For discussion **PWSC(2003-04)65**
on 18 February 2004

ITEM FOR PUBLIC WORKS SUBCOMMITTEE OF FINANCE COMMITTEE

HEAD 705 – CIVIL ENGINEERING
Environmental Protection – Refuse Disposal
162DR – Restoration of five urban landfills – post-completion environmental monitoring work

Members are invited to recommend to the Finance Committee the upgrading of **162DR** to Category A at an estimated cost of $74.9 million in money-of-the-day prices for the continuation of the environmental monitoring work at the five urban landfills for a further period of seven years.

PROBLEM

We have carried out an environmental review on the five restored urban landfills, which include Jordan Valley Landfill, Ma Yau Tong Central Landfill, Ma Yau Tong West Landfill, Sai Tso Wan Landfill and Ngau Chi Wan Landfill. The review has revealed that further environmental monitoring work at the sites is necessary. If the monitoring work is to be discontinued, the landfill sites may have adverse environmental impacts and may pose a threat to the safety of the public.

PROPOSAL

2. The Director of Environmental Protection, with the support of the Secretary for the Environment, Transport and Works, proposes to upgrade **162DR** to Category A at an estimated cost of $74.9 million in money-of-the-day (MOD) prices for the continuation of the environmental monitoring work at the five urban landfills for a further period of seven years.

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PROJECT SCOPE AND NATURE

3. The scope of the environmental monitoring work proposed for continuation comprises –

(a) operation and maintenance of the landfill gas management systems to control gas emission and to prevent off-site gas migration;

(b) operation and maintenance of the leachate management system to control surface and groundwater infiltration into the landfills and to extract, collect, treat and dispose of the landfill leachate;

(c) environmental monitoring and auditing; and

(d) maintenance of landscape and site infrastructure.

The site plan of the landfills is at Enclosure 1. We plan to continue with the environmental monitoring work at the five urban landfills for a further period of seven years from May 2005 to May 2012.

JUSTIFICATION

4. All landfills produce landfill gas and leachate[1]. Landfill gas, which is a product of refuse decomposition, is malodorous and potentially asphyxiating, flammable and explosive. Leachate is highly polluting and, if not properly controlled, may result in serious contamination of water bodies due to infiltration or direct discharge of leachate.

5. Municipal solid waste, when disposed of at landfills, does not exhibit homogeneous geotechnical properties, as is subject to a continuing biological degradation process. This results in differential settlement of the landfill surface and may lead to slope instability problems. We therefore need to monitor and improve slope stability at landfills. For some landfills, we also need to stabilise the natural slopes adjacent to the top platform of landfills to prevent possible boulder falls or soil debris flows.

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[1] "Leachate" is the water which has permeated through the water mass.

6. The five urban landfills are located in Kwun Tong and Wong Tai Sin areas. They were closed between 1977 and 1990[2]. To minimise the adverse environmental impacts and to put the land to productive use, we sought funding approval from the Finance Committee (FC) in 1995 vide PWSC(95-96)15 for the design and construction of the restoration facilities[3] as well as seven years' post-completion work to maintain the facilities and monitor the landfill gas migration and leachate pollution. FC also agreed that we should carry out an environmental review every five years, starting from the commencement of the environmental monitoring work, to determine if the landfill sites have been completely restored and if further monitoring is needed. If further monitoring work is required, funding approval from FC would have to be sought again.

7. In May 1998, the construction of the restoration facilities for the five urban landfills was completed, and the post-completion environmental monitoring work commenced[4]. In March 2003, the construction of a multi-purpose grass pitch for soccer and baseball at Sai Tso Wan Landfill commenced. The grass pitch is planned to be opened for use by the public in mid-2004. We are now planning to develop part of the Ngau Chi Wan Landfill site into a rest park. As regards the other three restored urban landfills (i.e. Ma Yau Tong Central Landfill, Ma Yau Tong West Landfill and Jordan Valley Landfill), the Administration has plans to develop recreational facilities thereon, and is exploring the possibility of involving the private sector in developing and managing the recreational facilities on the restored landfills. The estimated capital and recurrent costs of the planned facilities at the three landfills are provided at Enclosure 2.

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[2] The closure dates of the five urban landfills are – Ngau Chi Wan Landfill in 1977, Sai Tso Wan Landfill in 1980, Ma Yau Tong West Landfill in 1981, Ma Yau Tong Central Landfill in 1986 and Jordan Valley Landfill in 1990.

