

13. EASTERN WATERS ISLAND LANDFILL

13.1 Basic Information

Project Title

13.1.1 Eastern Waters Island Landfill (EWIL) – marine site M.8.

Nature of Project

13.1.2 The Project would form a new marine based waste disposal site in the remote Eastern Waters of Hong Kong (*Figure 13.1*).

13.1.3 The EWIL would require construction of an artificial island of approximately 875ha. 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.

13.1.4 Construction works would be as described in Part A, Section 3.2. In addition works for the EWIL would include:

- Dredging of about 25Mcum of underlying muds for construction of an outer seawall.

Location and Scale of Project

13.1.5 The EWIL is located adjacent to the eastern boundary of SAR waters. It is 17km east of the Clear Water Bay Peninsula and 11km east of both Basalt Island and the Ninepin Group of Islands. Seabed levels in this area are approximately 25m below Chart Datum, except for Victor Rock, an isolated underwater pinnacle formation consisting of a number of outcrops at a depth of about -10mPD. Victor Rock is approximately 3km to the northwest of the site.

13.1.6 The EWIL would cover an area of 875ha to an elevation of +6 mPD. The artificial island would accommodate a landfill with a capacity of 140Mcum to an elevation of +56mPD. The site would accommodate approximately 400Mcum of fill material.

History of Site

13.1.7 The site is located within open marine waters and is to be formed entirely as part of this project. There has been no previous development activity within the site area.

Number and Types of Designated Projects Covered

13.1.8 The EWIL would qualify as a Designated Project under the five categories listed in Part A; Section 2.1.

13.2 Outline Of Planning and Implementation Programme

13.2.1 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 13.2*. Assuming landfill operations start in 2022, EWIL would be full during the period 2040 to 2050, depending upon the rate of waste arisings and the number of other landfills operating concurrently.

13.2.2 The site is currently not covered by any statutory town plans, as described in Section 3.3, Town Planning Ordinance procedures to cover the site would be required and the reclamation would need to be gazetted under the Foreshore & Sea-bed (Reclamations) Ordinance.

13.2.3 According to the Territorial Development Strategy Review, the area where the site is located is of potentially high recreational value. There are no other identified uses in this area.

13.2.4 The South East New Territories (SENT) Development Strategy Review focused on conserving the natural environment of the sub-region. The SENT Strategy Review proposed areas for inshore water recreation marine park and marine conservation areas in the coastal areas of Port Shelter.

13.3 Possible Impacts on the Environment

13.3.1 Possible impacts on the environment during the construction, operation and aftercare phases of the EWIL are outlined below. *Figure 13.1* provides details of identified sensitive receivers. The individual assessments are summarised in *Tables 13.1 and 13.2*.

Air Quality

13.3.2 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.
- 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.

13.3.3 No Air Sensitive Receivers (ASRs) are found within a 500m radius from the boundary of this site. Thus, no significant air quality impacts associated with reclamation, operation and construction of the landfill facility within the site are anticipated.

13.3.4 The site lies in an open marine area, with no known developments (existing or planned) within 5km of the site boundary. The build-up of air pollutants is not anticipated.

13.3.5 Marine vessels will be the mode of transportation for waste delivery to the site. The amount of air pollutants resulting from the territory-wide waste delivery to the site will be less compared to a land based site that relies on road transport. 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 410km. Given the likely distance to be travelled, the regional impacts from waste transportation may be moderate.

Noise

13.3.6 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.

13.3.7 No noise sensitive receivers are found within a 300m radius from the boundary of this site. Thus, no significant noise impacts associated with reclamation, operation and construction of the landfill facility within the site are anticipated.

13.3.8 Although 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 offshore site with no NSRs 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.

13.3.9 Potential operational phase noise impacts would need to be considered in subsequent studies in the event that the island reclamation is used for other land uses (in addition to landfill) or a separate afteruse is developed on top of the landfill following completion of the land filling operations.

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

Water Quality

Baseline Conditions at the Site

13.3.11 The site is located within the Mirs Bay Water Control Zone (WCZ). The site is located at some distance offshore and is predominantly influenced by oceanic currents which flow to the south west in the winter and north east in the summer. Background water quality conditions have been established from EPD routine water quality monitoring stations, the latest available data being that collected in 2000, (EPD 2001). Locations of the nearest water quality monitoring stations (MM14 and MM15) are presented in *Figure 13.1*.

13.3.12 Water quality data for 2000 at the monitored stations indicates full compliance with the Mirs Bay WCZ Water Quality Objectives (WQOs) for key parameters such as dissolved oxygen, (DO), *E. Coli*, total inorganic nitrogen (TIN) and un-ionised ammonia.

13.3.13 The nearest regular EPD sediment monitoring station in this area is MS14, which lies approximately 1.3km to the southwest. Sediments at MS14 are considered to be uncontaminated according to EPD data. The potential for impacts associated with contaminated marine muds is considered to be limited.

Key Issues and Sensitive Receivers

13.3.14 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).

