9. SOKO ISLANDS LANDFILL

9.1 Basic Information

Project Title

9.1.1 Soko Islands Landfill Site, (SIL) – marine site M.4.

Nature of Project

9.1.2 The Project would form a new marine based waste disposal site adjacent to the Soko Islands, (*Figure 9.1*).

9.1.3 The SIL would require construction of an artificial island of approximately 475ha. The site would be designated as a public filling area for the receipt of inert C&D material; once the reclamation is completed, the site would be developed as a landfill for subsequent operation for the disposal of waste.

9.1.4 Construction works would be as described in Part A, Section 3.2. In addition works for SIL would include:

- Dredging of 8Mcum of underlying muds for seawall construction.

Location and Scale of Project

9.1.5 The SIL is situated 1.5km to the west of the Soko Islands and about 3km south of the Shek Pik Reservoir on Lantau Island. Seabed levels in this area vary from 5 to 20m below Chart Datum, (the deeper waters coincide with an area previously dredged as part of the West Soko's Marine Borrow Area). This site is bound by the SAR boundary to the south and west, a major shipping channel to the north and the proposed Soko Islands Marine Park to the east.

9.1.6 The SIL would cover an area of 475ha to an elevation of +6 mPD. The artificial island would accommodate a landfill with a capacity of 75Mcum to an elevation of +56 mPD. The site would accommodate approximately 125Mcum of fill material.

History of Site

9.1.7 The site includes the West Soko's Marine Borrow Area, enclosing partially exploited sand borrow pits (9Mcum of sand was extracted for the Hong Kong International Airport). It is understood that sand extraction activities are no longer carried out.

Number and Types of Designated Projects Covered

9.1.8 The SIL would qualify as a Designated Project under the five categories listed in Part A; Section 2.1. The site is in close proximity to a potential Marine Park around the Soko Islands, (see *Figure 9.1*). Therefore, the site may also qualify as a Designated Project under the following Clauses of Schedule 2 of the EIA Ordinance:

C2 Reclamation of > 1ha (including associated dredging works), a boundary of which is less than 500m from an existing or planned Marine Park or Reserve.

9.2 Outline of Planning and Implementation Programme

9.2.1 An outline for the planning and implementation of this site is summarised in Part A; Section 3.3 and an outline programme is shown in *Figure 9.2*. Assuming landfill operations start in 2018, SIL would be full during the period 2030 to 2035, depending upon the rate of waste arisings and the number of other landfills operating concurrently.

9.2.2 The proposed site is currently not covered by any statutory town plans, as described in Section 3.3, Town Planning Ordinance procedures to cover the proposed site would be required and the reclamation would need to be gazetted under the Foreshore & Sea-bed (Reclamations) Ordinance. The area lies just to the south of a site being studied for designation as a Fisheries Protection Area.

9.2.3 This site falls within the boundary of the study area of the South West New Territories Development Strategic Review (SWNTDSR). The SWNTDSR identified the coastal waters off south west Lantau, Soko Islands and South Lamma as potential Marine Parks. The waters around the Soko Islands were identified in the Territorial Development Strategy Review as having high potential recreational / ecological value, and as a significant area for marine ecology. The planning intention of this Marine Park is to protect and conserve the relatively unspoilt marine environment, and provide recreational and educational opportunities to the public in areas, as appropriate. The area of the Soko Islands (particularly Tai A Chau) is being actively considered for resort develop opportunities by the Commissioner for Tourism. In addition, preparation works for the designation of the waters off Southwest Lantau and Soko Islands as Marine Parks are at their final phase.

9.3 Possible Impacts on the Environment

9.3.1 Possible impacts on the environment during the construction, operation and aftercare phases of SIL are outlined below. *Figure 9.1* provides details of identified sensitive receivers. The individual assessments are summarised in *Tables 9.1 and 9.2*.

Air Quality

9.3.2 The reclamation and landfill development has the potential to cause the following air quality impacts:

- Dust (TSP / RSP) and exhaust emissions from on-site plant during construction and operation (following reclamation).
- Gaseous emissions during landfill operation and aftercare arising from non-point source emissions and gas flaring / utilisation (including emissions of methane, carbon dioxide, carbon monoxide, sulphur dioxide, nitrous oxides, etc.).
- Odours arising during the operation of the landfill from waste decomposition and leachate treatment.

9.3.3 No air sensitive receivers have been identified within 500m of the site. There are no residents on the Soko Islands and the nearest ASRs are on South Lantau at Chung Hau, (Sha Tsui Detention Centre and Shek Pik Prison) at a distance of approximately 4km. Significant air quality impacts are not anticipated. However, potential operational phase air quality impacts would need to be considered in subsequent studies in the event that the island reclamation is used for other landuses (in addition to landfill) or a separate afteruse is developed on top of the landfill following completion of the landfilling operations. Afteruse issues are not considered further in the SEA.

9.3.4 This is a marine site and marine vessels will be used for waste delivery to the site. The amount of air pollutants resulting from the territory-wide waste delivery to the site is anticipated to be less compared to a land based site that relies on road transport. However, the estimated cumulative distance to be travelled from the existing and planned (South East Kowloon RTS to be commissioned in 2012) marine RTSs to the site is approximately 440km. Given the distance to be travelled and the benefit of the use of marine transport, the regional impacts of waste transportation is considered to be moderate.

Noise

9.3.5 The reclamation and landfill development has the potential to cause the following noise impacts:

- construction – from dredging, tipping, piling works and general construction activities;
- operation – from the use of fixed plant, marine vessels, waste reception area, pumping plant, possible helicopter noise etc.

9.3.6 No noise sensitive receivers have been identified within 300m of the site, the nearest NSRs are on South Lantau at Chung Hau, (Sha Tsui Detention Centre and Shek Pik Prison) at a distance of approximately 4km. Significant noise impacts are not anticipated. However, potential operational phase noise impacts would need to be considered in subsequent studies in the event that the island reclamation is used for other landuses (in addition to landfill) or a separate afteruse is developed on top of the landfill following completion of the landfilling operations.