[3] The restoration facilities include (a) landfill gas management systems to control gas emission and prevent off-site gas migration; (b) a leachate management system at the Jordan Valley Landfill to extract, collect, treat and dispose of the leachate, together with facilities at the other four landfills to collect leachate for transfer to the Jordan Valley Landfill; (c) engineered capping layers (with low permeability) and surface water drainage systems to reduce infiltration of rain water into the waste mass thereby reducing the amount of leachate to be treated; and (d) improvements to the slope stability and landscaping of the landfill sites and other ancillary engineering works.

[4] Funding was sought for the first seven years' post-completion environmental monitoring work up to May 2005.

8. In late 2002, the Environmental Protection Department (EPD) carried out an environmental review of the landfill sites as required by the FC. The review was completed in December 2003. It confirmed that further monitoring work at the landfills is necessary. Although the amount of landfill gas and pollution level of leachate generated have substantially decreased since 1998, they are still of significant quantity and require continuous control and treatment.[5] Also, site settlement is expected to continue and regular maintenance work will be required to maintain the surface drainage, slopes and internal roads. Hence, it is necessary to continue on-site monitoring to ensure that the sites pose no threat to the safety of the public and have minimal adverse environmental impacts, and that the future multi-purpose grass pitch at Sai Tso Wan Landfill and the rest park at Ngau Chi Wan Landfill could operate in a safe environment.

FINANCIAL IMPLICATIONS

9. We estimate the cost of the proposed post-completion environmental monitoring work for seven years to be $74.9 million in MOD prices (see paragraph 10 below), made up as follows –

		$ million
(a)	Operation & maintenance of landfill gas management systems	11.3
(b)	Operation & maintenance of leachate management systems	21.7
(c)	Environmental monitoring and audit	14.7
(d)	Maintenance of landscape	4.4
(e)	Maintenance of site infrastructure	22.0

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[5] For example, the landfill gas generation rate of the five urban landfills has reduced from 50-400 cubic metres per hour (m^3/hour) in 1998 to 40-260 m^3/hour in 2003. The methane content in the landfill gas is between 16% - 44%, compared with 18% - 55% in 1998. Such volume of landfill gas and methane content levels still require monitoring as the landfills could only be considered as fully restored from the perspective of landfill gas safety when the methane content is reduced to 1%. For the leachate, the concentration level of total nitrogen has reduced from about 200-1200 milligrams per litre (mg/l) to around 55-710 mg/l between 1998 and 2003. However, except for the Ngau Chi Wan Landfill, the current total nitrogen content of the other four landfills still exceeds the acceptable discharge standard of 200 mg/l stipulated in the Technical Memorandum of the Water Pollution Control Ordinance for discharge to Government sewers.

(f)	Contingencies	3.0	
	Sub-total	77.1	(in September 2003 prices)
(g)	Provision for price adjustment	(2.2)	
	Total	74.9	(in MOD prices)

10. Subject to approval, we will phase the expenditure as follows –

Year	**$ million (Sept 2003)**	**Price Adjustment Factor**	**$ million (MOD)**
2005 – 2006	13.1	0.97734	12.8
2006 – 2007	15.3	0.97245	14.9
2007 – 2008	15.3	0.96759	14.8
2008 – 2009	9.5	0.96638	9.2
2009 – 2010	7.3	0.96638	7.1
2010 – 2011	7.3	0.96638	7.1
2011 – 2012	7.3	0.96638	7.1
2012 – 2013	2.0	0.96638	1.9
Total	77.1		74.9

11. We have derived the MOD estimates on the basis of the Government's latest forecast of trend labour and construction prices for the period 2005 to 2013. The cost of the post-completion environmental monitoring work will be subject to price adjustment as the period will exceed 21 months.

12. The environmental monitoring work for closed landfills may last more than two decades (could be up to 30 years). The estimated costs for the

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restoration and post-completion environmental monitoring works of all the restored landfills are provided at Enclosure 3. At the urban landfills, the first seven years' environmental monitoring work, costing about $147 million (in MOD prices), involved landfill gas and leachate management, site maintenance work as well as about 17 000 annual measurements of landfill gas, 3 300 annual measurements on leachate quality, and 4 400 annual measurements on groundwater and surface water quality. A detailed breakdown of the monitoring programme for the five urban landfills is at Enclosure 4. The environmental monitoring work will continue in the next seven years. We propose to carry out an environmental review every five years to determine if the monitoring work should continue. We will continue with the existing 30-year "design-build-and-operate" (DBO) contract to ensure that continuous liability is borne by the contractor. As specified in the contract, we have the right to terminate the contract or amend the coverage of the contract provided that we give the contractor sufficient advance notice.