13.3.15 There are no Water Sensitive Receivers (WSRs) in the immediate vicinity of the site. The nearest WSRs are:

- Gazetted beach at Clear Water Bay First (18km); and
- Gazetted beach at Clear Water Bay Second (18km).

13.3.16 In addition, there are a number of ecological resources around the site that may be sensitive to any decline or change in water quality or sediment deposition / erosion patterns. Potential impacts upon these are discussed in the "Ecology" subsection. These receivers include:

- Corals and associated marine fauna at Victor Rock (3km);
- Corals at the Ninepin Group (11km);
- Bluff Island and Basalt Island SSSI;
- Potential Marine Park / Reserve at Bluff Island and North & South Ninepin;
- Potential Marine Park / Reserve at Long Ke Wan and Pak Lap Wan;
- Potential Marine Park / Reserve at Tai Long Wan;
- Occasional Finless Porpoise;
- Fisheries protection area at Clear Water Bay (9km); and
- Marine Reserve at Cape D'Aguilar (16km).

13.3.17 The locations and uses of the WSRs are shown in *Figure 13.1*.

Reclamation and Site Formation

- 13.3.18 The placement of fill for island construction may lead to localised increases in suspended solids levels. The water quality and hydrodynamic modelling indicated that the impacts of the island construction on SS were fairly small, and that no the predicted levels would not approach or exceed WQO. The highest SS level increase is predicted to occur at SC14 (12.75%) during the Phase 2 construction wet season.

Hydrodynamic and Water Quality Impacts Following Island Formation

- 13.3.19 The water quality and hydrodynamic modelling indicated that the presence of the artificial island would have minimal impacts on the accumulated flows through major channels, with the largest impact occurring in the Tathong Channel in the dry season, where a 1.49% increase is predicted. The modelling also indicated that the changes in the flow velocity fields would be small and localised. The predicted overall change in current magnitude is predicted to be 3.3% to the northeast and 16.3% to the southwest of the island.
- 13.3.20 For the hydrodynamic and water quality modelling, 46 sensitive receivers that are close to the site were selected for presentation. Of the 46 chosen indicator points, 12 are located in the Port Shelter WCZ (FC6-11, GB7-10, MP7 & SC16), 22 in the Mirs Bay WCZ (FP9, SC5-8, FN1a-d, MP4, 8-11, 8b, GT3 and SC12-14, 15, 17, 21), 1 in the Eastern Buffer WCZ (FC5), 1 in the Mainland waters (MF) and the remaining 10 in the Southern WCZ (NS6-7, SC3-4, 11, MR1, GB6, FP6, SC18 and GT2).
- 13.3.21 According to the dry season water quality modelling results, the predicted 90%ile DO for depth average and bottom layer ranged from 5.89 to 7.10mg/L which comply with the WQOs of ≥ 4 mg/L for depth averaged DO and ≥ 2 mg/L for bottom layer DO as well as the Mainland sea water quality standard of > 5 mg/L. Compared to the baseline water quality results, the largest percentage decrease in DO caused by the presence of the island would be less than 4% which were predicted at FC7 (Ma Nam Wat Fish Culture Zone and Trio Beach).
- 13.3.22 The predicted average salinity in the dry season ranged from 33.96 to 34.00ppt. The differences in salinity levels caused by the presence of the island would be minimal (less than 0.05%) 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.
- 13.3.23 The predicted dry season SS levels at the indicator points were in the range of 1.59 to 4.47mg/L. It is predicted that the waste disposal on the island would increase the SS levels at some of the sensitive receivers with the largest differences of 6.65%, 6.88%, 12.50% and 8.16% predicted at Station MP8b (Tai Long Wan), FC10 (Kai Lung Wan fish culture zone), FC11, (Tai Tau Chau fish culture zone) and GT3 (Green Turtle site near Port Island) respectively. Comparing to the WQO requirement 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 100mg/L, these differences are still considered small.
- 13.3.24 The predicted average dry season *E.coli* levels ranged from 1 to 45count/100mL which were well within the WQO of 610cfu/100mL as well as the Mainland standard of 200count/100mL.
- 13.3.25 The predicted average dry season UIA (0.00170 – 0.00349mg/L) at all indicator points were very small as compared to the WQO of 0.021mg/L as well as the Mainland standard of 0.02mg/L.

