

# **Integrated Waste Management Facilities Site Selection Report**

## **PURPOSE**

This report presents the results of the site selection exercise for the development of Integrated Waste Management Facilities (IWMF) in Hong Kong.

## **BACKGROUND**

### **Imminent Waste Management Problems in Hong Kong**

2. Hong Kong has an imminent waste problem. At present, we rely solely on landfills to dispose of our waste. However, Hong Kong's waste arising has grown considerably in the past decades and our existing landfills would be filled up within the next few years. To tackle our municipal solid waste (MSW) problem in a holistic manner, the Government published "A Policy Framework for the Management of MSW 2005-2014" (Policy Framework) in December 2005. The Policy Framework has laid down a comprehensive set of policy tools and initiatives to reduce MSW generation at source, to promote recovery and recycling of waste and to treat unavoidable waste properly by advanced technologies such as state-of-the-art incineration technology. The aim is to achieve the following three waste management targets-

- (a) to reduce the amount of MSW generated in Hong Kong by 1% per annum up to the year 2014, based on the 2003 levels;
- (b) to increase the recovery rate of MSW to 45% by 2009 and 50% by 2014; and
- (c) to reduce the total MSW disposed of in landfills to less than 25% by 2014.

3. Based on the waste statistics for 2006, the first year implementation of the Policy Framework initiatives, the recovery rate of domestic waste increased from 16% in 2005 to 20% in 2006, largely as a result of enhanced community

efforts in joining the Source Separation of Domestic Waste Programme. The overall recovery of MSW also increased from 43% in 2005 to 45% in 2006, three years ahead of the target listed in paragraph 2(b) above. However, despite our efforts in waste reduction, the amount of MSW generated remains on an increasing trend. Even though the amount of waste land-filled was reduced by 1%, MSW generated in 2006 actually increased by 3.6%. In the meantime, the capacities of our three strategic landfills, viz. the West New Territories (WENT) Landfill, the South East New Territories (SENT) Landfill and the North East New Territories (NENT) Landfill are fast depleting. Even with the full implementation of the waste reduction and recycling measures under the Policy Framework, the three landfills will be exhausted one by one within the next 10 years. Immediate action is required to expand the existing waste management facilities and develop new waste treatment facilities, in order to avert our waste crisis and to achieve our long-term waste management targets.

### **The Need for More Sustainable Technological Solution**

4. In order to achieve the target of reducing MSW disposed of in landfills to less than 25%, we cannot solely rely on landfills as the final waste treatment method. We must adopt other waste treatment technologies. To identify advanced waste treatment technologies worldwide that is appropriate for Hong Kong, in April 2002 we invited Expression of Interest (EOI) from local and international waste management industry to submit proposals for the development of IWWMF. An Advisory Group on Waste Management Facilities (AG), which is chaired by the Permanent Secretary (Environment) and comprises non-official members from professional bodies, academia, green groups and business sectors, has been set up to assist and advise in the technology selection exercise.

5. In accordance with the EOI assessment, the AG recommended that the IWWMF would adopt a multi-technology approach such that the most suitable technology could be applied to deal with different waste streams of MSW. Overall there are three fundamental technologies -

- (a) Biological Treatment - including composting and anaerobic digestion which would treat source-separated biodegradable materials such as food waste;
- (b) Mechanical-Biological Treatment (MBT) - comprising mechanical

and biological processes which recover recyclable materials and treat biodegradable fraction from mixed waste;

- (c) Thermal Treatment – incinerating the unavoidable mixed waste not handled by biological treatment or MBT and recovering the energy contained.

6. Among the above treatment technologies, state-of-the-art thermal technology, such as mass burn incineration, which could reduce the bulk size of waste significantly by some 90% and recover valuable energy, would play a key role in the context of overall waste management strategy. Modern incineration technology is well proven by its use in many technological advanced and environmentally conscientious countries, such as Germany, the Netherlands, Singapore and Japan. Modern incineration facilities adopting advanced process control measures and advanced pollution abatement equipment can meet the most stringent international emission standards. They can also recover energy through heat and electricity generation thereby reducing the use of fossil fuel and curbing greenhouse gas emissions.

