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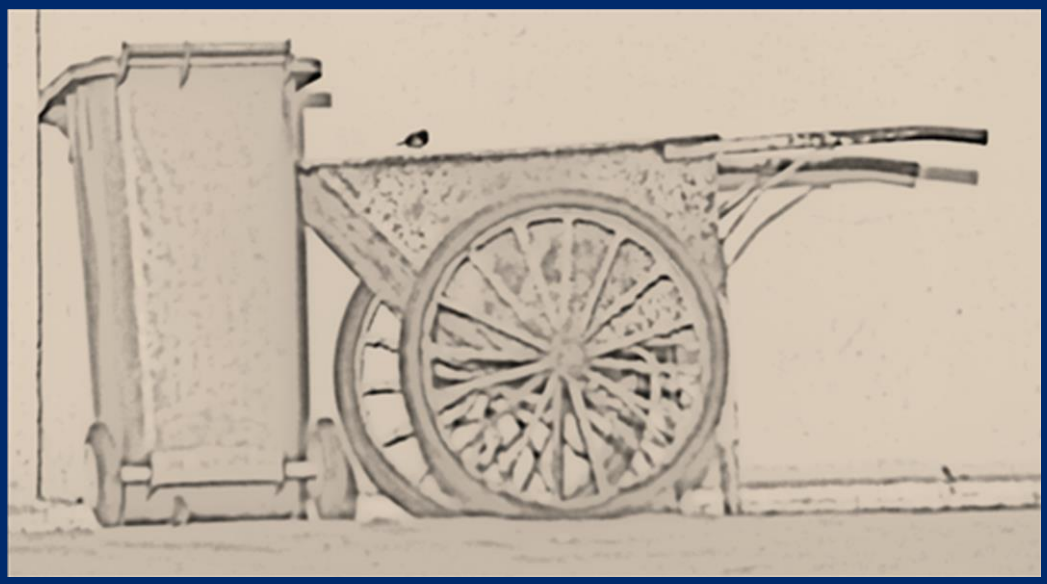
TA-8566 REG: Mainstreaming Integrated Solid Waste Management in Asia - Solid Waste Management Team (46248-001)

Prefeasibility Study – Landfill Upgrading Design Build Operate Contract

Mahasarakham,Thailand



December 2016

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List of Abbreviations

ADB.	Asian Development Bank
CAPEX.	Capital Expenditure
DBO.	Design Build Operate
NPV.	Net Present Value
O&M	Operation and Maintenance
OPEX.	Operational Expenditure
LAO.	Local Administrative Organizations
LGU.	Local Government Unit
PFS.	Pre-feasibility Study
PPP.	Public Private Partnership
RDF.	Refuse Derived Fuel
RoE.	Return on Equity
THB.	Thai Baht
VfM.	Value For Money
WACC.	Weighted average cost of capital

Executive Summary

The ISWM proposes that a major investment be made by Mahasarakham in upgrading its present dumpsite into a modern landfill. Whether the funding comes from outside sources or not, it is important that this investment be protected not only by highly professional implementation but by a subsequent operating regime that best ensures high standards of performance and good relations with neighbors.

This prefeasibility study focuses on the potential outsourcing of designing and constructing the landfill upgrade followed by the long term operation. It is hoped that outside professional management will help bring multi-project experience of successful landfill implementation and operation from elsewhere in Thailand and that financial contractual incentives tied to detailed objective performance standards will properly motivate their ongoing achievement.

The PFS highlights some key technical objectives of the DBO contract, and in particular, highlighting the need to correctly shape and compact the landfill for leachate and storm water management and use of soil as cover material to effect remediation.

During market sounding meetings with prospective private contractors, disappointment was raised over the quality of implementation and operation of some very expensive solid waste disposal projects by LAO's after the contractor's private design and build schemes were completed.

On the whole, market soundings indicated serious interest from the (albeit limited) community of landfill contractors in both construction and long term landfill operations. This gives confidence that a well-run tendering process could attract multiple bids and competitive prices.

1. Introduction

The purpose of this pre-feasibility report under Asian Development Bank RETA 8566 is to summarize and preliminarily assess key commercial and technical issues for the proposed private sector Design-Build-Operate contract model for short term capital intensive upgrading improvement and long term operation of the Municipality of Mahasarakham's existing landfill. This report should be read together with the Solid Waste Action Plan which features a proposed terms sheet and bid parameters for this contract. This study acts as a pre-cursor to a Final Full Feasibility Study along with fully developed Prequalification and Bidding Documents inclusive of a Draft Detailed Contract which could follow on from this RETA.