- 13.3.26 The dry season TIN levels ranged from 0.0456 to 0.0949mg/L and below the annual mean WQO for TIN of 0.1mg/L for both the Southern WCZ and Port Shelter WCZ and 0.3 and 0.4mg/L for the Mirs Bay WCZ and Eastern Buffer WCZ respectively. Since the WQO of TIN is an annual mean value, the predicted mean TIN levels for both the dry and wet seasons were averaged to represent the annual mean values. As a result, exceedances were found at SC3, SC4, SC11, SC16, SC18, GB6 and 7, FP6, GT2, MR1, NS6 and 7 and FC6 (ranged from 0.10 to 0.15mg/L). However, the averaged baseline values (0.10 to 0.15mg/L) at these 13 stations also exceeded the WQO. All these stations are located in Port Shelter WCZ and Southern WCZ with an annual mean WQO of 0.1mg/L. The predicted values at the remaining stations complied with their respective WQOs. The TIN results for the Mainland station (MF) also complied with the Mainland standard of 0.3mg/L for both the dry and wet season.
- 13.3.27 According to the wet season water quality modelling results, the predicted 90%ile DO for depth average ranged from 3.99 to 5.46mg/L and the values complied with the WQOs of ≥ 4 mg/L except for GB9 and FC7. The 90%ile DO of 3.99mg/L was predicted at both GB9 and FC7 which breached the WQO with a percentage difference of 0.25% and -6.34% as compared to the baseline values of 3.98 and 4.26mg/L respectively. At other stations where there was a decrease in 90%ile DO levels, the percentage reduction were all below 3.0%. The DO results for MF (4.79mg/L) also breached the Mainland standard of 5mg/L.
- 13.3.28 For 90%ile bottom DO, the values ranged from 1.44 to 5.17mg/L. Only FC8 (Fish Culture Zone at Kau Sai) with value of 1.44mg/L breached the WQO of ≥ 2 mg/L for bottom DO level. However, the baseline values of FC8 also breached the WQO.
- 13.3.29 The predicted average wet season salinity ranged from 24.98 to 31.22ppt. Comparing to the baseline water quality results, the percentage differences in salinity caused by the presence of the island were small (less than 3%) 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.
- 13.3.30 The predicted wet season SS levels at the indicator points were in the range of 1.62 to 4.57mg/L. It is predicted that the island would increase the SS levels at most of the sensitive receivers with the largest differences of 6.78%, 8.24%, 8.96%, and 18.70% predicted at Station SC11 (Po Toi Island surveyed corals), GB10 (Silverstrand Beach), GB9 (gazetted beach at Hebe Haven) and FC7 (Fish Culture Zone at Ma Nam Wat) respectively. Compared to the WQO requirement 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 100mg/L, these differences are still considered acceptable.
- 13.3.31 The predicted average wet season *E.coli* levels ranged from 1 to 32count/100mL and well below the WQO of 610cfu/100mL and the Mainland standard of 200count/100mL.
- 13.3.32 The predicted average wet season UIA (0.00310 – 0.00709mg/L) at all indicator points were low and well below the WQOs of 0.021mg/L for annual mean and the Mainland standard of 0.02mg/L. The largest percentage increase caused by the island as compared with the baseline scenario was at GB9 (gazetted beach at Hebe Haven) and FC7 (Fish Culture Zone at Ma Nam Wat) with values of 7.91% and 7.59% respectively.
- 13.3.33 For the predicted wet season TIN levels, the values were quite high and ranged from 0.0685 – 0.2163mg/L. The largest two levels were at GT2 (Green Turtle site at Po Toi) and SC3 (surveyed corals near Beaufort Island) with values of 0.2163 and 0.2093mg/L respectively. Compliance of the predicted values with the annual mean WQO for TIN is discussed in Section 13.3.26.

Cumulative Impacts

- 13.3.34 A proposed submarine gas pipeline connecting the Liquefied Natural Gas Receiving Terminal (GRT) at Cheng Tou Jiao in China to the Power Station at Lamma Island is currently under examination. The overall feasibility and preferred alignment has not been confirmed. If the project proceeds, the alignment is likely to run in close proximity to the EWIL site. It is assumed that construction would be completed before works on an island landfill. However, if construction works for these two projects were to be undertaken concurrently, there would likely be cumulative water quality impacts, in particular the localised increased in suspended solids and associated impacts.
- 13.3.35 The open sea mud disposal areas at East of Ninepin and East Tung Lung Chau are currently being used for disposal of uncontaminated muds. These are discussed further in Chapter 12 (East Tung Lung Island Landfill). Although only uncontaminated mud is being disposed of at these sites, there may be cumulative impacts on the water quality in term of elevated suspended solid level if the EWIL starts before the end of the service life of the disposal areas.
- 13.3.36 The extent and magnitude of cumulative impacts would be considered further at the detailed EIA stage of the project when further details of the implementation programmes are known.

Waste Management / Disposal Impacts

- 13.3.37 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 in the SAR. The location of barging points would vary during the filling process, according to the source of materials at any given time.
- 13.3.38 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.
- 13.3.39 Anticipated volumes of materials are as follows:
- Volume of public fill that could be accepted for island construction: 400Mcum
 - Volume of muds be dredged for outer sea wall: 25Mcum
- 13.3.40 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.
- 13.3.41 Regarding the GHG emissions, waste delivery to the site will be by marine vessel which will have a lower GHG emission per kg waste handled than road transport given the fact that its capacity is almost 100 times larger than a truck. However, the cumulative distance between marine RTSs and the site is around 410km (referred to Preliminary Marine Review (March 2002)), the impacts associated with GHG emissions is considered to be moderate.