7. MBT on the other hand occupies a large area and the product outlets are uncertain. The Advisory Council on the Environment (ACE) considered that mechanical sorting and recycling could be viable but their implementation hinge on the provision of a collection system for recyclables and related infrastructures which are not yet available. Recognizing this and the limitations of MBT, and with reference to international trend of MBT developments, it is more suitable to have a demonstration-scale sorting and recycling operation which could provide useful local experience for future consideration of the technology.

**8. In summary, we propose that the integrated facility solution would comprise an Organic Waste Treatment Facility (OWTF) employing biological treatment technology for source-separated organic waste, and also the Integrated Waste Management Facilities (IWMF) with thermal treatment as the core technology plus a demonstration-scale sorting and recycling plant for mixed MSW.**

## SITE SELECTION

9. After the promulgation of the Policy Framework in December 2005, we have worked together with concerned government departments and have engaged a consultant, Camp Dresser & McKee International Inc. (the Consultant), to start conducting a site search exercise for the IWWMF. The approach and the assessment results for the site search exercise are presented as below.

10. Instead of integrating the three technological components at a single site under a single programme, we consider that it is more practicable to develop them under separate programmes for the ensuing reasons. Currently Hong Kong produces about 3 200 tonnes per day of food waste of which 700 tonnes per day is generated from the commercial and industrial sectors that could be more easily separated at source for collection. On the other hand, domestic MSW is now mixed with food waste, which cannot be easily separated.

11. Food waste is not suitable to be compacted at the existing refuse transfer stations for transportation. It should be transported directly to an OWTF developed under separate programme for specialized treatment. Moreover, in consideration of the need to progressively develop logistic arrangements for collection of source separated food waste, our plan is to proceed with the development of OWTF in two phases at two different locations. The first phase of the OWTF, with a design capacity of 200 tonnes per day (tpd) is planned to be built in Siu Ho Wan of Lantau Island. The second phase will be of similar capacity<sup>1</sup> and to be built in Sha Ling of the North District.

12. The other component of the integrated waste management strategies, i.e. thermal treatment of the main mixed MSW stream with the possibility of incorporating a small scale sorting and recycling plant is the subject of a site search study, the findings of which are now available.

13. We plan to develop the IWWMF in phases. Having regard to the need to have the IWWMF with a reasonable scale so as to achieve economy of

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<sup>1</sup> The total capacity of the OWTF will be about 400 tpd and this will leave room for the commercial and industrial sectors to develop their own treatment facilities.

scale and having regard to the capacities of waste treatment facilities in overseas having similar demographic and geographic characteristics of Hong Kong, we propose the IW MF would adopt a treatment capacity of about 3 000 tpd for the initial phase. The required treatment capacity for the remaining phase would be determined following our review of the implementation of the first phase of the IW MF, the progress of various waste management initiatives and the reduction as well as the recycling rates of the waste in Hong Kong. Together with the associated facilities, the initial phase of IW MF would occupy an area of about 10 hectares.

### Identification of Potential Sites

14. The site search exercise attempted to identify potential sites all over Hong Kong, taking into account environmental, technical / engineering, and economic considerations, as well as social impact and implications to consumers / users. At the start of the site search exercise, the Consultant made reference to the recommendations of the AG to exclude the following areas from consideration for the development of the IW MF (see Table 1).

**Table 1.** Areas not recommended by the AG for the development of the IW MF

- All areas for Residential and Commercial Use;
- All 23 existing or potential Country Parks;
- All existing or potential Marine Parks and Marine Reserves;
- All Special Areas (outside Country Parks);
- All Sites of Special Scientific Interest (SSSI) (including buffer areas);
- All Restricted Areas (Wildlife);
- The RAMSAR Site (including buffer area);
- All Green Belt (GB) and Urban Fringe Parks;
- All Conservation Areas (CA);
- All Coastal Protection Areas (CPA);
- All Water Gathering Grounds;
- All Wetlands Areas;
- All Fish Culture Zones;
- All Proposed Fisheries Protection Areas;
- All Gazetted Beaches;
- All Declared Monuments, Graded Historical Buildings and

Structures, Deemed Monuments and Archaeological Sites;

- All Cemeteries, Burial Grounds or Grave Zones;
- All Fairways and Shipping Lanes and Port Areas;
- All Airports and Restricted Areas around them (including the Military Airport);
- All Tunnels and Roads, existing and proposed Railways;
- All Other Major Infrastructure (including Castle Peak Firing Range);
- All Major Tourism Development Areas; and
- All Priority Sites for Enhanced Conservation promulgated under the New Nature Conservation Policy.