2. Project Description

2.1 Project Rationale

The Municipality of Mahasarakham is planning a major upgrading of its existing landfill facility to bring it into line with international standards for municipal waste landfills. However, experience from other municipal governments in Thailand suggests that best practices for designing, constructing and operating new landfill infrastructure often are not implemented when left to local government management only. Instead, it is better to enlist outside assistance at least during the construction and early to mid-stage operations.

The Thai central government recognizes that Operation and Maintenance (O&M) of landfill and waste treatment/disposal sites are too complicated for many Local Administrative Organizations (LAOs) to handle (or they actually lack technical knowledge and experience), so the Government has in recent years provided encouragement to LAOs outsources waste management services to the private sector while LAOs become regulators.

Successful upgrading and sustainable professional operation of the landfill is an important pre-condition to use of other disposal techniques such as Refuse Derived Fuel (RDF) and Waste-to-Energy which the Municipality hopes to explore afterwards.

2.2 Project Objective

The Project Technical Objectives include redesigning and maintaining an appropriate landfill configuration, surface water management, leachate management and maximizing landfill capacity in accordance with an appropriate standard of practice.

These technical objectives are best addressed by a Private Contractor taking full control of landfill operations and being compensated (i) for construction and remediation on a milestone basis and (ii) for operations on the basis of fee per ton of new waste fee for services with deduction for failure to achieve specified performance targets. This ensures a fixed price is agreed for construction and remediation costs and that there is year to year stability in the solid waste disposal operating budget.

2.3 Scope of Work Required by RETA 8566

RETA 8566 requires that this Prefeasibility Study covers both technical and commercial aspects for this Public-Private-Partnership project which has been identified in the Integrated Solid Waste Management Strategy. This must include a financial analysis of investment costs, revenue streams and gap in funding (if any). As the initial assessment is on the viability of a private operation, financial analysis is undertaken from the concessionaire's perspective.

In Thailand, landfill construction and improvement projects are generally funded by central government grants. It is anticipated that the introduction of a private Design-Build-Operate concessionaire will provide the municipality with additional strong justification for Thailand government funding of the project.

3. Context

3.1 Policy Context (objectives of PPP structure)

Construction, Operations and Management arrangements range from small service consulting contracts involving no performance risk to a concessionaire taking full control and risk position on performance targets for the Municipality's solid waste disposal function, including employees, finances and overall responsibility for performance.

The objective of this study is to analyse the full management responsibility option for construction and management in which case the Municipality remains owner of the landfill.

3.2 Technical Context – Performance Targets

The waste disposal site is currently divided into two completed cells and the current operating cell, separated by a rural road and an as yet undeveloped cell which has some landfill development restrictions at present

The current dumpsite requires significant remediation before closure, in terms of reducing the slope of the external batters which ranges from 45° up to the angle of repose for the waste deposited. External batters are not high being less than a maximum of 8 to 10 metres and commonly only 5 or 6 metres high above the surrounding natural ground level.

Once the external batter slopes have been reduced to the required 1 vertical to 2.5 horizontal, then intermediate soil cover to a thickness of 300 mm needs to be applied. The city will need to determine whether the existing footprint of the waste mound extends beyond the actual property boundaries, and if so, must determine the allowable limit of the remediated site's footprint. At the time of reporting, both solid waste and leachate were observed on adjacent properties beyond the footprint of the operation.

Cover soil required for the remediation of the site could possibly be found on site. However, this needs to be determined by the city when reviewing the foot print of the cell compared with the property boundary, and possible access to the undeveloped corner block. If there is little other virgin land available within the defined property area, soil will have to be imported to the site.

In terms of the approach to remediation, it would be appropriate to keep operating the site in parallel as the new landfill is being developed. However, the concessionaire will be obliged to operate the old dumpsite such that the new waste is placed to provide the required final batter and landfill cell basal slopes. This placement of new waste would be sensibly integrated into the flattening of the external batter slopes to provide the overall required final configuration and slopes, especially for the "completed" two narrow cells.