9.3.7 Whilst it is not anticipated at this stage, it is possible that activities could continue beyond normal working hours during the construction and operation phases. This would depend upon working arrangements for fill delivery, day-to-day landfill operations and the overall construction programme. However, as this is an off-shore site with no noise sensitive receivers in the vicinity, the more stringent requirements for noise emissions during the evening and night time periods are not expected to be an issue for this site.

9.3.8 The site can only be accessed by marine traffic during both operation and construction phase. Noise from land based waste delivery vehicles is not a concern for this site.

Water Quality

Baseline Conditions at the Site

9.3.9 The site is located within the Southern Water Control Zone (WCZ). The current through this area mainly flows in a south-east / north-west and north-west / south-east direction. Background water quality conditions have been established from EPD routine monitoring stations, the latest available data are that collected in 2000, (EPD 2001[1]). The site is situated in the western waters of Hong Kong which are characterised by elevated levels of suspended solids, (compared to Eastern Waters) as a result of the influence of the Pearl River Estuary. Locations of the nearest water quality monitoring stations (SM20 and SM17) are presented in *Figure 9.1.*

9.3.10 Water quality data for 2000 at the monitored stations indicates full compliance with the Southern WCZ Water Quality Objectives (WQOs) for key parameters such as dissolved oxygen, (DO), E. Coli, and un-ionised ammonia. However, levels of total inorganic nitrogen (TIN) exceeded WQOs at both stations.

9.3.11 The nearest regular EPD sediment monitoring station in this area is SS6, which lies approximately 5km to the east. Sediments at SS6 are considered to be uncontaminated according to EPD data. The potential for impacts associated with marine muds is considered limited. Water quality modelling is being carried out separately and will be included in separate reporting.

[1] EPD (2001) Marine Water Quality in Hong Kong (in 2000). Environmental Protection Department, Hong Kong Government.

Key Issues and Sensitive Receivers

9.3.12 The project has the potential to cause the following water quality impacts:

- Sediment loss to the water column during dredging / reclamation;
- Runoff with elevated levels of suspended solids from the site during landfill construction (post-reclamation); and
- Change in the hydrodynamic regime (i.e., change in flushing capacity and sediment deposition / erosion patterns).

9.3.13 Sediment plumes may have some influence on beaches on south Lantau. However, as these sensitive receivers are not along the main flow path, impacts are anticipated to be minor.

9.3.14 The area north of Soko Island has no other WQSRs within 1,000m, the nearest gazetted beach is on Lantau Island – Tong Fuk which is over 6.8km away. Other beaches on Lantau Island include Cheung Sha Upper (7.6km), Cheung Sha Lower (8.8km) and Pui O (11.0km).

Reclamation and Site Formation

9.3.15 Due to the exposed location of the site, localised dredging is likely to be necessary for the seawalls prior to construction of the reclamation. However, the dredged material can be placed within the existing gazetted Soko Islands borrow area (within the footprint of the reclamation) reducing transport and spillage losses.

9.3.16 The placement of fill for island construction is also likely to lead to localised increases in suspended solid levels. Hydrodynamic and Water Quality Modelling predicts that the WQO for increase in SS would be exceeded at SC19 (36.09%), to the north of the Soko Islands during the dry season period in Phase 3 construction. Whilst not exceeding WQO, raised levels of SS were predicted at MP13 (19.53%) near south-west Lantau during the Phase 1 construction dry season of, at MP5, SC19 and MP13 (14.68%, 21.3% and 20.9% respectively) during the Phase 2 construction dry season and wet season (9.42%, 15.09% and 9.49% respectively) and at MT5, MP13 and SC19 (20.38%, 21.09% and 36.09% respectively) during the Phase 3 construction dry season and at SC19 (20.35%) in the wet season.

Hydrodynamic and Water Quality Impacts Following Island Formation

9.3.17 The presence of an island could locally affect the flow current in the area. Tidal currents in this area are moderate, (depending on the phase tidal cycle). On the ebb tide, the flows accelerate around the southern tip of Lantau to pass by the Soko's, (ERM 1999[2]). The impacts on flow through the major channels, predicted due to the presence of the island, would be small, with the largest difference being a 4.03% increase of accumulated flow predicted at West Lamma Channel during the wet season. An increase in currents to the west and north of the island at 3.7% and 29.9% (on average) was also predicted.

9.3.18 In the water quality modelling, 16 sensitive receivers that are close to the site were selected for presentation. Of the 16 chosen indicator points, 5 are located in the Southern WCZ (MP5, FP4, SC19, MP12 and RD), 1 in the North Western Supplementary WCZ (MP13) and 10 in Mainland waters (WD2, MF2 to MF7 and MF10 to MF12). WD2 (Chinese White Dolphin Conservation Zone) and MFs (Fish/Scollop/Rockshore Culture Areas) are classified as Category 1 and 2 respectively in the Mainland Sea Water Standard.

[2] ERM-Hong Kong Ltd (1999) Strategic Assessment and Site Selection Study for Contaminated Mud Disposal – Strategy Selection Report, Civil Engineering Department.

9.3.19 According to the dry season water quality modelling results, the predicted 90%ile DO for depth average and bottom layer ranged from 6.34 to 6.75mg/L and were above the WQO of 4mg/L and 2mg/L respectively as well as the Mainland standard of 6mg/L (category 1) and 5mg/L (Category 2). Compared to the baseline water quality results, the presence of the island would reduce both 90%ile depth-averaged and bottom DO at MP5 (Potential Marine Park/ Marine Reserve near Fan Lau), FP4 (Finless Porpoise Area near Tung Wan, Lantau Island), MF7 and MF11 (Fish/Scallop/Rockshore Culture Areas near Aizhou Islands and Baili Island). The percentage decreases at these sensitive receivers were less than 2%.

