of approximately 16 ha and the dredging of both approach channel and turning basin. As a result, it is expected that the overall impacts to the water quality of Black Point, though primarily localised to the marine works areas (reclamation and dredging), will impact water quality parameters both in nearshore and offshore areas.

(1) Environmental Protection Department (2004) Water Quality in Hong Kong in 2003

Sediment Quality Conditions

Some marine sediments in the vicinity of the site are known to have levels of Arsenic that exceed the Lower Chemical Exceedance Level, which could indicate contamination, and the requirement for confined marine disposal.

Terrestrial Ecological Resources

Black Point is mainly composed of shrubland habitat interspersed with grassland. The densest and tallest shrubland vegetation occurs on the northern slopes of the headland. The southern side of the headland is covered with grassland and scattered rocky boulders and outcrops. The vegetation is typical of granite hill slopes in Hong Kong and similar vegetation is well-represented in the Hong Kong Country Parks.

Land for the construction of the LNG terminal at Black Point will be obtained partly from the excavation of the hillside (*Figure 4.36*). This will lead to the direct loss of natural habitat (marine and terrestrial) and will potentially lead to an increase of several detrimental effects on the headland's fauna and flora by increasing the level of fragmentation of the natural habitats. It must however be noted that the absence of a subsea interconnecting pipeline partially compensates the greater magnitude of water quality impacts associated with the reclamation works.

Marine Ecological Resources

The site at Black Point is located at the outer limit of Deep Bay. While Deep Bay supports sensitive seagrass beds, mangroves and Horseshoe Crab nursery grounds, the Black Point site is relatively remote from these areas. The closest mudflat and mangrove (i.e., Ha Pak Nai) is located 4km away to the north. The coastline at Black Point has been modified in the past as a result of the reclamation for the Black Point Power Station, the neighbouring ash lagoons and the WENT Landfill. The adjoining coast, where the LNG terminal would be located on reclaimed land, presently consists of natural rocky shore.

The composition of benthic fauna inhabiting subtidal soft bottom sediments off Black Point comprise estuarine species reflecting the pronounced influence of freshwater discharges from the Pearl River. Species richness of fauna is medium and diversity is low compared to other areas in Hong Kong (1).

Despite the ever-present marine traffic in the Urmston Road Channel, the waters off the west New Territories, including Black Point, are a habitat for the Indo-Pacific Humpback Dolphin (*Sousa chinensis*). Dolphin monitoring data has indicated the waters south of Black Point support a high abundance of dolphins and the waters are utilised by these animals throughout the year.

(1) CityU Professional Services (2003) Consultancy Study on Marine Benthic Communities in Hong Kong. Final Summer Field Survey Report. Commissioned by Agriculture Fisheries and Conservation Department.

Approximately 4km to the south west of Black Point is the designated Sha Chau and Lung Kwu Chau Marine Park.

In addition to the AFCD data set (1995 – 2004), a recent extensive programme of vessel-based surveys has been conducted. The survey has provided a detailed updated overview of dolphin utilisation of Hong Kong western waters spanning South West Lantau, West Lantau, North West Lantau and Deep Bay areas. During the field survey, dolphins were observed throughout all the surveyed areas except directly south of the Sha Chau/ Lung Kwu Chau Marine Park and the very northern end of the Deep Bay survey area.

The results of the survey showed that Deep Bay has relatively low densities (0.08 – 0.23 dolphins km^{-2}) and low estimates of abundance (<10 dolphins). As such it appears that dolphins use the mouth of Deep Bay at a low level throughout the year. In contrast, West Lantau had highest dolphin densities (1.71 – 2.81 dolphins km^{-2}) and comparatively higher abundance (47-78) of dolphins. It was evident that dolphins use this area as part of their habitat in all seasons.

The extensive reclamation foreseen for the construction of the LNG terminal at Black Point (*Figure 4.36*) will lead to the loss of natural habitat and the alteration of water quality parameters (e.g. suspended sediments) that have potential detrimental effects on the marine organisms of Black Point's coastal waters. Due to the overall low ecological importance of the marine habitats identified at and around Black Point, it is however expected at this early stage of the assessment that the overall impacts as a result of the construction and operation of the LNG terminal will not be significant. Furthermore, with respect to South Soko and Area 137, the absence of a subsea interconnecting pipeline (and its associated impacts on marine ecology), partially compensates the greater magnitude of marine impacts associated with the reclamation works.