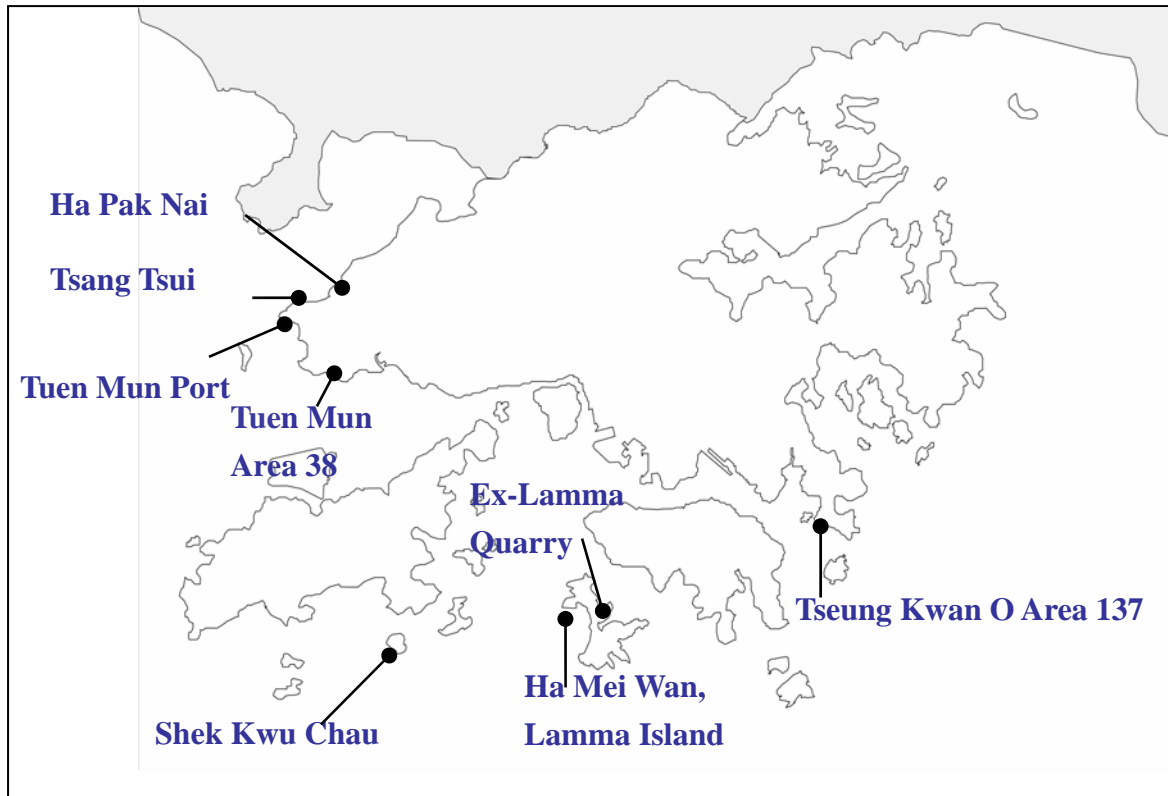
15. Apart from considering the recommendations of the AG, the Consultant also took account factors such as -

- (a) The IWMF should be located in areas compatible with neighboring activities;
- (b) It should have marine access; and
- (c) It should be less exposed to wave or typhoon in case outlying islands are chosen.

16. Having considered the above and the proposed sites for waste treatment facilities in our previous studies, an initial list of eight potential sites was drawn up as follows -

- Tseung Kwan O Area 137
- Ha Mei Wan, Lamma Island
- Ex-Lamma Quarry, Lamma Island
- Shek Kwu Chau
- Tuen Mun Area 38
- Tsang Tsui Ash Lagoons
- Ha Pak Nai
- Tuen Mun Port (near Black Point Headland)

Figure 1 shows the locations of the eight potential sites.