9.3.20 The predicted average dry season salinity ranged from 32.75 to 34ppt. The differences in the dry season salinity levels caused by the presence of the island were minimal (less than 1%) at all the selected indicator points as compared to the WQO requirement that change due to any waste discharge should not exceed 10% of natural ambient level.

9.3.21 The predicted dry season SS levels at the indicator points were in the range of 3.82 to 5.49mg/L. Compared to the baseline water quality results, the percentage differences in SS level caused by the presence of the island were less than 4%. Recognising the WQO requires that any waste discharge should not raise the natural ambient level by 30% as well as the Mainland standard that man-made increment should not exceed 10mg/L (Category 1) and 100mg/L (Category 2), these differences are considered small.

9.3.22 The predicted dry season *E.coli* levels at all indicator point were 1count/100ml and were well below the WQO of 610cfu/100ml and the Mainland standard of 200count/100ml. No notable change in *E.coli* levels was observed at any of the indicator points.

9.3.23 The predicted average dry season UIA (0.00207 – 0.00344mg/L) at all indicator points were very small and well below the WQO of 0.021mg/L and the Mainland standard of 0.020mg/L. Both MP5 (Potential Marine Park/ Marine Reserve near Fan Lau) and FP4 (Finless Porpoise Area near Tung Wan, Lantau Island) show an increase in the UIA level of 11.06% and 5.08% respectively while no notable change or reductions were observed in the remaining receivers.

9.3.24 The predicted dry season TIN levels at the indicator points in Mainland waters ranged from 0.0935 to 0.109mg/L. The predicted levels were below the Mainland waters Standard of 0.2mg/L (Category 1) and 0.3mg/L (Category 2). Meanwhile in Hong Kong waters, MP5 (Potential Marine Park/ Marine Reserve near Fan Lau) and FP4 (Finless Porpoise Area near Tung Wan, Lantau Island) showed an increase in TIN level of 14.17% and 6.52% respectively. Since the Hong Kong WQO of TIN is an annual mean value, the predicted levels for the dry and wet seasons were averaged and compared with the WQO. The results are discussed below in Section 9.3.30.

9.3.25 According to the water quality modelling results for the wet season, the predicted 90%ile DO for depth average and bottom layer at the sensitive receivers in Hong Kong waters ranged from 4.62 to 5.38mg/L and the values were above the WQOs of 4mg/L and 2mg/L respectively. However, for the sensitive receivers in Mainland waters, most of the sensitive receivers breached the marine water standards. For WD2 (Chinese White Dolphin Conversation Zone), the depth-averaged and bottom layer DO of 4.97 and 4.8mg/L were below the Mainland water standards of 6mg/L for Category 1. The 90%ile DO levels at MF2 to MF6, (ranged between 4.5 to 5.0mg/L), breached the Mainland water standards of 5mg/L for Category 2. However, the DO baseline levels at these indicator points also breached the relevant standards. Compared to the baseline water quality results, the percentage differences for 90%ile depth-averaged and bottom DO at all indicator points were less than 4%.

9.3.26 The predicted average salinity in the wet season ranged from 11.40 to 26.50ppt. The percentage differences were within 5% and are below the WQO of 10%.

9.3.27 The predicted wet season SS levels at all the indicator points were in the range of 4.36 to 10.07mg/L. Compared to the baseline water quality results, the percentage differences in SS level caused by the presence of the island were in the range of 0.1 to 8.15%. Recognising the WQO requirements that any waste discharge should not raise the natural ambient level by 30% as well as the Mainland standard that man-made increment should not exceed 10mg/L (Category 1) and 100mg/L (Category 2), these differences are considered very small.

9.3.28 The predicted *E.coli* wet season concentrations at all indicator points were low and ranged from 1 to 8count/100mL which were well below the WQO of 610cfu/100mL as well as the Mainland standard of 200count/100ml.

9.3.29 The predicted average wet season UIA (0.00338– 0.00498mg/L) at all indicator points were low and were well below the WQO of 0.021mg/L and the Mainland standard of 0.020mg/L.

9.3.30 For the predicted wet season TIN levels, the values ranged from 0.1852 to 0.5238mg/L. The wet season TIN levels at WD2 for both baseline scenario (0.516mg/L) and operational scenario (0.523mg/L) exceeded the Mainland standard for Category 1 of 0.2mg/L. The TIN levels at MF2 to MF6 in Mainland waters were in the range from 0.3557 to 0.4988mg/L which is above the Mainland standard for Category 2 of 0.3mg/L. It should be noted that the predicted TIN levels for the baseline scenario also exceeded the relevant Mainland Standards. Meanwhile, since the Hong Kong WQO of TIN is a yearly value, the predicted mean TIN levels at MP5, FP4, MP13, SC19, MP12 and RD for the dry and wet seasons were averaged to represent the annual mean values. Of the 6 indicator points, only MP13 was shown to comply with the WQO. The remaining 5 sensitive receivers, located in the Southern WCZ breached the WQO of 0.1mg/L with calculated annual mean values ranged from 0.229 to 0.242mg/L. The calculated averaged baseline concentrations at these stations also exceeded the WQO.

Cumulative Impacts

9.3.31 There are no known proposed or committed marine developments currently planned within the area of the site. CED has advised that the South Cheung Chau Disposal Ground (which receives uncontaminated dredged muds) has little or no capacity remaining. It is assumed that mud-dumping activities at the Disposal Ground will have ceased by the time of construction.

Waste Management / Disposal Impacts

9.3.32 For construction of the "island" on which the landfill would be located, inert C&D material would be brought in exclusively by marine vessel, from a network of barging points across the SAR. The location of barging points would vary during the filling process, according to the source of materials at any given time.