Given the relatively large size of the site and the increasingly higher clay content within the soil profile at increasing depth, it is considered that it would be unnecessary to remove all waste and place a basal low permeability liner under the current mound area. Similarly, it is considered unnecessary to install a perimeter leachate interception drainage system as the entire site will eventually be incorporated into a landfill designed cell. (However the newly developed landfill cell with clay liner will have a network of leachate pipes leading to a pump station for leachate irrigation or reinjection during wet weather.)

A controlled landfill will be developed at the northern end of the current operating cell initially, and the controlled landfill will then be extended to cover the whole site eventually.

The first performance target will be to ensure that all external storm water runoff is directed away from the landfill cells where small valley features may bring rainwater runoff into the cell location. No runoff should be allowed to enter the cell site. The existing external storm

water diversion network requires remediation and also is currently carrying large volumes of leachate and solid waste which must be removed.

The second component of landfill development will be the excavation of the base of the first landfill cell to satisfy engineering requirements in terms of slope for requisite lateral drainage of any leachate above the liner, and also the minimum longitudinal slope for achieving pipe flow velocity requirements. The existing waste would be shaped to provide the requisite Vee shape with both lateral and longitudinal fall as required. The shaped waste would then be proof compacted preferably using a 50 tonne roller to provide a stable base for the placement of the clay liner. Given the observed clay content of the soils on site, a relatively impermeable basal liner will then be constructed on the prepared and sloped base by placing 3 to 4 layers of 200 millimetre thick compacted clay.

A network of leachate drains will then be installed on top of this liner with slotted pipes installed within a gravel surround to maximize leachate interception efficiency. The leachate pipes will direct leachate into a leachate pumping station located at the downstream end of the first cell. Suitable pumping equipment will be installed within the station to facilitate the irrigation of collected leachate during dry weather over previously worked areas or access roads. In wet weather, a reinjection pit will be constructed at the top of the waste mound to allow leachate to be directed into the top of the mound for absorption within the upper drier waste lifts within the cell.

Other engineering activities will be required, such as a provision of suitable water supplies and wastewater management from the ablution facilities and truck cleaning activities, as well as the installation and maintenance of access roads and landfill equipment and the posting of appropriate signage. The existing weighbridge must be either repaired or a new one installed to allow accurate weighing of waste tonnage into the site as this will be the basis of payment for the landfill privatized operation.

The operation of the site will then be in accordance with the accepted Operations Manual and Environmental Management and Monitoring Plan requirements. One of the key aspects will be to ensure regular cover of the exposed waste with appropriate soil to a minimum thickness of 150 mm. Intermediate areas must be covered to a depth of at least 300 mm with final cover being 600 mm thick.

The other key operational strategy will be to maximize the slope of waste batters within the site to minimization rain water infiltration, and therefore, minimizing the volume of leachate formed. External batters should be at the standard site of 1 vertical to 2½ horizontal and with daily working areas and dumping tables having a slope of no less than 5% at any time. Waste on the current site is far too flat which would be maximizing leachate formation. A subset of these activities would include having defined allowable tipping areas rather than allowing waste to be deposited almost anywhere on site, and the establishment of an appropriately sized tipping face to minimize the amount of exposed waste at any time.

Other operational requirements, such as collecting any litter on site due to truck spillage or wind, will be included. General operational requirements will also need to address flies, rodents and odour issues as appropriate; however these should be readily manageable if the site is operated as described above.

3.3 Institutional Context

The outsourcing of landfill management under a private design-build-operate contract would be the first major Public-Public-Partnership for the Mahasarakham municipal government. It would be particularly important to establish an effective interface between the waste collection division and the landfill concessionaire. Recycling operations consisting of scavenging rights of Municipal collection employees and existing scavenger on site rights at the landfill should also be maintained.

A contract between the city and a private company for landfill construction and operation would hinge on achievement of performance targets and the Municipality's capacity to fairly assess penalties against a concessionaire for objective non-performance. This would be best executed by a city official with an inspection / regulatory function. As the contract would be subject to independent arbitration, the subject official would need to have requisite training to avoid repeated appeals to the arbitrator based on professionally faulty judgements.

3.4 Results of Market Sounding Exercise

In late October 2016, meetings were held with two major domestic companies with active track records in management of solid waste disposal management for Local Administrative Organizations (LAO's). Principal feedback from the meeting consisted on the following:

- Both had strong interest in pursuing a Design-Build-Operate contract for the Mahasarakham landfill.
- Both saw themselves as concessionaire not investor and expected the Municipality raise money in the usual way from central government grants.
- Both requested a contract duration of at least 10 years.
- Both recognized that the most urgent priority was to upgrade the landfill, but after this was accomplished, requested the exclusive right to use the landfill as feedstock for either RDF or Waste to Energy.
- Operating fees should be adjusted annually for domestic inflation.
- One company emphasized the need to avoid the Thailand PPP law for approvals as the track record of the central government for LAO PPP approvals was "long or never".