Fisheries Resources and Operations

The waters beyond 3km to the south of Black Point are reported to be a spawning ground for commercial fisheries and hang trawl fishermen are particularly dependent on these waters for their catches. Overall, in comparison to other Hong Kong waters, capture fishing operations in terms of the number of vessels operating in the waters adjacent to Black Point are, according to AFCD's data, generally low. Adult fish production in these waters was reported to be relatively low and these waters were not known for fish fry production. The dollar value of catches from these waters was reported as low in comparison to other fishing grounds in Hong Kong.

In view of the overall low level of importance of the commercial fisheries activities at Black Point, it is expected that the potential construction and operation impacts of the LNG terminal on the local fisheries will not be significant.

Cultural Heritage Resources

The site of the Black Point Power Station was formerly the Yung Long Archaeological Site. This archaeological site was rescue excavated during the construction of the Black Point Power Station. Although the hillsides of the site for the LNG terminal are part of the area of the former archaeological site it is not expected that significant archaeological deposits remain.

There are some graves in the vicinity of the site but a review of information on declared monuments and recognised sites of archaeological significance indicated there were no declared or deemed monuments, graded buildings, graves or significant archaeological deposits within the Black Point site. Owing to historic use of waters around the Pearl River estuary, marine sediments may have potential to contain artefacts of marine archaeological significance and would require further investigation.

At this early stage of the assessment it is expected that the potential impacts associated with the construction of the LNG terminal at Black Point will have no significant impact on sites of cultural, historical/heritage or archaeological importance.

Landscape and Visual Conditions

Owing to the presence of the Black Point Power Station and current industrial usage of areas adjacent to Black Point, this site is generally considered to be of low landscape quality, which could accommodate additional industrial facilities such as the LNG terminal. The proposed terminal will only be visible from a limited number of locations, and these impacts will only be significant at close proximity to the Black Point Terminal as at distances of greater than 1260m, the LNG terminal will not have a substantial visual impact.

The installation of the LNG terminal will potentially have a moderate to significant negative impact on the existing Landscape Character of Black Point, particularly the hill slope area. However, this impact will only be apparent when the site is viewed from relatively close proximity. As most of the Visually Sensitive Receivers (VSRs) are located in ocean areas, the impact is greatly reduced as all visitors will experience this impact from marine vessels. No VSRs located in residential areas, on public roads, or in publicly accessible lookouts or Country Parks will experience this impact on the Landscape Character.

Therefore whilst the impact on the Landscape Character of Black Point is moderate - significant, it is considered acceptable, as there is a low number of VSRs affected (*Figure 4.37*).

EXISTING VIEW LOOKING NORTH EAST TOWARDS THE DEVELOPMENT FROM LUNG TSAI BEACH

WIREFRAME VIEW OF THE PROPOSED DEVELOPMENT AND THE DIGITAL TERRAIN MODEL COMPOSITED ONTO THE PHOTOGRAPH

VIEW DISPLAYING THE 3D MODEL OF THE PROPOSED DEVELOPMENT

Figure 4.37

Landscape Visual Assessment - Black Point
View from Lung Tsai Beach

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4.11.14 *Area 137 - Tseung Kwan O*

General Layout

Located on a site that has recently been reclaimed for special industrial use, this site lies on the opposite shore to Cape Collinson and Chai Wan. The site is within close proximity to the Tathong Channel and a restricted area of low marine traffic volume. There are a number of submarine cables buried nearby and these generally pass south to the boundary of HKSAR waters. Area 137 (Fat Tong O) is located to the southern side of the new town development of Tseung Kwan O (Junk Bay).

Area 137 occupies an area of approximately 104 hectares. This reclamation site has served as a public filling area since January 1997 to receive public fill generated from the construction industry. Reclamation works in the northern part of Area 137 were completed in 2004 (*Figure 4.38*).

The potential conceptual site layout (1) for Area 137, together with its main engineering parameters (as listed in the EIAO Study Brief), are reported in *Figure 4.39*. The jetty has been located on the western limit of the site facing the Tathong Shipping Channel.