9.3.33 Whilst various options for construction that avoid dredging have been investigated, it is anticipated that muds would need to be excavated to facilitate construction of the outer seawall, prior to public filling. Excavated muds would then be disposed of within the area to be reclaimed with public fill. Following this, the "island" would act as a major recipient of municipal solid waste and other landfilled waste streams.

9.3.34 Anticipated volumes of materials are as follows:

- Volume of public fill that could be accepted for island construction: 125Mcum
- Volume of muds to be dredged for the outer sea wall: 8Mcum

9.3.35 Various potentially polluting materials may be stored, handled and transported to / from the site. Examples may include chemicals for waste water/leachate treatment, waste oils, fuel for plant working on the site, etc. These would be managed as described in Section 5.5.

9.3.36 Waste delivery to the site will be by marine vessel which will have a lower GHG emission per kg waste handled, compared to the road transport given the fact that the capacity of a marine vessel is almost 100 times more than a truck. The cumulative distance between marine RTSs and the site is around 440km as estimated in the Preliminary Marine Review (March 2002). In view of these, the potential GHG impacts are considered to be moderate.

Ecology

Baseline Conditions

9.3.37 Notwithstanding the previous sand extraction over a portion of the site area, there are a number of ecological resources of conservation interest in the vicinity of the potential SIL.

9.3.38 The site lies in an area known to contain fish spawning and nursery grounds. There are medium density sightings of the Chinese White Dolphin and Finless Porpoise as well as coral communities at the nearby Soko Islands. There are proposals to designate the adjacent Soko islands as a Marine Park. The site is one of six that has been short-listed for deployment of an artificial reef (AR) by AFCD, (ERM 1999a[3]). *Figure 9.1* shows the locations of ecologically sensitive areas in the vicinity of the site.

9.3.39 Ecological surveys have been undertaken at the west and northern coast of the adjacent Soko Islands (Siu A Chau), under the Coastal Ecology Studies conducted by CED (BCL 1997[4]) and as summarised in the Artificial Reef Deployment Study, (ERM 1999a). The surveys concluded that overall, the coral, fish and invertebrate communities at the Soko Islands (adjacent to the site) were low to moderate both in terms of species diversity and abundance.

9.3.40 Notwithstanding their low abundance and diversity, the occurrence of both hard and soft corals was considered to be notable. Corals generally exhibit a low tolerance to elevated sediments in the water column and distribution was previously thought to be restricted to the clearer waters east of Lamma Island, which are less affected by sediment loads of the Pearl River Estuary. It is not clearly understood why hard corals have been able to colonise in this area, however it is thought that the backwash from boats passing along the shipping channel immediately to the north may help to prevent sedimentation of corals in this location.

9.3.41 Benthic invertebrate surveys during 1976 and 1977 as part of a territory wide study (Shin and Thompson, 1982) identified that the south west waters, (including Soko Islands) dominated by polychaete communities (82.5%), with a high species diversity. More recent grab surveys within the site footprint of the proposed SIL, (at the edge of the former marine borrow area) confirmed the dominance of polychaete communities, and also recorded very high numbers of benthic macroinvertebrates. However, it was postulated that the marked increase in macroinvertebrates may have been due to a recruitment pulse immediately prior to sampling (ERM 1997a)[5].

9.3.42 Cetacean surveys in Hong Kong waters, between 1995 and 2000, (Jefferson 1998 and 2000) indicate that the area is a habitat for the Chinese White Dolphin and Finless Porpoise The site does not fall within the critical habitat areas for either of these species, (see *Figure 9.1*). Frequency by Finless Porpoise is generally low, (their core habitat is further east toward South Lamma). However, Chinese White Dolphin can be abundant particularly during summer and autumn months[6].

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[3] ERM-Hong Kong Ltd (1999a) Artificial Reef Deployment Study: Technical Paper 3 – Site Selection, Agriculture & Fisheries Department, Hong Kong Government.

[4] Binnie Consultants Limited (1997) Coastal Ecology Studies: Soko Islands Qualitative Survey Final Report. Civil Engineering Department, Hong Kong Government.

[5] ERM-Hong Kong Ltd (1997a) Seabed Ecology Studies: Soko Islands Final Report, Civil Engineering Department, Hong Kong Government.

[6] http://www.afcd.gov.hk/con_new/cdp_distribution.htm

9.3.43 The nearest sites designated for their conservation interest are the proposed Marine Parks at the Soko Islands and at South Lantau (which are approximately 1.5km to the west and 2km to the north respectively).

9.3.44 The key sensitive receivers during construction phase are ecological habitats near the site. Therefore the sediment plume impact from the site is likely to be significant.

9.3.45 The sheltered bays around Tong Fuk, (South Lantau) are a recognised habitat for Horseshoe Crab. Given the lack of disturbance to the existing South Lantau coastline west of Tong Fuk it is also likely these species are to be found in isolated undisturbed bays on south west Lantau, closer to the SIL, and possibly around the Soko Islands.

Direct Habitat Loss

9.3.46 The site footprint covers an area of 475ha, and partially coincides with the former borrow area. No direct studies on the recolonisation of the former borrow are have been carried out, however, the site is comparatively ecological poor, and direct impacts are likely to be moderate. Loss of water column habitat and feeding ground is also likely to impact upon the Chinese White Dolphins / Finless Porpoise.

Water Quality / Hydrodynamics

9.3.47 Ecologically important habitats at the Soko Islands and South Lantau are relatively close to the potential SIL and impacts on local flow regime and disturbance to the status quo may be significant. Fish and coral habitat may be adversely affected if sediment is transported / deposited around the Soko Islands and at the proposed Artificial Reef.