Ecology

Baseline Conditions

- 13.3.42 Due to the remoteness of the site, there are relatively few ecological resources of recognised conservation interest in the near vicinity of the EWIL. However there are sites of high ecological value closer to the Sai Kung and Clear Water Bay Peninsulas.

- 13.3.43 The isolated islands and submerged rocks of the Eastern Waters support some of the most diverse and locally important coral habitats in Hong Kong (ERM 1998a)¹. This includes the coral habitats found at the Ninepin Group of islands and Basalt Island (both about 11km west of the EWIL) as well as Victor Rock, the submerged rocky pinnacle about 3km north west of the site. These sites are characterised by diverse communities of hard and soft coral, gorgonians, sponges, holothurians, sea urchins, sea fans and fish species. The Bluff Island and Basalt Island SSSI (11km to the west) has been designated primarily due to its unique grassland community, however, the value of rocky shore communities on both islands is graded as high. In addition, a study is currently being carried out by Hong Kong Institute of Education² to determine the suitability of the area around Sai Kung Peninsula (Bluff Island to Tai long Wan) for designation as a Marine Park or Marine Reserve.
- 13.3.44 Underwater dive surveys of Victor Rock and East Ninepin (Shue Long Chau) indicated a high diversity and abundance of marine ecology at Victor Rock and a medium to high diversity and abundance of marine ecology at East Ninepin. Both sites were noted as having a “high conservation value” (Binnie, 1995c)³. Six major types of corals including all hard (stony) corals are protected in the HKSAR under the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187).
- 13.3.45 The benthic habitat in the general area of the EWIL, is characteristic of soft sediments, regular trawling in the area has resulted in a uniformly disturbed habitat. Grab samples taken at the East of Ninepin disposal ground showed that the recolonised dumped material was distinct from surrounding reference stations, being dominated by spionid polychaetes with an overall lower diversity (ERM 1997d4). The surveyed areas were categorised as being “moderately disturbed”.
- 13.3.46 According to recent cetacean survey data, the site is outside of the range of Chinese White Dolphin and there is a low density of sightings of Finless Porpoise, the core area of which is around Ha Mei Tsui at the south west of Lamma Island.

Direct Habitat Loss

- 13.3.47 The site footprint covers a surface area of 875ha. As result of the disturbance due to extensive trawling in the area, it is anticipated that there will be no benthic species of particular ecological interest in the area and loss of this habitat is unlikely to be significant.

Water Quality / Hydrodynamics

- 13.3.48 Dredging and reclamation activities may result in noise disturbance and changes in water quality, which in turn may drive the Finless Porpoise out of the area. Any deterioration in water quality would also drive fish from the area due to their sensitivity to increased suspended sediment levels, resulting in reduced feeding opportunities for the Finless Porpoise. However as this is not a core habitat for this species, impacts are anticipated to be acceptable.

¹ ERM-Hong Kong Ltd (1998A) Environmental Impact Assessment, of Backfilling marine Borrow Areas at East of Tung Lung Chau. Civil Engineering Department, Hong Kong Government

² Hong Kong Institute of Education. Study on the suitability of Tai Long Wan Area as marine park or marine reserve
Hong Kong Institute of Education. Study on the suitability of Long Ke Wan and East High Island Dam, Pak Lap Tsai and Pak Lap as marine park or marine reserve.
Hong Kong Institute of Education. Study on the suitability of Bluff Island, North and South Ninepin as marine park or marine reserve.

³ Binnie Consultants Limited (1995c) Fill Management Study - Phase IV Investigation and Development of Marine Borrow Areas: Marine Ecology of Hong Kong: Report on Underwater Dive Surveys Oct 1991 – Nov 1994 Vol I. Civil Engineering Department, Hong Kong Government.

⁴ ERM-Hong Kong Ltd (1997d) Seabed Ecology Studies: East of Ninepins Final Report, Civil Engineering Department, Hong Kong Government.