This layout has been preferred to the location of the jetty on the southern limit of the site within Joss House Bay (Tai Miu Wan) due to potential fisheries and marine works issue. Due to the shallow waters that characterise the bay, extensive dredging would be required to allow the safe approach and manoeuvrability of the LNG carriers. The proximity of the fish culture zones at Tung Lung Chau to the extensive marine works would potentially lead to detrimental effects on the fish cultures and thus cause potential issues with the fishing community on the island.

Furthermore, the northern portion of Joss House Bay (just south of the site) has been identified on the admiralty charts as a *Foul Area* in which anchoring or trawling should be avoided. Marine works within Joss House Bay may be feasible; however they may potentially be constrained due to the presence of sunken/abandoned facilities or objects.

It must however be noted that, although the selected layout avoids the potential issues highlighted above for Joss House Bay, it will potentially pose marine operation/collision risk issues due its proximity to the Traffic Separation Scheme of the Tathong vessel fairway, increasing the potential impacts of passing vessels on the LNG carriers manoeuvres, as well as exposing the jetty and the LNG carrier to potential collision risks with existing shipping activities.

(1) The potential conceptual layout presented in this report is intended for indicative illustration purposes only and is not to be considered as a the final layout that will be assessed in the EIA.

N

Not to Scale

Figure 4.38

Aerial Photograph of Area 137

Environmental Resources Management

ERM

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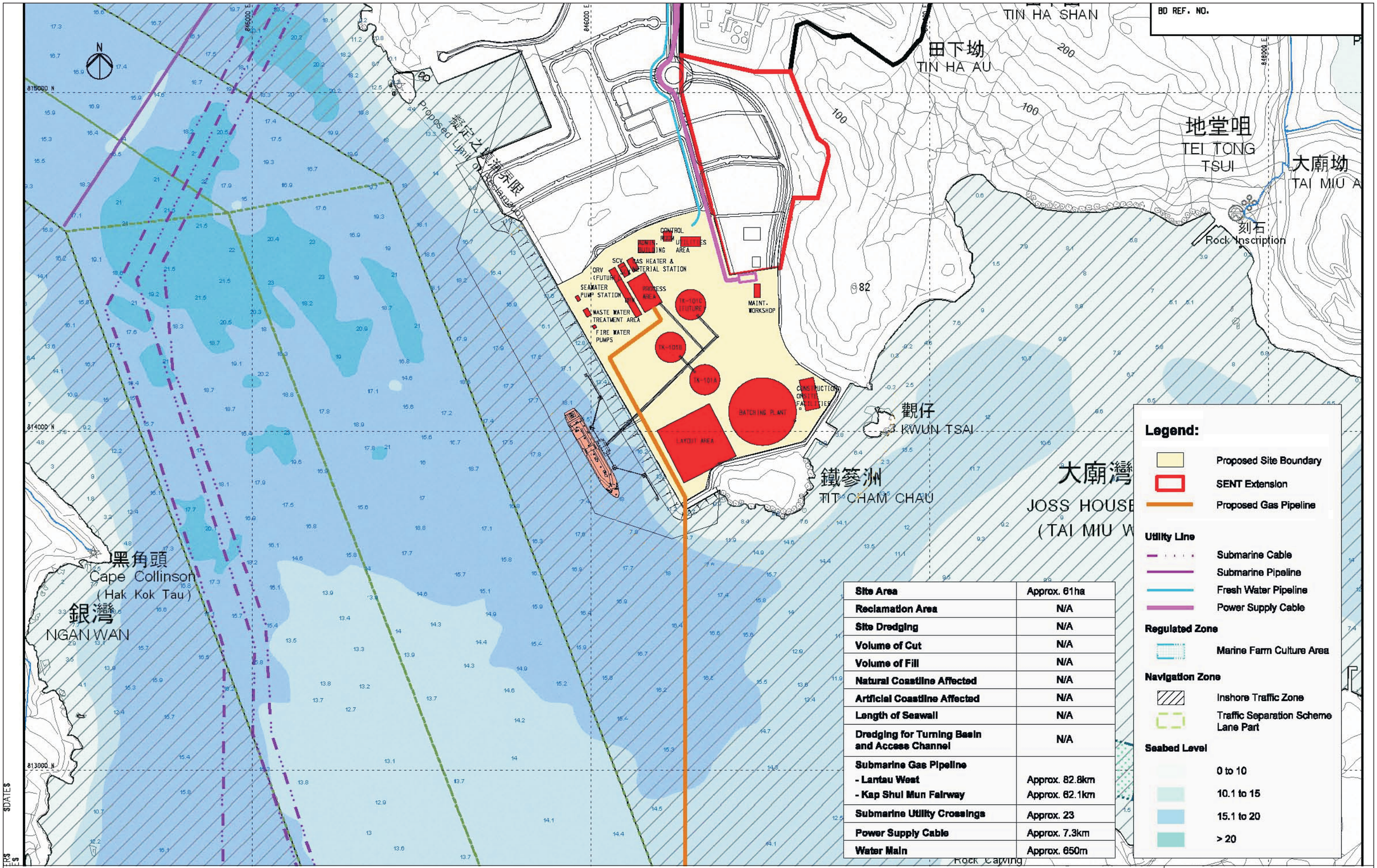