9.3.48 The results of numerical modelling do not indicate a significant decline in water quality associated with works for the SIL. Suspended solids concentrations at the coral community at north Siu A Wan (SC19) are predicted to increase by 1.5mg/L above baseline levels. However, the spread of the sediment plume may potentially be significant as levels of suspended solids as far west as the potential Southwest Lantau Marine Park / Reserve (MP13) and as far north as the potential Fan Lau Marine Reserve (MP5) are predicted to increase by an average of 1mg/L. Thus, the diversity and number of ecological receivers exposed to this marginal increase may be significant.

9.3.49 The model output does not indicate that there will be any significant operational change in hydrodynamics / water quality.

Marine Vessel Disturbance

9.3.50 Increased vessel movements in the area will increase the likelihood of vessel disturbance of marine mammals. Whilst the area is not a core habitat for Chinese White Dolphin, sightings are moderate, and the incidence of vessel collision, particularly during summer and spring months is likely to be significant.

Fisheries

9.3.51 Baseline data on fisheries is available from Port Survey Data and data from the Consultancy Study, Fisheries Resources and Fishing Operations in Hong Kong waters (Fisheries Resources Survey, ERM 1998)[7].

9.3.52 The site lies in an area identified as having significant spawning and nursery grounds as well as holding significant fish stocks. Trawl surveys to the north and east of the Soko Islands under the Fisheries Resources Survey yielded large fish catches compared to other areas of Hong Kong surveyed indicating a high value fishery area. The majority of the catch comprised mantis shrimp, which have a high commercial value.

[7] ERM-Hong Kong Ltd (1998) Fisheries Resources and Fishing Operations in Hong Kong Waters, Agriculture & Fisheries Department, Hong Kong Government.

9.3.53 A trawl survey conducted under the Fisheries Resources Survey reported the highest mean catch weight per month from sites in southern waters, particularly South Cheung Chau, South Lantau, and South Lamma. As noted in the C&D Materials Study, *(Conceptual Layout Study Report, March 2002)*, the data collected under the Fisheries Resources Survey was from a single survey and the findings run contrary to the relative production estimates from the fisher and port surveys. This indicates that the area is potentially richer in resources than its current exploitation rate would imply. As the site footprint covers an area of 475ha, there would be a direct fisheries impact through the loss of spawning / nursery grounds.

9.3.54 There are no fish culture zones in HKSAR waters in the vicinity of the proposed SIL. Two sites, located to the immediate east and west of Tai A Chau (approximately 3km from the SIL) are reportedly being examined as a potential Fish Culture Zones, (ERM 1997b)[8]. As reported in the 'Ecology' sub-section above, the results of the modelling exercise for waters around the Soko Islands predict only a marginal increase in suspended solids levels of 1.0 - 1.5mg/L above baseline. There are five fish culture areas in Mainland waters to the south and southwest of the proposed SIL (MF2 – MF6). The predicted increase in suspended solids levels at these sites does not exceed 1mg/L above baseline conditions during construction, and there are no predicted increases in any modelled parameter during facility operation.

Cultural Heritage

9.3.55 There is no immediate evidence of archaeological remains in this area. However Siu A Chau and Tai A Chau land based archaeological sites are located on the nearby Soko Islands. Archaeological finds on these islands indicate occupation of the islands during prehistoric times and during the Tang Dynasty. This suggests that the coastal area of the Soko Islands has been used by seafaring people for several thousands of years.

9.3.56 Recognising the likelihood of archaeological remains in this area and the lack of archaeological data currently available for this site a detailed marine archaeological investigation should be carried out in any future studies.

Landscape and Visual

9.3.57 *Landscape Planning Designations* – This area of landscape is not covered by any planning designations reflecting landscape/landscape values and so there will be no impact on these values.

9.3.58 *Landscape Resources* - the site lies in a marine area, so that the only landscape resource affected will be an area of offshore water. Given the low sensitivity of this resource, there will be no significant impacts on landscape resources.

9.3.59 *Landscape Character* – The island landfill site falls within the Southern Coastal Waters LCA and partly within the South Lantau Waters LCA (*Figure 9.4*). The landscape of this part of the former is characterised by a generally expansive and open water, whilst that of the latter is a more sheltered coastal landscape characterised by the relationships of outlying islands and areas of sea between them. The coastal waters of South Lantau are extremely natural and undisturbed (*Figure 9.3*). Numerous islands are scattered along the coast, with the Sokos forming a coherent group. Key islands in this area include Lantau, the Soko Islands as well as islands in PRC territorial waters (*Figure 9.4*).

9.3.60 There exists potential for a large magnitude of impact on landscape character, resulting from construction works that will introduce new artificial elements which are incompatible with the existing mainly open and natural characteristics of the marine landscape. The predicted impact on landscape character during the construction/operation phase of the life cycle of the project will be substantial. During the afteruse phase, these impacts are likely to be reduced a little, as the completed island is restored and the landscape mitigation measures are fully implemented. As a consequence, the long-term impact on landscape character will be moderate/substantial.

[8] ERM-Hong Kong Ltd (1997b) Site Search for a New Power Station: Preliminary Site Search (Revised Final Technical Report No. 2), Hongkong Electric Company, Ltd.

9.3.61 VSRs – VSRs affected by the proposals are identified in *Tables 9.3 and 9.4*. The extent of the project visual envelopes is shown in *Figure 9.5* and the key views to the proposed island landfill are shown in *Figure 9.6*. Recreational VSRs, such as Chinese White Dolphin watchers, boating, fishing, diving, water sports activities and visitors to Fan Lau Fort near Lantau Trail, will be most affected by the proposed islands as they are possibly the closest VSRs. Other recreational VSRs affected will be those at Lantau Peak (Fung Wong Shan) Trail, Tai Long Wan Beach, Tian Tan Buddha Status and Pui O Wan Beach.