- 13.3.49 There is potential for adverse water quality impact on sub-tidal coral communities, from sediment deposition and increased turbidity that may affect photosynthetic activity of this diverse and ecologically fragile community. The results of the water quality / hydrodynamic modelling exercise show that levels of suspended solids at various sensitive receivers in Inner Eastern Waters would be above background concentrations to the order of around 5mg/L. Taking a precautionary approach, such an increase may adversely affect the sub-tidal coral and associated benthic community.
- 13.3.50 Given its closer proximity to the site, the ecologically sensitive Victor Rock coral habitat (SC14) is potentially more at risk from the effects of sediment disturbance / transport and the effects of any increase in other water quality parameters. This location represents the worst-case scenario for all ecologically sensitive receivers modelled in the area.
- 13.3.51 During the construction phase, the model output shows that suspended sediment levels in the vicinity of the coral community at Victor Rock (SC14) during the wet season Phase 1 works (i.e., initial filling of the water column) increase by 10.55% above the baseline level. This is equivalent to a mean daily sedimentation rate of 2.2 g/m² that, depending on the actual deposition area, could potentially generate give rise to an adverse impact on the coral community. Likewise, during the Phase 2 construction wet season there is a predicted increase over the baseline of 4.3 g/m²/day; with sedimentation from Phase 3 construction wet season predicted to be 2.3 g/m²/day.
- 13.3.52 The worst-case dry season scenario would be a predicted mean sedimentation rate of 0.2 g/m²/day; insignificant when compared with the sedimentation limit of 100 g/m²/day.
- 13.3.53 Following construction of the EWIL, the island site may result in changes to the hydrodynamics of the area, including slightly increased velocities in the north south direction between the island and the Sai Kung Peninsula, with a possible reduction in circulation within Inner Port Shelter. Any minor increase in flow velocities would benefit filter-feeding opportunities for the coral and the benthic communities around the Ninepin and Basalt Island. Any reduction in flows within Port Shelter would likely reduce the flushing capacity of these sheltered waters with a consequent negative impact upon fish fry and capture fisheries.
- 13.3.54 With respect to the effect on hydrodynamics from the operational EWIL, as predicted by the numerical model, there is no significant change in the flux of water at two key assessment points in the vicinity of the EWIL. From this it can be confirmed that no significant hydrodynamic effects would arise.
- 13.3.55 As regards potential changes in water quality induced by hydrological change, there would be no significant change. Model output data in the vicinity of Victor Rock shows no significant change in concentrations of key parameters during the wet season (i.e., worst-case scenario). The greatest percentage change is predicted for Total Inorganic Nitrogen (TIN) with a 1.24% increase (to 0.122mg/L). A decline in salinity at Victor Rock of 1%, or 0.3ppt is also predicted. As such, there would be no negative impacts upon the coral communities in the vicinity.
- 13.3.56 The worst-case increase in suspended sediment levels at the coral communities closest to the potential EWIL is 0.07mg/L at SC13 (coral near Pak Lap Wan) during the dry season, and an increase of 0.08mg/L at SC8 (coral near Basalt Island) during the wet season. The increase under both of these scenarios is negligible and of no impact potential to the coral communities.

Marine Vessel Disturbance

- 13.3.57 It is known from data on strandings of Finless Porpoise specimens that vessel collision is a significant cause of death (Jefferson, 2001). Whilst the area is not a core area for the species, the increase in marine traffic required for site formation and landfill operations could lead to an increase in incidences of vessel collision.

Fisheries

- 13.3.58 The fisheries of the sites located in the Eastern Waters, (M8, M9 and M10) are generally of low significance compared to other fishing areas in Hong Kong waters. The Eastern Waters as a whole are productive, but this productivity tends to be restricted to inland areas. Trawl catches at Ninepin, Basalt Island waters are characterised by high biomass of commercially valuable Grouper, Yellow Croaker and Pomfret species. Purse seine vessels are based mainly in ports in the Eastern Waters of Hong Kong and concentrate their activity there. Less than 7% of their time is spent fishing outside Hong Kong waters and their catches contribute the largest portion of the entire fishing fleets catch from Hong Kong waters, (ERM 1998⁵).
- 13.3.59 Port Shelter is recognised as a nursery area for commercial fish species and it also includes a number of fish culture zones. In addition, the Artificial Reef Deployment Study (ERM 1999a⁶) has identified an area adjacent to Basalt Island as being suitable for construction of an artificial reef. Due to the importance of the fisheries in the Port Shelter area, two key initiatives have been proposed for the area. Under the second phase of the AFCD's artificial reefs programme a "no take AR deployment area" was proposed at Outer Port Shelter, whilst a working group on fisheries management proposed the establishment of a Fisheries Protection Area at Port Shelter⁷.
- 13.3.60 As noted above, the presence of the island site may result in minor changes to flow patterns in and around Port Shelter, possible affecting the fisheries resources in this relatively sheltered bay. However, effects are anticipated to be minimal. Marine dredging works will have potential to affect fisheries in the area; again impacts are not anticipated to be significant. Overall, the potential impact of constructing the EWIL upon fisheries resources is considered limited primarily due to its remoteness to areas of high fisheries value.

Cultural Heritage

- 13.3.61 This site is located some distance offshore. There is no immediate evidence of archaeological remains in this area or in the near vicinity. The nearest sites of known archaeological interest are located at the Sai Kung Peninsula. In addition, an historic shipwreck was found in the waters now occupied by High Island Reservoir (formerly known as Kwun Mun Channel) in 1974. The shipwreck, dating to late Song-early Ming Dynasties, was found during the construction of the High Island Water Scheme. Together with the shipwreck, some pottery and porcelain shards and glass beads of Indian origin were also recovered.
- 13.3.62 Given the remoteness of this site from known land based sites of cultural heritage interest, the likelihood of archaeological remains in this area appears limited. However, given 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

- 13.3.63 *Landscape Planning Designations* – This area of seascape is not covered by any planning designations reflecting landscape values and so there will be no impact on these values.
- 13.3.64 *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.

⁵ ERM-Hong Kong Ltd (1998) Fisheries Resources and Fishing Operations in Hong Kong Waters, Agriculture & Fisheries Department, Hong Kong Government.