13. We estimate that the annual recurrent expenditure would be about $0.73 million.

PUBLIC CONSULTATION

14. The Kwun Tong District Council (KTDC) and Wong Tai Sin District Council (WTSDC) supported the restoration works for the urban landfills. We briefed the KTDC and WTSDC respectively in September 2002 and September 2003 on the progress of the monitoring work. On 29 January 2004, we consulted the Legislative Council Panel on Environmental Affairs on the proposal to continue the environmental monitoring work at the landfill sites for a further period of seven years. Members supported the proposal, and requested information on the estimated costs of the planned facilities at the Ma Yau Tong Central Landfill, Ma Yau Tong West Landfill and Jordan Valley Landfill, as well as the estimated costs for the restoration and post-completion environmental monitoring works of the restored landfills. The supplementary information is provided at paragraphs 7 and 12 above.

ENVIRONMENTAL IMPLICATIONS

15. We completed in 1992 an Initial Environmental Impact Assessment (EIA) study, covering both the restoration and post-completion environmental monitoring work, as part of the feasibility study for the restoration work of the urban landfills. The study indicated that the restoration and monitoring work would ensure proper control of the emission and off-site migration of landfill gas and leachate. This would ameliorate the environmental impacts of the landfills and enable the landfill sites to be put to beneficial use.

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16. During the contract period, we will withhold payments to the contractor if there is any non-compliance with the required environmental standards.

17. We have given due consideration to the need to minimise the generation of construction and demolition (C&D) materials, and to reuse and recycle such materials by wherever practicable. We will encourage the contractor to use non-timber formwork and recyclable materials for temporary works. We will control the disposal of C&D waste to landfills or other appropriate reception facilities through a trip ticket system and will record the disposal, reuse and recycling of C&D materials. We estimate that the project will generate about 500m^3 of C&D materials. We would reuse about 360m^3 (72%) on site, recycle or reuse 130m^3 (26%) as fill materials, and dispose of 10m^3 (2%), most of which is non-inert waste, at landfills.