9.3.62 Because of the location of the island there are no large areas of population within the primary visual envelope. Key residential VSRs in the area include mainly the population of Tai Long Wan Village (Shek Pik). Institutional VSRs will be affected at Chung Hau Prison and the Sha Tsui Detention Centre in Chung Hau. Other VSRs, such as travellers on vessels using the fairways and shipping lanes as well as the South Lantau Road, are often transient and so resulting visual impacts are less.

9.3.63 All VSRs will experience works on the landfill (shipping, marine vessels and partially constructed island) as relatively close artificial elements contrasting with the coherent natural qualities of the existing landscape. Resulting impacts during construction/operation period will be moderate to substantial. After the restoration of the landfill island, its visual impact will be reduced and the overall residual visual impacts on major VSRs during the afteruse phase will be slight to moderate.

9.3.64 *Mitigation Measures* – Landscape and visual mitigation measures are outlined in Section A of the Report and illustrated in *Figure 9.8*.

Landfill Gas

9.3.65 There are no sensitive receivers (targets) or pathways within 500m of the site. Therefore, there are no potential off-site landfill gas hazards. Landfill gas would have safety implications for those working on the site. In the event that the reclamation on which the landfill would be constructed is also developed for other afteruses, the potential operational phase landfill gas hazards would need to be considered for those developments.

9.3.66 Given the remote location of the site and the lack of any sizeable population nearby, the direct off-site use of LFG as an energy source in surrounding communities, is not considered practical. However, it will be used as an on-site energy source.

9.4 Environmental Protection Measures to be Incorporated into Design and Further Environmental Implications

9.4.1 Environmental design measures have been identified in Part A (Section 3.8) and generic approaches to mitigating impacts on different environmental parameters are outlined in Part A (Section 5). Whilst the specific requirement for environmental mitigation would be dependent upon the findings of an EIA, the following environmental protection measures are those which are site-specific.

Air Quality

9.4.2 No specific air quality mitigation measures are recommended at this stage, other than good site practice.

Noise

9.4.3 No specific noise mitigation measures are recommended at this stage, other that good site practice.

Water Quality

9.4.4 Mitigation is likely to be required to prevent impacts during dredging and filling for the artificial island reclamation. Construction procedures, defining the rates and method of dredging and filling taking in to account the hydrodynamics of the surrounding waters and tidal effects (ebb and flood) should be defined in any EIA. If significant impacts are predicted, a silt curtain may be installed around the immediate works area to prevent dispersion of sediments.

Solid Waste

9.4.5 As an artificial island site, application of a floating boom curtain to control the dispersal of litter within public fill.

Ecology

9.4.6 No specific measures to protect areas of ecological value are recommended at this stage. The application of measures to prevent unacceptable impacts on water quality will also apply to ecological resources, and are likely to be necessary. Given the sensitivity and close proximity of adjacent ecological resources, the likely effectiveness of any mitigation measures would need to be carefully evaluated.

9.4.7 It is envisaged that given adequate edge protection design, assemblages typical of those adapted to hard substrates would colonise the rubble mound sea wall of the artificial island. Ecological enhancement through construction of an artificial reef, would be appropriate, at SIL, as the site has been identified as a potential site for an AR under the AFCD Study[9].

Fisheries

9.4.8 Mitigation applied for the protection of ecological resources would apply equally to the protection of fisheries resources.

Cultural Heritage

9.4.9 No specific measures for the protection of cultural heritage are deemed necessary at this stage. This should be re-evaluated in the event that a marine archaeological assessment is carried out as part of an EIA if this site is investigated further.

Landscape & Visual

9.4.10 Landscape and visual mitigation measures are identified in Part A of the Report.

[9] ERM-Hong Kong Ltd (1998). Artificial Reef Deployment Study, Final Report.

9.5 Summary

9.5.1 A summary of the SEA for the SIL is provided in *Tables 9.1 and 9.2*:

Table 9.1: Soko Islands Landfill SEA

	Impacts	Score	Commentary
Air Quality Assessment			
1	Distance to areas of air sensitive land use	**O**	There are no ASRs within 500m of the site.
2	Presence of topographic features which could decrease or exacerbate impacts	**O**	There are no features which would affect air dispersal. In addition as there are no ASRs within 3km, this criterion is not applicable.
3	Occurrence of meteorological conditions which could exacerbate impacts	**O**	The predominant wind direction is towards ASRs. However the remoteness of ASRs is such that this criterion is not applicable.
4	Cumulative Impacts of relevant emissions (TSP (construction), NO_x, CO, SO_2 – LFG Flare) taking into account ambient conditions	**O**	Review of all known planning information (OZPs and the SWNT Development Strategy Review) indicate there are no other confirmed or planned developments within 3km of this marine site, which could contribute to cumulative air quality impacts.
5	Total Emissions of Air Pollutants from the territory-wide waste transportation between the RTSs and the Site	**-**	Waste will be delivered to the site by marine vessel and the cumulative distance to be travelled is estimated to be 440km.
6	Overall Impact	**O / -**	Overall air quality impacts is considered to be **'Neutral / Negative – Low'**. This is because local impacts are not anticipated due to the absence of ASRs within 500m from the site but there are potential for regional impacts (from waste delivery).
Noise Assessment			
1	Distance to areas of noise sensitive land use	**O**	There are no NSRs within 300m of the site.
2	Topographic Features (only applicable if there are NSRs within 300m)	**O**	The area between the proposed landfill site and the nearest land mass Soko Islands is marine (flat). Notwithstanding, as there are no NSRs within 3km this criterion is not directly applicable.
3	Cumulative Impacts of developments within 300m	**O**	No developments that could cause cumulative impacts.
4	Overall Impact	**O**	**'Neutral'**. Negligible noise impacts on surrounding NSRs due to its remote siting.