⁶ ERM-Hong Kong Ltd (1999a) Artificial Reef Deployment Study: Technical Paper 3 – Site Selection, Agriculture & Fisheries Department, Hong Kong Government.

⁷ AFCD (2001). Fisheries. [<http://www.afcd.gov.hk/web/english/fisheries/fish/>].

- 13.3.65 *Landscape Character* - The island landfill site falls within the Eastern Coastal Waters Landscape Character Area. The seascape of this part of Hong Kong is an expansive area of open water to the East of Clear Water Bay Peninsula, lying on the edge of the boundary of the HKSAR waters (*Figures 13.3 and 13.4*). There are no major shipping channels in the vicinity of EWIL and the most notable features are the remote Ninepin Group of islands that is approximately 10km west of the site. The islands are steep-sided, uninhabited and covered only with grass and form a coastal landscape character which is rugged and remote.
- 13.3.66 There exists potential for significant impacts on landscape character resulting from construction works that will introduce new artificial elements incompatible with the existing natural and tranquil landscape character. The predicted impact on landscape character during the construction/operation phase of the project will be substantial. At the end of the construction/operation phase, these impacts are likely to be reduced, as the completed island is restored and the landscape mitigation measures are fully implemented. However, the scale of the island is large and the form and the profile of the island and the coastal edge finishing will be rather artificial in nature. The character of the proposed island is therefore incompatible with the existing natural landscape character. As a consequence, the long-term impact on landscape character will be moderate/substantial.
- 13.3.67 *VSRs* – *VSRs* affected by the island landfill are identified in *Tables 13.3 and 13.4*. The extent of the project visual envelope is shown in *Figure 13.5* and the key views to the island landfill are shown in *Figure 13.6*.
- 13.3.68 As the island landfill site is approximately 16km from the Clear Water Bay Peninsula, there are no *VSRs* close to the site. *VSRs* that will be the most affected are very few recreational receivers that use the area for passive and active recreation. However, the magnitude of impact on them will be small. Other distant recreational *VSRs* will be affected at Shek O, Clear Water Bay, Tai Wan Beach of Tai Long Wan/Maclehose Trail, Leung Shuen Chau. Other receivers, such as travellers on vessels using the shipping route, are often transient. Generally, all *VSRs* are far away from the site, and the residual visual impact during the construction/operation and afteruse phase will be insubstantial.
- 13.3.69 *Mitigation Measures* – Landscape and visual mitigation measures are identified in Part A of the Report and are illustrated in *Figure 13.8*.

Landfill Gas

- 13.3.70 There are no sensitive receivers (targets) or pathways within 500m of the site and therefore no potential off-site landfill gas hazard. 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.
- 13.3.71 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.

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

- 13.4.1 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 site-specific to EWIL.

Air Quality

- 13.4.2 No specific air quality mitigation measures are recommended at this stage, other than good site practice as described in Part A (Section 5).

Noise

- 13.4.3 No specific noise mitigation measures are recommended at this stage, other than good site practice as described in Part A (Section 5).

Water Quality

- 13.4.4 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 the EIA. If significant impacts are predicted, a silt curtain may be installed around the immediate works area to prevent dispersion of sediments.

Waste Management / Disposal Impacts

- 13.4.5 No specific waste management mitigation measures are recommended at this stage, other than good site practice as described in Part A (Section 5).

Ecology

- 13.4.6 No specific mitigation measures to protect ecological resources are recommended at this stage, other than good site practice as described in Part A (Section 5).

Fisheries

- 13.4.7 There are no particular measures that are proposed for fisheries resource protection.

Cultural Heritage

- 13.4.8 There are no particular measures that are proposed for protection of cultural heritage resources.

Landscape & Visual

- 13.4.9 Landscape and visual mitigation measures are identified in Part A of the Report and are illustrated in *Figure 13.8*.

13.5 Summary

13.5.1 A summary of the SEA for the EWIL is shown in *Tables 13.1 and 13.2*:

Table 13.1: Evaluation Summary for Eastern Waters Island Landfill SEA

	Impacts	Score	Commentary
Air Quality Assessment			
1	Distance to areas of air sensitive land use	○	There are no air sensitive receivers (ASRs) within 500m of the artificial island site.
2	Presence of topographic features which could decrease or exacerbate impacts	○	The site does not lie within any airshed and generally experiences wind. It is unlikely that dust or odours would accumulate around the site.
3	Occurrence of meteorological conditions which could exacerbate impacts	○	Winds blow both towards and away from ASRs. No prevailing wind direction has been identified.
4	Cumulative Impacts of relevant emissions (TSP (construction), NO _x , CO, SO ₂ – LFG Flare) taking into account ambient conditions	○	The site is located in open marine waters to the southern HKSAR waters fringe, with no known developments that have relevant emissions within 5km from the site.
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 410km.
6	Overall Impact	○ / -	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	○	There are no noise sensitive receivers (NSRs) within 300m of the artificial island site.
2	Topographic Features (only applicable if there are NSRs within 300m)	○	The site is located within open marine waters with no NSRs located within 300m from the site boundary. Therefore, this criterion is not applicable.
3	Cumulative Impacts of developments within 300m	○	There are no known developments (existing or planned) within 300m of the site.
4	Overall Impact	○	' Neutral '.