**Figure 1 – Potential Sites for the Development of IWMF**

17. Concerned government departments were invited to comment on the initial list with reference to the site requirements and location factors, and to advise a shortlist of potential sites for further assessment by the Consultant. With due consideration of site availability, land use, traffic, environmental, social and other relevant aspects, it was concluded that the last two of the above sites, namely Ha Pak Nai and Tuen Mun Port, be dropped for further consideration.

18. The reasons for dropping the Ha Pak Nai site are that it is located at the ecologically sensitive coastal area at Deep Bay and embraces numerous active fish ponds. The site is zoned as “Coastal Protection Area” on the Outline Zoning Plan and the proposed development of IWMF is not in line with the planning intention of the area. Moreover, it is located immediately next to the Ha Pak Nai Archaeological Site which is worthy of preservation.

19. As for Tuen Mun Port site, the site area has not yet been formed. The plan under a previous study was to use part of the site formed through reclamation for the proposed Tuen Mun Port Development (TMPD) project

to build the waste treatment facility. As currently there is no programme to implement the TMPD project and no reclamation has been carried out in that area, locating an IWMF on that site is therefore not possible. Moreover, the proposed site is very close to Lung Kwu Sheung Tan where a number of indigenous villages exist and that it is in close proximity to Lung Kwu Tan which has already been developed as a popular recreational spot. It is also close to the Sha Chau and Lung Kwu Chau Marine Park designated for the conservation of Chinese White Dolphins. All these have made the Tuen Mun Port site not suitable for IWMF development.

20. The remaining six sites therefore formed the basis of the Consultant's site selection assessment -

- S1 - Tseung Kwan O Area 137
- S2 - Ex-Lamma Quarry, Lamma Island
- S3 - Ha Mei Wan, Lamma Island
- S4 - Shek Kwu Chau
- S5 - Tsang Tsui Ash Lagoons
- S6 - Tuen Mun Area 38

### **Site Selection Assessment by the Consultant**

21. The Consultant then evaluated the performance of each of the six site options under five general categories, which are -

- (1) Environmental
- (2) Engineering / Technical;
- (3) Economics;
- (4) Social; and
- (5) Consumer & User (Community Impacts).

22. Under the above five general categories, there are 20 criteria considered which are listed out in Table 2.



**Table 2 – Major Siting Criteria**

<b>Major Criteria</b>	<b>Environmental</b>	<b>Technical/ Engineering</b>	<b>Economics</b>	<b>Social</b>	<b>Consumer &amp; User</b>
1. Air Quality	√				
2. Noise	√				
3. Visual and Landscape	√				
4. Ecology (Terrestrial)	√				
5. Drainage, Water Quality, Marine Ecology & Fisheries	√				
6. Land Use				√	
7. Land Ownership				√	
8. Traffic Impact				√	
9. Community Impacts					√
10. Ease of Integration with Existing or Planned MSW Infrastructure		√			
11. Site Access		√			
12. Constraints to Site Layout		√			
13. Utilities		√			
14. Construction Duration		√			
15. Construction Risk		√			
16. Operational Risk		√			
17. Capital Cost			√		
18. Operating Cost			√		
19. Opportunity Cost of Land			√		
20. Hazard to Life	√				

23. The assessment aimed at identifying those sites that would have significant adverse impacts if the IWMF was to be located there. Weightings were assigned to individual categories and criteria according to

their relative importance. Scores for each site would be calculated to reflect their suitability. Sensitivity tests were then conducted, during which the weighting for individual selection criteria was varied under different scenario so as to verify the robustness of the result. This evaluation was qualitative and based on the detailed assessments carried out under all previous related studies and the latest available data. Following the assessment, the Consultant prepared a draft site search report which was circulated to relevant Bureaux/Departments (B/Ds) for comments. With inputs from B/Ds, the Consultant further reviewed the assessment result and came to the following recommendations.

### **Assessment Result**

24. The outcomes of the assessment indicated that the Tseung Kwan O Area 137 (S1), Ex-Lamma Quarry, Lamma Island (S2), Ha Mei Wan, Lamma Island (S3) and Tuen Mun Area 38 (S6) had some major constraints and the Consultant did not recommend these sites for further engineering and Environmental Impact Assessment (EIA) studies.