	Impacts	Score	Commentary
Water Quality Assessment			
1	Water Course Diversion	**O**	As a marine site, no water-course diversions are required.
2	Potential for sediment contaminant release	**O**	The site is a partially within the Soko Islands marine Borrow Area. EPD routine monitoring data indicates the potential for impacts associated with contaminated muds is limited.
3	Potential impacts on WSRs	**-**	Exceedance of the WQO for SS is predicted in one location, SC19 (to the north of the Soko Islands) during construction. It is predicted that both DO and TIN standards in the operational phase would be breached, however, these were both breached in the baseline scenario and the elevations due to the presence of island were not significant, therefore, the island would not be the cause of the exceedances.
4	Potential Impacts on Groundwater	**O**	This is a marine site - there are no groundwater issues.
5	Potential Cumulative Impacts (Potential for concurrent projects to exacerbate preceding impacts)	**O**	No major marine developments currently planned around the site.
6	Overall Impact	**-**	Potential water quality impacts are considered to be **'Negative – Low'**. There are a limited number of WSRs in the area; Soko Islands in close proximity may experience significant SS levels during construction of the artificial island.
Waste Management Assessment			
1	Balance of Materials (surplus/deficit of public fill needed for landfill development)	**+**	The site could accommodate a major volume of public fill (125Mcum) negating the need to import filling material for site formation. Dredged muds will be incorporated with the fill materials within the island footprint.
2	GHG emissions from mode of transport for delivery of waste to the site from RTSs	**-**	Waste will be delivered to the site via marine vessel. The distance travelled from marine RTS(s) to the site has been estimated to be 440km.
3	Overall Impact	**O**	**'Neutral'**. Overall the site is considered to have neutral impact due to the balance out of the benefit for being able to accommodate C&D surplus materials and the relatively larger amount of GHG emissions for the longer distance travelled.

	Impacts	Score	Commentary
Ecological Assessment			
1	Potential for secondary environmental impacts on "Areas of Absolute Exclusion"	**–**	The model output indicates that sediment plume from the Works may affect most likely in a limited manner the waters around the potential Marine Parks / Reserves at Soko Islands, Southwest Lantau and South Lantau (Fan Lau).
2	Affects an important habitat	**- -**	Benthic habitats previously disturbed, not considered of major importance. Coral at Soko Islands susceptible to sedimentation impacts. Loss of habitat for fish (feeding habitat for Chinese White Dolphin) and potential disturbance of habitat for Horseshoe Crab S Lantau.
3	Affects species of conservation importance	**- /- -**	This site may disturb an area of moderate density sighting of Chinese White Dolphin and coral habitat off north Siu A Chau.
4	Potential for Cumulative Ecological Impacts on sites of recognised value	**O**	No major marine developments currently planned around the site.
5	Overall Impact	**- / - -**	Ecological impacts are considered to be **'Negative – Low / High'** due to the close proximity to two proposed Marine Parks as well as the potential impacts upon species of conservation interest.
Fisheries Assessment			
1	Potential for secondary environmental impacts on "Areas of Absolute Exclusion"	**-**	There is some potential for slight increases in suspended solids levels on a number of Mainland FCZ to the south. The potential Marine Parks at Soko Islands, Southwest Lantau and South Lantau (Fan Lau) may also experience marginal increases in suspended solids levels.
2	Affects important mariculture/ fisheries resources (including spawning / nursery ground)	**- -**	This site is within a known spawning ground of a productive fishing area. Whilst predicted increases in suspended solids are low, there would be direct habitat loss.
3	Potential for Cumulative Fisheries Impacts on sites of recognised value	**O**	No major developments planned within 5km of the site.
4	Overall Fisheries Impact	**- / - -**	The potential fishery impacts are considered to be **'Negative – Low / High',** due to the potential direct impact on fisheries and spawning grounds, as well as indirect impacts on nursery function of beaches on S. Lantau.

	Impacts	Score	Commentary
Cultural Heritage Assessment			
1	Important cultural (Declared, Deemed or Graded Sites) / archaeological sites	**O**	There are no known sites of cultural heritage significance.
2	Potential for archaeological value	**-**	There is evidence of land based archaeological finds nearby on the adjacent Soko Islands, suggesting that the coastal area of the Soko Islands has been used by seafaring people for several thousands of years. Recognising the lack of archaeological data currently available, it is considered that the likelihood of archaeological remains in this area is reasonable. A detailed marine archaeological investigation should be carried out in any future studies.
3	Potential for Cumulative Heritage Impacts on sites of recognised value	**O**	The nearest sites of cultural heritage value are land based, (on the Soko Islands (1.5km), therefore they would not be affected by this development. There are no planned or confirmed projects, which may cause cumulative heritage impacts.
4	Overall Impact	**-**	The potential impacts on cultural heritage are considered to be **'Negative – Low'**. Whilst there is not direct evidence of cultural heritage remains in the site area, the occurrence of remains on nearby Soko Islands increases the potential for marine archaeological finds.
Landscape and Visual Impact Assessment			
1	Implications for Landscape Planning and Designations	**O**	This area of landscape is not covered by any planning designations reflecting landscape/landscape values and so there will be no impact on these values. Overall impacts will therefore be Neutral.
2	Impacts on Landscape Resources	**O**	As the site lies in a marine area, there will be no significant impacts on landscape resources. Overall impacts will therefore be Neutral.
3	Impacts on Landscape Character	**- -**	The proposed SIL is incompatible with the open, isolated and natural qualities of this area of sea and coast and resulting impacts on landscape character will be Negative – High.
4	Visual Impact	**- / - -**	The numbers of VSRs affected by the proposal is comparatively small. The most affected VSRs are a limited number residents in Tai Long Wan Village and visitors who use that part of the sea area for active and passive recreation and the impact on them is substantial to moderate. Generally, visual impacts will be Negative – Low/High.
5	Overall Impact	**- / - -**	Overall, landscape and visual impacts will be **'Negative – Low / High'** for the following reasons: • There are no landscape designations covering the disposal site; • No significant landscape resources are affected; • The open, natural and isolated landscape character of the Southern Coastal Waters will be significantly compromised; • There are very low numbers of residential VSRs within the visual envelope of the Site and an extremely small number close to it.