	Impacts	Score	Commentary
Water Quality Assessment			
1	Water Course Diversion	0	Artificial island. Not relevant.
2	Potential for sediment contaminant release	0	None. EPD routine sediment quality monitoring data collected near to EWIL shows that the marine sediment is not contaminated.
3	Potential impacts on WSRs (including increase or exceedance of WQO)	0 / -	<p>The presence of the artificial island will result in very minor changes to the hydrodynamics in the area. No WQO exceedance would be caused in the construction phases.</p> <p>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.</p>
4	Potential Impacts on Groundwater	0	Artificial island. Not relevant.
5	Potential Cumulative Impacts	0 / -	There are a number of dredging and backfilling projects in the area, (East Tung Lung / E of Ninepin) which may contribute to the filling related pollutants in the water column. Assumed that the potential submarine gas pipeline connecting (GRT) at Cheng Tou Jiao in China to Lamma PS would be completed prior to EWIL construction.
6	Overall Impact	0 / -	'Neutral / Negative – Low' . The site is some distance from WSRs, however marginal decrease in water quality anticipated during construction and operation.
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 (400Mcum) 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 410km.
3	Overall Waste Impact	0	'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"	-	Whilst distant, minor impacts possible at the Bluff Island & Basalt Island SSSI and Marine Reserve at Cape D'Aguilar (11km and 16km to the west, respectively). In addition, a Conservation Area has been proposed around Sai Kung Peninsula, (Bluff Island to Tai Long Wan).
2	Affects an important habitat	- / - -	<p>The primary concern regards potential sedimentation and increased turbidity of the water column around the ecologically sensitive Victor Rock (~3km from the potential EWIL) that is habitat to a diverse coral community of conservation importance. The Inner Eastern Waters also support scattered coral communities of conservation value that could potentially be adversely affected by filling works.</p> <p>The area is not a core part of the Chinese White Dolphin or Finless Porpoise habitat. Benthic habitats are not of high conservation value.</p>
3	Affects a species of conservation importance	- / - -	<p>All hard (stony) corals, such as those prevalent at Victor Rock, are protected in the HKSAR under the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187).</p> <p>The Finless Porpoise is listed under Appendix I of CITES and is protected under the Wild Animals Protection Ordinance (Cap. 170). The density of sightings in this area is moderate.</p>
4	Potential for Cumulative Ecological Impacts on species / habitat of recognised value	-	There are a number of dredging and backfilling projects in the area, (East Tung Lung / E of Ninepin) which may contribute to the filling related pollutants in the water column. The Lamma Power Station / Shenzhen submarine gas pipeline would be completed prior to EWIL construction.
5	Overall Ecological Impact	- / - -	Although modelling does not predict significant water quality decline associated with the works, the area is of broad conservation value as illustrated by the proposal to designate a Conservation Area around the Sai Kung Peninsula. In particular, the area is of conservation value due to the presence of ecologically valuable and sensitive coral reef habitat at Victor Rock, and a range of scattered coral communities around Inner Eastern Waters. As such, the overall impact potential is 'Negative – Low / High' .

	Impacts	Score	Commentary
Fisheries Assessment			
1	Potential for secondary environmental impacts on "Areas of Absolute Exclusion"	-	There are no existing "Areas of Absolute Exclusion" likely to be affected by the works. However, a Fisheries Protection Area has been proposed at Port Shelter, with a "no take artificial reefs deployment area", proposed at Outer Port Shelter. Whilst there is some potential for impact, the output of the numerical modelling exercise does not support the potential for direct impacts.
2	Affects an important mariculture / fisheries resources (including spawning / nursery ground)	-	The fishing zone in the vicinity of the site has generally low fisheries productivity in the HKSAR. Spawning and nursery ground for a range of commercially important fish and crustaceans are found some distance from the site at Port Shelter.
3	Potential for Cumulative Fisheries Impacts on sites of recognised value	-	Backfilling projects in the area, (East Tung Lung / E of Ninepin) may contribute to the filling related pollutants in the water column negatively impacting fish species.
4	Overall Impact	-	Fisheries impacts are considered to be ' Negative – Low '. The site area itself is of relatively low fisheries importance. The nearest areas of high value fisheries are located at inland waters. However the Port Shelter area to the west is also a nursery ground where fisheries protection measures including a FPA and artificial reef have been proposed.
Cultural Heritage Assessment			
1	Important cultural (Declared, Deemed or Graded sites) / archaeological sites	0	There are no known sites of cultural heritage significance.
2	Potential for archaeological value	-	The site is remote from land based archaeological sites with links to maritime activities. An historic shipwreck together with pottery / porcelain shards and glass beads was found in the waters now occupied by High Island Reservoir in 1974. Notwithstanding the lack of archaeological data currently available at the site, it is considered that the likelihood of archaeological remains in this area is limited. A detailed marine archaeological investigation should be carried out in any future studies.
3	Potential for Cumulative Heritage Impacts on sites of recognised value	0	There are no planned or confirmed projects, which may cause cumulative heritage impacts.
4	Overall Impact	0	' Neutral '. The potential impacts on cultural heritage are considered to be negligible. Whilst the occurrence of a shipwreck at High Island Reservoir is of interest, the site is remote from land based archaeological sites with links to maritime activities. A detailed marine archaeological investigation should be carried out in any future studies.