Legend:

- Proposed Site Boundary
- SENT Extension
- Proposed Gas Pipeline

Utility Line

- Submarine Cable
- Submarine Pipeline
- Fresh Water Pipeline
- Power Supply Cable

Regulated Zone

- Marine Farm Culture Area

Navigation Zone

- Inshore Traffic Zone
- Traffic Separation Scheme Lane Part

Seabed Level

- 0 to 10
- 10.1 to 15
- 15.1 to 20
- > 20

Site Area	Approx. 61ha
Reclamation Area	N/A
Site Dredging	N/A
Volume of Cut	N/A
Volume of Fill	N/A
Natural Coastline Affected	N/A
Artificial Coastline Affected	N/A
Length of Seawall	N/A
Dredging for Turning Basin and Access Channel	N/A
Submarine Gas Pipeline	
- Lantau West	Approx. 82.8km
- Kap Shui Mun Fairway	Approx. 62.1km
Submarine Utility Crossings	Approx. 23
Power Supply Cable	Approx. 7.3km
Water Main	Approx. 650m

Figure 4.39

Potential Site Layout at Area 137
(Indicative for Illustration only)

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In order to reduce the frequency of existing shipping activities interfering with the LNG carriers operations (approach, manoeuvre, berthing and unloading), international maritime practices, as well as standard operators procedures, set a safety zone around the terminal/approach channel/turning basin to allow the LNG carriers to manoeuvre safely. This however is deemed not feasible for the Area 137 site as, due to the proximity of the site to the Tathong channel, the safety zone would encroach on one of Hong Kong's principal vessel fairways greatly impacting its shipping activities. For this reason shipping safety zones are generally not permitted in Hong Kong waters.

Planning and Landuse

Area 137 is zoned "Other Specified Uses" annotated for "Deep Waterfront Industry" on the Approved Tseung Kwan O Outline Zoning Plan (OZP) No. S/TKO/15. According to the statutory planning intention, this zone is intended primarily for special industries which require marine access, access to deep water berths or water frontage. Industries to be accommodated within this zone are usually capital intensive, land intensive and cannot be accommodated in conventional industrial buildings.

According to the Definition of Terms Used in Statutory Plans, there is no provision within the existing land use zone for the LNG Terminal (either as of right or upon application to the Town Planning Board). Thus a rezoning request would be required which entails a statutory procedure under Section 12A of the Town Planning Ordinance with potential statutory opportunities for public comment and associated planning delays/risks. As the site is relatively close to major urban areas and clearly visible from Hong Kong Island East and parts of Tseung Kwan O, there is potential for significant public objections to slow down the process.