LAND ACQUISITION

18. The project does not require any land acquisition.

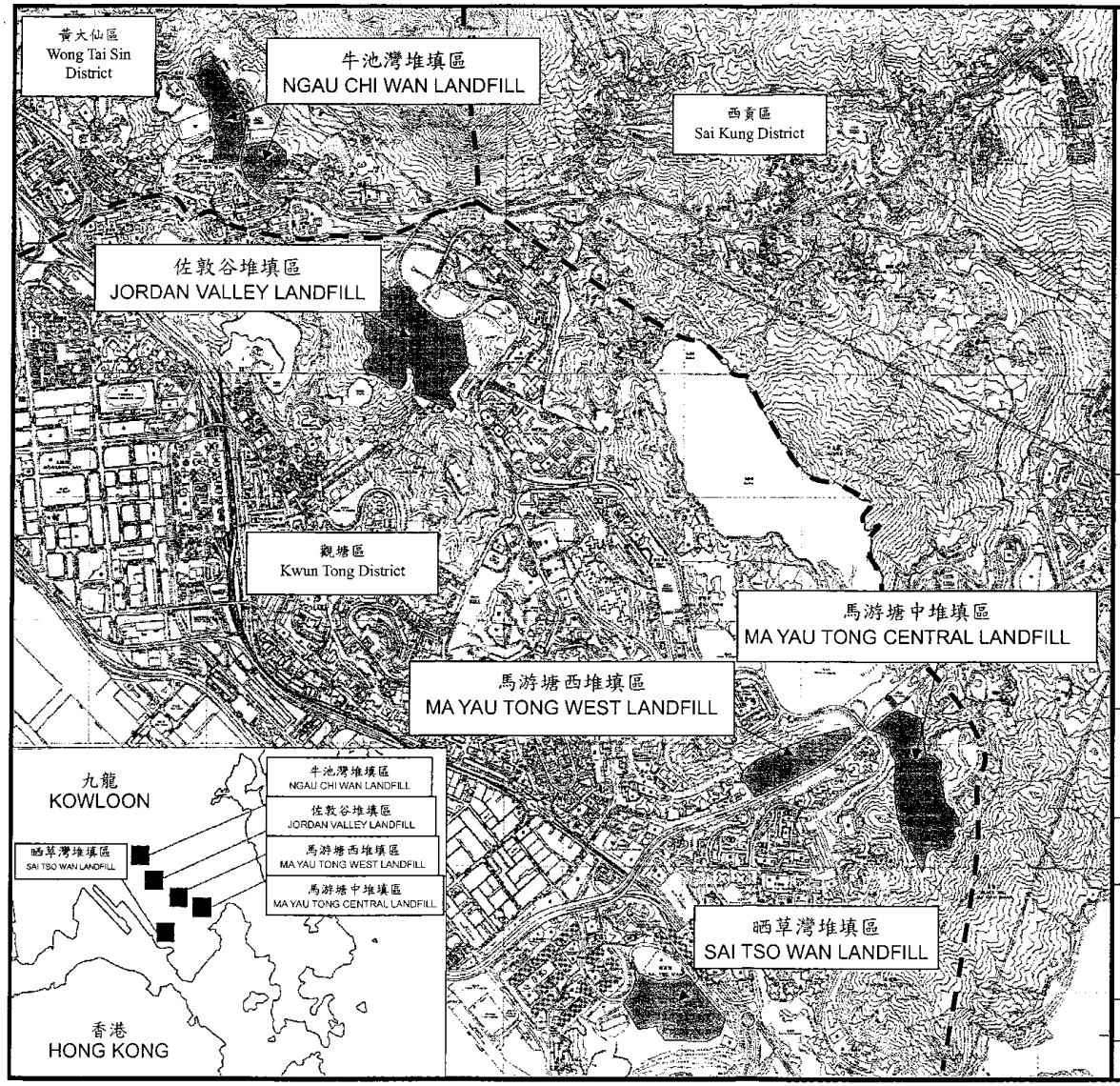
BACKGROUND INFORMATION

19. We included **45DR** "Restoration of landfill sites" in Category B in August 1990. In 1993, we upgraded part of **45DR** to Category A as **90DR** "Restoration of urban landfills – priority works" at an estimated cost of $15 million for priority remedial measures to several urban landfills including Jordan Valley Landfill, Ngau Chi Wan Landfill, Ma Yau Tong Central Landfill and Ma Yau Tong West Landfill to minimise environmental impacts to surrounding developments prior to the restoration work. In June 1995, we upgraded part of **45DR** to Category A as **155DR** "Restoration of urban landfills – works" at an estimated cost of $514 million for construction of the restoration facilities and the first seven years' post-completion environmental monitoring works.

20. The proposed works will not involve any tree removal and/or planting proposals.

21. We estimate that the proposed project will continue to provide 40 existing jobs (31 professional/technical staff and 9 labourers), totalling 3 360 man-months.

Environment, Transport and Works Bureau
February 2004



LEGEND:
圖例:

LANDFILL
堆填區

DISTRICT BOUNDARY
區域界線

Project
PWP Item No. 5162 DR – Restoration of five urban landfills – post-completion environmental monitoring work
工務計劃項目編號 5162 DR – 五個市區堆填區修復計劃 – 驗收後的環境監測工程

Title
SITE LOCATION PLAN
修復工程工地範圍

SHEET 1 of 1

Drawing No.
04_09_UL_SITE LOCATION.DWG

ENVIRONMENTAL PROTECTION DEPARTMENT
環境保護署

Date: 05-04-2004

CAD File

Status: NTS

Enclosure 1 附件 1

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Enclosure 2 to PWSC(2003-04)65

The estimated costs of the planned facilities at Jordan Valley Landfill, Ma Yau Tong West Landfill and Ma Yau Tong Central Landfill

	Planned facility	Estimated capital cost ($ million)*	Estimated recurrent cost ($ million)*
Jordan Valley Landfill	An ecological theme park with an environmental education centre and two gateball pitches	94.0	7.8
Ma Yau Tong West Landfill	A rest park	60.0	3.0
Ma Yau Tong Central Landfill	Lam Tin Park extension	43.5	2.2

*Rough estimate subject to revision at the planning stage

Enclosure 3 to PWSC(2003-04)65

The estimated costs for the restoration and post-completion environmental monitoring works of the restored landfills