	Impacts	Score	Commentary
<i>Landscape and Visual Impact Assessment</i>			
1	Implications for Landscape Planning and Designations	○	This area of seascape is not covered by any planning designations reflecting landscape/seascape values and so there will be no impact on these values. Overall impacts will therefore be Neutral.
2	Impacts on Landscape Resources	○	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	--	Construction and operation of the island will be incompatible with the open and natural and tranquil landscape qualities of the area. Once completed, the afteruse mitigation will reduce the overall impact of the island a little. However, this landfill will still be incompatible with existing landscape character and resulting impacts will be Negative – High.
4	Visual Impacts	-	The number of VSRs affected by the site is very few and most of these are very distant. The most affected VSRs are a limited number of recreational VSRs which use the area for passive and active recreation. Generally therefore, visual impacts will be Negative – Low.
5	Overall Impact	-	Overall, landscape and visual impacts will be 'Negative – Low' for the following reasons: <ul style="list-style-type: none"> • There are no landscape designations covering the disposal site; • No significant landscape resources are affected; • The open, natural and isolated landscape character of the Eastern 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.
<i>Landfill Gas Assessment</i>			
1	Distance between the new / extended landfill and SRs	○	The nearest sensitive receivers are >250m from the site.
2	Number of Receivers within 250m (i.e. the LFG Consultation Zone)	○	There are no sensitive receivers within 250m of the site.
3	Man Made/Natural Pathways for LFG Migration	○	None.
5	Additional Utilisation of LFG to Reduce Greenhouse Gas Emissions	○	There are no potential users of LFG (other than on-site use)
6	Overall Landfill Gas Impact	○	'Neutral' .

Table 13.2: Summary of Eastern Waters Island Landfill SEA

Overall Impacts	Score	Commentary
Overall Air Quality Impact	0 / -	Neutral / Negative – Low
Overall Noise Impact	0	Neutral
Overall Water Quality Impact	0 / -	Neutral / Negative – Low
Overall Waste Management Impact	0	Neutral
Overall Ecological Impact	- / - -	Negative – Low / High
Overall Fisheries Impact	-	Negative – Low
Overall Cultural Heritage Impact	0	Neutral
Overall Landscape & Visual Impact	-	Negative – Low
Overall Landfill Gas Impact	0	Neutral

Table 13.3 Assessment of Significance of Visual Impacts of Eastern Waters Island 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 Receivers (order of magnitude only)	Magnitude of Impact During Construction (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)
<i>Recreational Receivers</i>							
VR68	Shek O	23km	Many	Negligible	Medium	Insubstantial	Insubstantial
VR69	Clear Water Bay	16km	Many	Negligible	Medium	Insubstantial	Insubstantial
VR70	Tai Wan Beach, Tai Long Wan/Maclehose Trail	16km	Few	Negligible	Medium	Insubstantial	Insubstantial
VR71	Leung Shuen Wan Chau (High Island)	19km	Few	Negligible	Medium	Insubstantial	Insubstantial
VR11	Area for Boating, Fishing, Diving and other Water sports activities	0-15km	Very Few	Small	Medium	Moderate to Slight	Insubstantial
<i>Travelling Receivers</i>							
VR49	Maritime Vessels	10-20km	Few	Negligible	Low	Insubstantial	Insubstantial

Table 13.4 Assessment of Significance of Visual Impacts of Eastern Waters Island Landfill During Afteruse Phase
(Note: All impacts are adverse unless otherwise noted)

Identity No. of VSR	Key Visually Sensitive Receiver (VSR)	Approx Minimum Distance Between VSR and Source(s)	No.s of Receivers (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)
<i>Recreational Receivers</i>							
VR68	Shek O	23km	Many	Negligible	Medium	Insubstantial	Insubstantial
VR69	Clear Water Bay	16km	Many	Negligible	Medium	Insubstantial	Insubstantial
VR70	Tai Wan Beach, Tai Long Wan/Maclehose Trail	16km	Few	Negligible	Medium	Insubstantial	Insubstantial
VR71	Leung Shuen Wan Chau (High Island)	19km	Few	Negligible	Medium	Insubstantial	Insubstantial
VR11	Area for Boating, Fishing, Diving and other Water sports activities	0-15km	Very Few	Small	Medium	Moderate to Slight	Insubstantial
<i>Travelling Receivers</i>							
VR49	Maritime Vessels	10-20km	Few	Negligible	Low	Insubstantial	Insubstantial