#### **(a) Tseung Kwan O Area 137 (S1)**



**Figure 2 – Aerial View of Tseung Kwan O Area 137**

- The proposed site is located at the southwest edge of Area 137 reclamation near Tit Cham Chau in Tseung Kwan O. It has been reserved for the use of “Potentially Hazardous Installations (PHIs)”.
- This site is currently the only available site in Hong Kong designated for PHIs such as oil depots, gas production plants, explosive depots and liquefied petroleum gas bottling and storage facilities. Due to stringent safety requirements, there is great difficulty in identifying other PHIs sites that could meet with Hong Kong’s future PHIs needs. Hence, should this site be taken for the development of IWMP, there will be no other available site to accommodate Hong Kong’s future PHIs requirements.
- As the site is directly facing Siu Sai Wan, Chai Wan, and Heng Fa Chuen on the eastern side of Hong Kong Island as well as the Lohas Park of Tseung Kwan O, it would have significant visual impact on the substantial population residing in these areas.

**(b) Ex-Lamma Quarry, Lamma Island (S2)**

- The proposed site is located at the ex-Lamma Quarry at the northeast side of the island. It is directly facing a popular tourist spot, Sok Kwu Wan where seafood restaurants and a mariculture zone exist, and is in proximity to various indigenous villages such as Luk Chau village. The overall planning intention for Lamma Island is to conserve the natural landscape and rural character and to enhance the island as a leisure destination. Hence, the development of an IWMP at this location is not compatible with these existing landuse as well as the future development, and will fundamentally change the nature of this part of the Island.



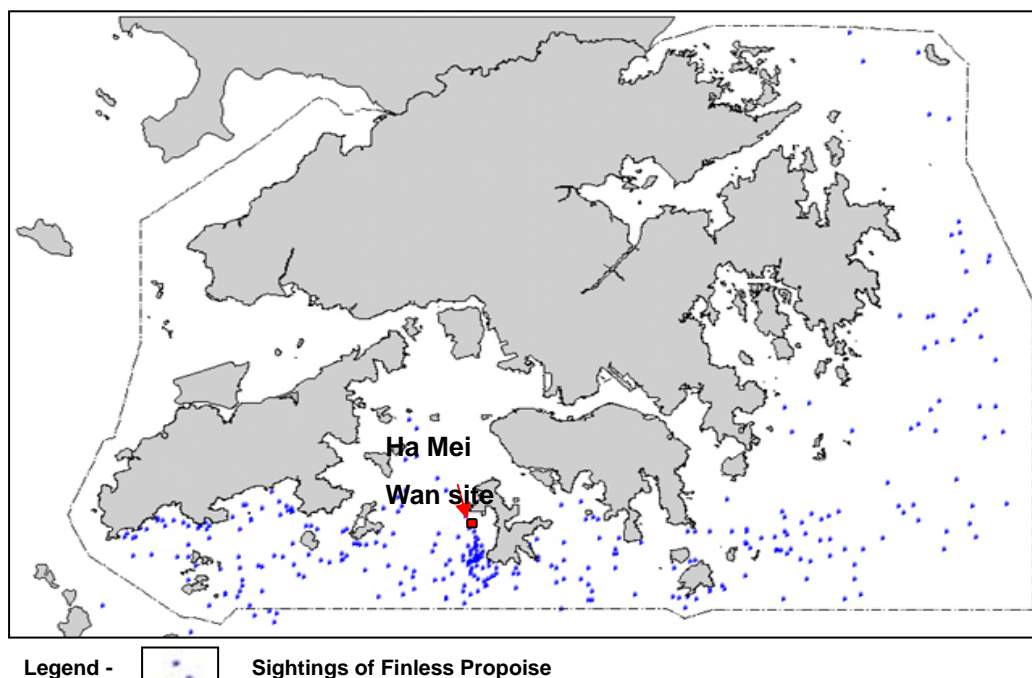
**Figure 3 – Aerial View of Ex-Lamma Quarry Site**

- The IWMF development would be incompatible with the planning intention of the remaining portion of the ex-Lamma Quarry site which is proposed for tourism and recreation purposes, and the adjoining “Comprehensive Development Area” (CDA) site which is planned for comprehensive low-rise residential development. The Planning and Development Study on Hong Kong Island South and Lamma Island has identified the ex-quarry site as having potential for development of tourism and recreation activities. A zoning review of the site will be initiated pending detailed consideration of the appropriate uses/proposal. Regarding the “CDA” site, with an open sea view and easy accessibility to Sok Kwu Wan ferry pier, it has high potential for a comprehensive residential scheme to bring significant improvement to the existing environment.
- As the site is directly facing Wah Fu, Aberdeen, Ap Lei Chau and Wong Chuk Hang on the southern side of Hong Kong Island, it would have significant visual effect on the substantial population residing in these areas.