Restored Landfill (approximate site area in hectares (ha))	Cost for construction of restoration facilities ($ million) (in MOD prices)	Cost for post-completion environmental monitoring works* ($ million) (in MOD prices)
Shuen Wan Landfill (50 ha)	160	105
Ngau Chi Wan Landfill (8 ha) Sai Tso Wan Landfill (9 ha) Ma Yau Tong West Landfill (5 ha) Ma Yau Tong Central Landfill (11 ha) Jordan Valley Landfill (11 ha)	249	295
Tseung Kwan O Landfill I (68 ha) Tseung Kwan O Landfill II/III (42 ha)	369	390
Ngau Tam Mei Landfill (2 ha) Ma Tso Lung Landfill (2 ha) Siu Lang Shui Landfill (12 ha) Gin Drinkers Bay Landfill (29 ha)	332	405
Total	1 110	1 195

*Assuming the environmental monitoring works will last 30 years

Enclosure 4 to PWSC(2003-04)65

The monitoring programme for the five urban landfills

Category	Monitoring Details	Measurement	Purpose
Landfill Gas	Measure surface landfill gas emission	Methane	To ensure no safety risks to the personnel on site.
	Detect landfill gas at perimeter monitoring boreholes, passive vents and utility manhole	Methane , Carbon Dioxide , Oxygen , Temperature	To monitor off site migration and safeguard the neighbourhood.
	Analyze landfill gas collected from boreholes and extraction wells	Oxygen, Nitrogen, Carbon Monoxide , Carbon Dioxide , Hydrogen , Methane , Ethane , Propane , n-Butane	To monitor changes in the landfill gas quality over the years.
	Detect landfill gas in buildings and confined space on site & off site	Methane , Carbon Dioxide , Oxygen	To ensure no safety risk to occupiers of these structures.
	Measure landfill gas at the extraction system	Methane , Carbon Dioxide , Oxygen ,Temperature , Differential Pressure, Static Pressure , Flow	To monitor the landfill gas composition to ensure optimal operation of the landfill gas management system.
	Analyze emissions of gas flaring facilities at JVL, MYTCL & STWL	Hydrogen Sulphide, Hydrogen Chloride, Hydrogen Fluoride, Hydrogen Bromide, Sulphur Dioxide, Nitrogen Dioxide, Carbon Monoxide, Total Non-methane Hydrocarbons	To check performance of the plants.
	Analyze volatile organic compound (VOC)	Trichloroethylene, Vinyl Chloride, Methylene Chloride, Chloroform, 1,2-Dichlorethane, 1,1,1-Trichloride, Carbon Tetrachloride, Tetrachloroethylene, 1,2-Dibromoethane, Toluene, Methane, Benzene	To ensure the VOC contents comply with international standards.
Groundwater	Measure groundwater level and quality	Well Depth , Groundwater Level , Temperature, pH, Electrical Conductivity , Dissolved Oxygen , Alkalinity, COD , Chloride, Ammoniacal Nitrogen , Total Kjeldahl Nitrogen , Total Oxidized Nitrogen, Total Nitrogen, Sulphate, Sulphite, Phosphorous, Total Organic Carbon, Sodium, Potassium, Calcium, Magnesium, Iron, Manganese , Cadmium, Copper, Nickel, Lead, Zinc, Mercury, Chromium, Sliver	To ensure no leachate contamination of the groundwater.

Category	Monitoring Details	Measurement	Purpose
Leachate	Measure level of leachate at monitoring wells	Well Depth, Leachate Level , Temperature , pH , Electrical Conductivity	To avoid excessive water pressure built up at the man-made slope which might affect the overall slope stability.
	Measure leachate quality at leachate management system	Temperature, pH, Electrical Conductivity, Alkalinity, COD, BOD, Chloride, Ammoniacal Nitrogen, Total Kjeldahl Nitrogen, Total Oxidized Nitrogen, Total Nitrogen, Sulphate, Total Organic Carbon, Sodium, Potassium, Calcium, Magnesium , Iron , Manganese, Cadmium, Copper, Nickel, Lead, Zinc	To check leachate strength related to landfill aging
Surface Water	Analyse surface water quality	Appearance, Temperature, pH, Electrical Conductivity, Dissolved Oxygen, Alkalinity, COD, BOD, Chloride, Ammoniacal nitrogen, Total Kjeldahl Nitrogen, Total Oxidized Nitrogen, Total Nitrogen, Sulphate, Total Suspended Solids, Total Organic Carbon, Sodium, Potassium, Calcium, Magnesium, Iron, Manganese, Cadmium, Copper, Nickel, Lead, Zinc	To ensure no discharge of contaminated surface water off site.
Nuisance	Dust	Total Suspended Particulates(TSP), Respirable Suspended Particulates(RSP)	To protect the general neighbourhood as well as visitors using the golf driving range from nuisance problem.
	Noise	Noise Level	
	Odour	Odour	