Presently there are several planning intentions for Area 137 which can be referred back to a number of strategic planning documents including:

- Port and Airport Development Strategy – Strategy Statement No. 5 – Tseung Kwan O Port Development which sets out the requirements to be met by the proposed port facilities in TKO

- Territorial Development Strategy Review (TDSR) which identified Area 137 as a Special Industrial Zone for various port-related uses that require deep water for the delivery of bulk products

Existing land uses in the Tseung Kwan O area located within 2 km of the site are mainly industrial in nature. Tseung Kwan O Industrial Estate, Fat Tong Chau (Junk Island) and the South East New Territories (SENT) Landfill are located to the north of the site. The TVB Broadcast and Production Centre is located adjacent to the northern boundary of the site. To the east of the site is the hillside along the eastern boundary of Clear Water Bay Country Park.

Existing residential developments and schools on the New Territories side are located in excess of 3 km of the site, with the nearest existing residential development, Oscar By The Sea (OBS), located 3.2 km from the boundary of the site (to the North). Planned residential developments in Area 85 (approx. 10,000 people) and Area 86 (approx 57,000 people) are located approximately 2.0 km to the North of the site. The first phases of these planned developments are anticipated to have population intake in 2007/8, according to information provided by Planning Department. On the Hong Kong Island side, across the Tathong Channel, Siu Sai Wan is located less than 2 km from the site with a population of 35,000 and Chai Wan at between 2 and 3 km from the site with a population of 111,400 (*Figure 4.40*).

Area 137 is not located within close proximity to residential developments. However, it is much more visible than the other two potentially eligible sites and closer to major urban districts thus having more public interests that are directly affected by the proposal and raising the site's level of sensitivity from a planning perspective. Major viewpoints would be from Siu Sai Wan, Shek O Back Beach (Rocky Bay), Shek O Road and Devils Peak (Tseung Kwan O) and the visual impacts on these will be assessed in the following section *Visual and Landscape Conditions*.

Water Quality Conditions

Waters off Tseung Kwan O are located in the Eastern Buffer Control Zone. These waters are not markedly affected by Pearl River discharges and are dominated by the inflow of oceanic waters from the east. Routine monitoring of water quality in Junk Bay indicates that waters fully complied with Water Quality Objectives for dissolved oxygen, total inorganic nitrogen and unionised ammonia in 2003. Compared to previous years, the latest available data indicate substantial improvements in water quality in 2003. These waters have experienced reductions in *E. coli* and nutrients (nitrogen and phosphorus) as a result of the diversion of major pollution discharges from outfalls in the area to Stonecutter's Island Sewage Treatment Works.

No significant marine works are foreseen for the construction of the LNG terminal, thus the potential impacts on the water quality parameters of Area 137's coastal waters are expected to be acceptable. However, due to the remoteness of Area 137 from BPPS, the extent of the impacts on water quality as a result of the interconnecting pipeline's construction activities will potentially be significant.

Sediment Quality Conditions

Routine monitoring of sediment quality in the vicinity of the Area 137 site at Station ES4, located approximately 2km to the west of Area 137, has indicated that coppers levels exceed the Lower Chemical Exceedance Level (LCEL), while silver levels exceed the Upper Chemical Exceedance Level (UCEL), which could indicate contamination, and the requirement for confined marine disposal.