**(c) Ha Mei Wan, Lamma Island (S3)**

- The proposed site is an artificial island to be reclaimed at the west

end of Lamma Island, it is close to the core habitat of Finless Porpoises and to the planned marine park near South Lamma Island. Moreover, waters around Ha Mei Wan are high productive fishing grounds and spawning / nursery grounds. In view of its close proximity to the various ecological sensitive receivers, and that development of the IWMF on this site would entail substantial dredging and massive reclamation works for the creation of an artificial island, there would be substantial adverse impacts on the water quality, the core habitat of Finless Porpoises, the fishing ground, spawning / nursery grounds and the marine ecology during the construction stage.



**Figure 4 – Ha Mei Wan Site and the distribution of sightings of Finless Propoise**

- Like the Ex-Lamma Quarry site, should the IWMF be built here, it would have significant visual impact on the substantial population residing in Wah Fu, Aberdeen, Ap Lei Chau and Wong Chuk Hang.

**(d) Tuen Mun Area 38 (S6)**

- The site is located in an industrial setting adjacent to the EcoPark and is not far from the WENT Landfill. It is in close proximity to the air sensitive receivers at Tuen Mun New Town, in particular the

## Melody Garden and Butterfly Estate near the Tuen Mun Pier.



**Figure 5 – Aerial View of Tuen Mun Area 38**

- The main concern of this site is the adverse cumulative air quality impact from IWMF and several major emission sources, including the Black Point Power Station, Castle Peak Power Station, Shiu Wing Steel Mill and Green Island Cement Plant etc. In view of its close proximity to the air sensitive receivers in Tuen Mun New Town, it is very likely that this site cannot meet the air quality requirements.
- Another major constraint of this site is its relatively small size. The site in question is currently reserved for another waste management facility and is only about 5.75 hectares, which is not enough to accommodate an IWMF of a capacity of 3 000 tpd of around 10 hectares. Even if developing the IWMF alone, additional land would need to be acquired from the nearby sites. However, other areas in Tuen Mun Area 38 have been planned for other land intensive facilities including EcoPark, construction and demolition handling facilities and permanent aviation fuel facility, etc. and there is no surplus land available. In addition, transfer of

waste to this site by marine vessels will be constrained. This is because there is limited space for the development of berthing facilities along the waterfront in Tuen Mun Area 38 as the waterfront area has already been reserved to meet the operational requirements of the planned uses.

25. The Consultant's assessment result demonstrates the sites at Shek Kwu Chau and Tsang Tsui Ash Lagoon are suitable for consideration as potential sites for developing the first phase of IWMF, with the Tsang Tsui Ash Lagoons site ranked as the most preferred site. The specific features and key advantages and constraints of the two sites are elaborated below.

### **Shek Kwu Chau (S4)**

26. The site is to be formed by reclamation at the South-western side of the Shek Kwu Chau which is located to the south of Chi Ma Wan Peninsula of Lantau Island. The key advantages of the site for IWMF development are -

- It is located far from any major population clusters. There is only a very light population of about 200 persons living in a rehabilitation centre managed by the Society for the Aid and Rehabilitation of Drugs Addicts (SARDA). As such, any visual impact could be insignificant due to the small number of sensitive receivers.



**Figure 6 – Aerial view of Shek Kwu Chau**

- Regarding air quality impact, the only major air sensitive receivers are residents in Cheung Chau and the impact should meet the air quality requirements. Moreover, the residents in Cheung Chau are in fact not located at the prevailing downwind direction. Since no other emission sources exist in the nearby areas, there are no concerns over the cumulative air quality impact.
- Due to its relatively central location with respect to the refuse transfer stations throughout Hong Kong Island and the outlying islands, the aggregate refuse vessel transfer trip length associated with an IWMF at Shek Kwu Chau would be less than the existing operation of refuse transfer to the WENT Landfill. This would offer more environmental and cost-effective marine transportation over reasonable trip length without undue impact on the marine traffic.
- Since the proposed IWMF would be developed on reclaimed land without encroachment onto the existing island, impacts on the terrestrial habitat on the existing island would be minimal.