	Impacts	Score	Commentary
Landfill Gas Assessment			
1	Distance between the new / extended landfill and SRs	**O**	This is a marine site located over 1.5km west of Soko Islands which are uninhabited. The nearest sensitive receivers are >250m away
2	Number of Receivers within 250m (i.e. Consultation Zone)	**O**	There are no sensitive receivers within 250m of the site.
3	Man-made / Natural Pathways for LFG Migration	**O**	None
4	Additional Utilisation of LFG to Reduce GHG Emissions	**O**	LFG would be utilised on-site. There are no potential off-site users of LFG.
5	Overall Impact	**O**	**'Neutral'**

Table 9.2: Summary of Soko Islands Landfill SEA

Overall Impacts	Score	Commentary
Overall Air Quality Impact	**O / -**	Neutral / Negative – Low
Overall Noise Impact	**O**	Neutral
Overall Water Quality Impact	**-**	Negative – Low
Overall Waste Management Impact	**O**	Neutral
Overall Ecological Impact	**- / - -**	Negative – Low / High
Overall Fisheries Impact	**- / - -**	Negative – Low / High
Overall Cultural Heritage Impact	**-**	Negative – Low
Overall Landscape & Visual Impact	**- / - -**	Negative – Low /High
Overall Landfill Gas Impact	**O**	Neutral

Table 9.3 Assessment of Significance of Visual Impacts for Soko Islands Landfill During Construction / Operation Phase (Note: All impacts adverse unless otherwise noted)

Identity No. of VSR	**Key Visually Sensitive Receiver (VSR)**	**Approx Minimum Distance Between VSR and Source(s)**	**Nos. of VSRs (order of magnitude only)**	**Magnitude of Impact During Construction / Operation** (Negligible, Small, Intermediate, Large)	**VSR Sensitivity** (Low, Medium, High)	**Impact Significance before Mitigation Measures** (Insubstantial, Slight, Moderate, Substantial)	**Significance of Residual Impacts** (Insubstantial, Slight, Moderate, Substantial)
Residential VSRs							
VR42	Tai Long Wan Village (Shek Pik)	5km	Very Few	Intermediate	High	Moderate to Substantial	Moderate
Institutional VSRs							
VR43	Chung Hau Prison and Sha Tsui Detention Centre	5.5km	Few	Intermediate	Low	Slight to Moderate	Slight to Moderate
Recreational VSRs							
VR44	Tai Long Wan Beach	5km	Few	Intermediate	Medium	Moderate	Moderate to Slight
VR45	Tian Tan Buddha Statue (Po Lin Monastery)	9km	Many	Intermediate	Medium	Moderate	Moderate
VR20	Lantau Peak (Fung Wong Shan)	11km	Very Few	Intermediate	Medium	Moderate	Moderate
VR46	Pui O Wan Beach	13km	Few	Small	Medium	Moderate to Slight	Slight
VR11	Area for Chinese White Dolphin Watching, Boating, Fishing and Diving activities	0km - 13km (varies)	Few	Large	Medium	Substantial to Moderate	Substantial to Moderate
VR47	Near Lantau Trail at Fan Lau Fort, Fan Lau	2km	Few	Large	Medium	Substantial to Moderate	Substantial to Moderate
Travelling VSRs							
VR48	South Lantau Road (Shek Pik Reservoir)	5km	Many	Small	Low	Slight	Insubstantial
VR49	On Vessels using the Fairways and Shipping Lanes	1km	Many	Intermediate	Low	Slight to Moderate	Slight to Moderate

Table 9.4 Assessment of Significance of Visual Impacts for Soko Islands Landfill During Afteruse Phase

(Note: All impacts adverse unless otherwise noted)

Identity No. of VSR	**Key Visually Sensitive Receiver (VSR)**	**Approx Minimum Distance Between VSR and Source(s)**	**No.s of VSRs (order of magnitude only)**	**Magnitude of Impact During Afteruse** (Negligible, Small, Intermediate, Large)	**VSR Sensitivity** (Low, Medium, High)	**Impact Significance before Mitigation Measures** (Insubstantial, Slight, Moderate, Substantial)	**Significance of Residual Impacts** (Insubstantial, Slight, Moderate, Substantial)
Residential VSRs							
VR42	Tai Long Wan Village (Shek Pik)	5km	Very Few	Intermediate	High	Moderate to Substantial	Moderate
Institutional VSRs							
VR43	Chung Hau Prison and Sha Tsui Detention Centre	5.5km	Few	Intermediate	Low	Slight to Moderate	Slight
Recreational VSRs							
VR44	Tai Long Wan Beach	5km	Few	Intermediate	Medium	Moderate	Slight
VR45	Tian Tan Buddha Statue (Po Lin Monastery)	9km	Many	Intermediate	Medium	Moderate	Slight
VR20	Lantau Peak (Fung Wong Shan)	11km	Very Few	Intermediate	Medium	Moderate	Slight
VR46	Pui O Wan Beach	13km	Few	Small	Medium	Slight	Insubstantial
VR11	Area for Chinese White Dolphin Watching, Boating, Fishing and Diving activities	0km - 13km (varies)	Few	Large	Medium	Substantial to Moderate	Moderate
VR 47	Near Lantau Trail at Fan Lau Fort, Fan Lau	2km	Few	Large	Medium	Substantial to Moderate	Moderate
Travelling VSRs							
VR48	South Lantau Road (Shek Pik Reservoir)	5km	Many	Small	Low	Slight	Insubstantial
VR49	On Vessels using the Fairways and Shipping Lanes	1km	Many	Intermediate	Low	Slight to Moderate	Slight