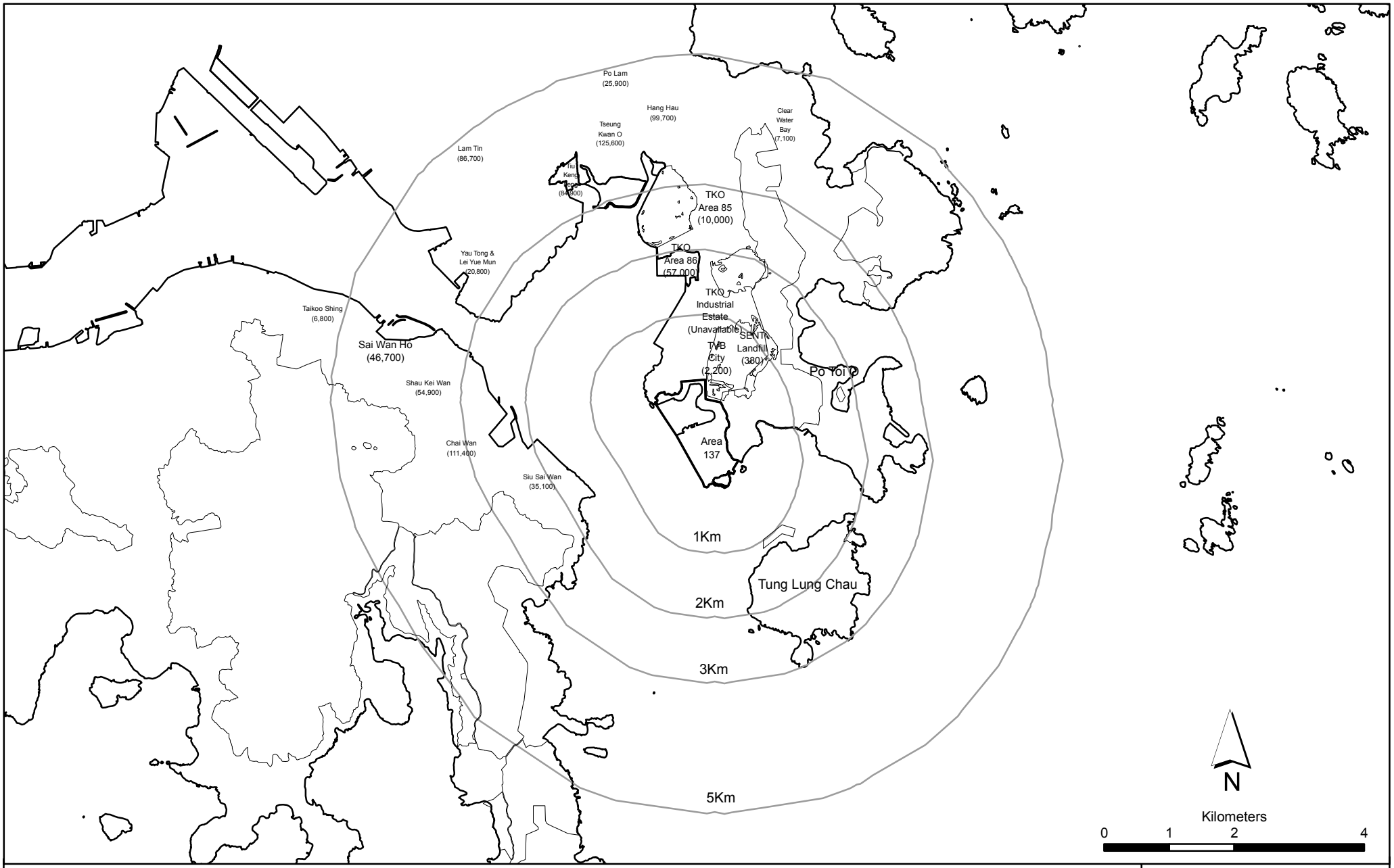

Figure 4.40

Population within 5 km of Tseung Kwan O, Area 137

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Terrestrial Ecological Resources

The Tseung Kwan O site is formed by recently reclaimed land and is therefore considered to be of no particular ecological value. Nevertheless the eastern side of Area 137 is bounded by the Clear Water Bay Country Park.

The LNG terminal will be constructed on an existing industrial site, thus significant direct and indirect impacts on terrestrial habitats present in and around Area 137 are not expected to be significant.

Marine Ecological Resources

Neither Indo-Pacific Humpback dolphins (*Sousa chinensis*) nor Finless Porpoises (*Neophocaena phocaenoides*) have been recorded in the vicinity of the Tseung Kwan O site. The nearest sighting of a Finless Porpoise was 2km south of Tung Lung Chau.

As the Tseung Kwan O site consists of newly reclaimed land it is considered that this coast is unlikely to have corals of particular ecological value. A recent study (1) on Tseung Kwan O indicated low abundance and diversity of corals on natural coasts in the bay including Junk Island, while moderate coral cover and low diversity of hard corals was recorded in East Joss House Bay and Tung Lung Chau. The west coast of Junk Bay consisting natural coast was reported as having sparsely scattered hard coral cover of low diversity. Areas of abundant soft corals were reported at the southwest corner of Junk Bay and Ngan Wan on the eastern coast of Hong Kong Island.