27. However, the construction of an IWMF on this site would involve reclamation which might affect the natural coastline, statutory gazetting procedures, and installation of power lines and the utilities, which might impact on the natural landscape and would reflect in longer construction time, higher cost and the development time table may be subject to greater uncertainty due to more complex technical requirements and statutory procedures. There are also some concerns which will need to be addressed in further engineering and EIA studies -

- The nearby marine area is a fish spawning and nursery ground. Chinese White Dolphin and Finless Porpoise have been sighted, though the area is not their core habitat. Further detailed study would be required to work out specific measures to alleviate the potential environmental impacts on water quality, marine ecology and fishery to acceptable levels.
- The compatibility of the IWMF with the adjacent rehabilitation centre will need to be carefully studied.



## Tsang Tsui Ash Lagoons (S5)



**Figure 7 – Aerial view of Tsang Tsui Ash Lagoons**

28. The Tsang Tsui Ash Lagoons are situated at the northwest New Territories adjacent to the WENT Landfill and the China Light and Power Company Ltd.'s (CLP) Black Point Power Station. The ash lagoons were constructed in the 1980s by CLP for the purpose of storing pulverized fuel ash (PFA) generated from the Castle Peak Power Station. However, the ash lagoons have not yet been full due to the periodic mining of ash from the site for commercial use. The site is divided by bunds into three approximately equal sized lagoons: the East Lagoon, the Middle Lagoon and the West Lagoon. Consideration is given to use the Middle Lagoon for developing an IW MF. There are several advantages for doing so -

- Being located right next to the WENT Landfill, the site has an operational advantage of sharing the existing infrastructures (e.g. berthing facilities and waste container storage area etc.) and efficient disposal of the ash residues generated by the IW MF to the WENT Landfill. Because of the above synergy effect, the IW MF could occupy a smaller site area, thus translating into both land and cost saving.
- It is also close to the existing power plant. Surplus energy generated from the IW MF can easily be connected to the power

grid.

- Unlike the island options, both marine and land transport of waste and ash are possible, and no reclamation is required.
- As there are no major population clusters in the vicinity, the IWMF should not have significant visual impact on the immediate local community.

29. Regarding air quality impact, preliminary assessment has found that the cumulative air quality impact arising from the IWMF and the existing and proposed emission sources nearby, such as the Power Stations in Black Point and Castle Peak, as well as the proposed Sludge Treatment Facility etc. on the nearby sensitive air receivers should meet the air quality requirements. Detailed assessment would need to be carried out to confirm the cumulative air quality impact should this site be selected for IWMF development.

30. **Given the above, the Consultant has concluded that only the Tsang Tsui Ash Lagoons site and the Shek Kwu Chau site are worth taking forward by the Government for detailed studies and further consideration as potential sites for IWMF.**

### **Further Technical Considerations**

31. From the merits and constraints identified, the air quality aspect of the Shek Kwu Chau site is comparatively more favourable. However, its potential impacts on the natural coastal landscape, marine ecology, water quality, and fishery would need further study and detailed assessment. In addition, the compatibility of the proposed IWMF with the adjacent rehabilitation centre would need to be reviewed and carefully considered.

32. Regarding the Tsang Tsui Ash Lagoons site, it has achieved the highest overall score because of the ease of integration with the existing landfill and waste reception facilities, much less impact on local ecology, shorter construction time, lower construction cost. However, the cumulative air quality impact on the air sensitive receivers would still need to be carefully and thoroughly studied and assessed to confirm its acceptability.

33. We will conduct the EIA and engineering studies to address the above issues. Subject to the study result, we aim to make a decision on the choice of site for the first phase of the IW MF and to commence actions for its construction as soon as possible with our target to have the IW MF in place for operation in mid 2010's.

**Environmental Protection Department**  
**January 2008**