No significant marine works are foreseen for the construction of the LNG terminal, thus the potential impacts on the marine ecological resources of Area 137 are expected to be acceptable. However, the overall magnitude of marine ecology impacts along the proposed pipeline route from Area 137 to BPPS will potentially be significant due to the length of the pipeline (>80 km) and the level/number of physical constraints present. The first ~40 km of the pipeline route from Area 137 to the Soko Islands is characterised by the presence of numerous submarine cables which have been laid in the southern waters of Hong Kong Island and Lantau Island. The elevated number of cable crossings associated with this first section of the Area 137 – BPPS pipeline route will increase the potential impacts to the marine environment as installation time will be increased. Once the pipeline reaches the Soko Islands, the remaining ~40 km to BPPS is largely unconstrained and aligned with the South Soko-BPPS route.

Fisheries Resources and Operations

Capture fisheries operations in waters off Area 137 are reported to be of moderate to high magnitude compared to other Hong Kong waters.

(1) Maunsell (2005) Further Development of Tseung Kwan O Feasibility Study EIA. For Civil Engineering and Development Department

Sampans are among the most common fishing vessels in these waters. Catches of adult fish are moderate while production of fish fry in these waters was reported as low compared to other Hong Kong fishing grounds. The dollar value of these catches was high compared to other Hong Kong waters. There is also a Fish Culture Zone at Tung Lung Chau, within 1.5 km of the site.

In view of the overall moderate level of importance of the commercial fisheries activities at Area 137, it is expected that the potential construction and operation impacts of the LNG terminal on the local fisheries will not be significant.

Cultural Heritage Resources

Owing to the fact that Area 137 is formed by reclaimed land, the site is considered to have no archaeological potential. Monuments and buildings of recognised cultural or historical interest in the vicinity of Area 137 include a Tin Hau Temple located about 1.2km to the east of the site in Joss House Bay and the Old Customs House located 1.5km to the north on Junk Island.

Due to the artificial nature of the site, the construction of the LNG terminal at Area 137 will have no significant impact on sites of cultural, historical/heritage or archaeological importance.

Visual and Landscape Conditions

The landscape character of Area 137 is considered to be urban industrial and it is expected that the Area 137 site could accommodate an LNG terminal and associated facilities with no substantial change to landscape quality.

The proposed LNG Terminal location at Area 137 would be visible from several Visually Sensitive Receivers (VSRs) which would include residents at densely populated urban areas of Siu Sai Wan and Chai Wan as well as residents at some of the existing or future residential developments at Tseung Kwan O including the cemetery. Other sensitive receivers may include hikers in the Clearwater Bay Country Park and visitors to the Tin Hau Temple at Joss House Bay. Visitors to the Tin Hau Temple would be visually screened from the site to a large extent by hillside at the east of the Area 137 site.

Four VSRs (Siu Sai Wan, Shek O Back Beach, Shek O Road and Devils Peak) were examined with the aid of a photomontage technique with the aim to determine the potential visual/landscape impact of siting the LNG terminal at Area 137. All four of these viewpoints have been identified as having a high sensitivity to change, and moderate to high user numbers. The assessment concluded that the proposed LNG Terminal would have a significant adverse visual impact on all of these four VSRs *(Figure 4.41)*.

EXISTING VIEW LOOKING EAST TOWARDS THE DEVELOPMENT FROM SIU SAI WAN

WIREFRAME OF THE PROPOSED DEVELOPMENT AND THE DIGITAL TERRAIN MODEL COMPOSITED ON TO THE PHOTOGRAPH

VIEW DISPLAYING THE 3D MODEL OF THE PROPOSED DEVELOPMENT

Figure 4.41

Landscape Visual Assessment - Area 137
View from Siu Sai Wan

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DATE: 23/06/2006

Environmental Resources Management

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Although Area 137 has been built to accommodate Deep Waterfront Industry, the site's high visibility to major urban districts such as Siu Sai Wan and Chai Wan (total population of approximately 146 000) will expose a large population to increased levels of perceived risks/perceived safety due to the apparent vicinity of the LNG terminal to these populated areas. This will potentially lead to an increase in the level of public interests with regards to the proposed development and may cause planning issues.

4.11.15 Conclusions

From a review of the detailed environmental, social and planning information of the three elected sites, it is deemed that South Soko and Black Point both present the necessary characteristics for the siting of the LNG terminal. The primary reasons for discarding Area 137 as a viable site for the LNG terminal are essentially attributable to drawbacks associated with the impact of passing traffic on the terminal's unloading operations, perceived safety and landscape/visual issues, impacts from pipeline construction and to a lesser extent potential planning delays.

From a terminal perspective, due to the environmental and marine transit issues identified within Joss House Bay (Tai Miu Wan), the jetty will have to be located on the western limit of the site and in close proximity to the Tathong Shipping Channel. The location of the approach channel and turning basin in close proximity to the vessel fairway will potentially impact the LNG terminal's operations and ship transits. As a safety zone to facilitate the LNG carrier's off-loading operations is unlikely to be permitted in Hong Kong, the potential impacts on the reliability of the LNG supply to the terminal and thus to BPPS are deemed significant. Area 137 is therefore considered to be less suitable with respect to Black Point and South Soko which present no marine transit or associated reliability issues.

From a perceived safety perspective, although Area 137 is not located within close proximity to residential developments, it is much more visible than the other two elected sites and closer to major urban districts, leading to greater public interests in an area which bears a history of local residents objecting to the use of Area 137 as an industrial site on site for Potentially Hazardous Installations (PHIs). In this respect, this site is considered to present greater permitting risks than the development of the South Soko and Black Point sites.

From a landscape and visual impact perspective, the development of the LNG terminal at Area 137 is estimated to have a significant adverse visual impact due to its exposure and proximity to densely populated areas. On the other hand, due to the remoteness and orientation of the sites at South Soko and Black Point, no VSRs located in populated areas or other sensitive receivers (such as residential areas, public roads, lookouts or Country Parks) will experience the visual impacts of the development of the LNG terminal.

To highlight the greater perceived safety issue and the landscape intrusion of Area 137 with respect to South Soko and Black Point, a direct comparison of the post-construction conditions is presented in *Figure 4.42.*

The greater length and level of constraints of the connecting pipeline from Area 137 to BPPS is considered to be a further drawback to the selection of Area 137 as a viable site for the LNG terminal due to the greater potential impacts of the marine works to marine ecology and water quality. In comparison to the South Soko - BPPS pipeline, the > 80 km pipeline from Area 137 to BPPS presents approximately 40 km (from Area 137 to the Soko Islands) of a highly constrained route as numerous submarine cables have been laid in the southern waters of Hong Kong and Lantau Islands. Once passed the Soko Islands the remaining 40 km to BPPS is largely unconstrained and aligned with the South Soko-BPPS route.

From a planning perspective, although Area 137 has been zoned in the OZP for uses compatible with Deep Waterfront Industry, there is no provision within the existing land use zone for the LNG Terminal (either as of right or upon application to the Town Planning Board). A rezoning request would therefore be required which would entail a statutory procedure creating potential statutory opportunities for public comment and associated planning delays/risks.

4.12 SUMMARY AND CONCLUSIONS

Following the conduct of an alternatives assessment, the results indicate that the development of a LNG terminal at a coastal location in Hong Kong is the preferred alternative for securing a future reliable gas supply to the Black Point Power Station. A phased approach to the screening and assessment of sites within Hong Kong was utilised, accounting for comment from the ESMG. This approach is consistent with other site selection projects undertaken recently in the Hong Kong SAR.

The results of this Hong Kong wide site search exercise indicated that two sites were worthy of further analysis based on their relative performance against a series of other shortlisted sites in relation to environmental, risk, planning, social, marine traffic and engineering criteria. The two preferred sites were South Soko Island, at the location of the former detention centre, and Black Point, on the headland adjacent to the existing power station.

VIEW OF SOUTH SOKO SITE FROM CHEUNG SHA BEACH (CLOSEST VILLAGE WITH A VIEW)

VIEW OF BLACK POINT SITE FROM LUNG TSAI BEACH (CLOSEST VILLAGE WITH A VIEW)

VIEW OF AREA 137 SITE FROM SIU SAI WAN (CLOSEST RESIDENTIAL AREA WITH A VIEW)

Figure 4.42 View Displaying the 3D Model of the LNG Terminal for South Soko, Black Point and Area 137

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DATE: 24/06/2006

Environmental Resources Management

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