3.5 Proposed Categories for Performance Targets

The proposed categories for contractual performance targets are presented in detailed in Error! Reference source not found..

However the performance measures may be summarized as follows:

- Quantity of waste received for landfill
- Construction of landfill base according to design
- Construction of landfill cell according to design
- Remediation of open dump areas
- Adequacy of internal access roads
- Cleanliness of access routes to landfill
- Residents' and private haulers' satisfaction with landfill
- Residents' dissatisfaction with landfill
- Private haulers' dissatisfaction with landfill
- Worker productivity
- Equipment productivity
- Recycling achievements
- Environmental controls
- Hazardous waste segregation
- Fair labor practices
- Occupational health and safety controls
- Fuel consumption
- Reliability
- Communication
- Finance

4. PPP Viability

4.1 Financial metrics for Design Build Operate Private contract

The Project's financial metrics are depicted below. The crucial financial metric in any private sector participation is the required Return on Equity (RoE) of the proposition. We have modelled the project with the required RoE of 15% as objective, and then working out backwards on what the annual revenues to the concessionaire should be offsetting opex and required RoE.

The project on hand has been structured as a DBO excluding equipment which are to be financed by the concessionaire. The concessionaire receives a payment covering all O&M cost and offsetting his investments made in equipment. In addition to this annual payment, and building on the DBO structure, we assume an additional milestone payment during two years from the Municipality to the concessionaire for the landfill investments financed by the Municipality. Note that all investments in fixed assets are financed by the Municipality but are executed by the concessionaire.

The annual O&M payment during the 10 years contract term to the concessionaire for operating the landfill amounts to 14.01 million THB. In addition, the municipality pays a milestone payment, compensating all investments made under the DBO contract, during two years of 19.91 million THB per year. We are assuming this latter would then be paid by the Municipality to the concessionaire according to contractually agreed construction progress triggering milestones payments.

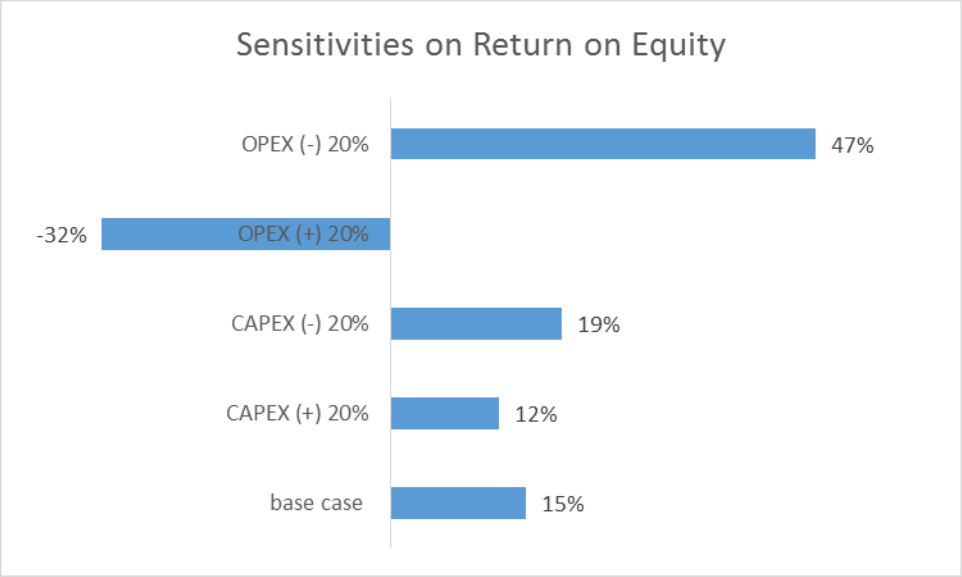
- **Table 4-1 Financial Metrics for DBO Contract**

INPUT		OUTPUT	
CAPEX invested by operator (THB million)	15.103	Return on Equity	15%
CAPEX in DBO contract (THB million)	35.174	O&M contract value paid to operator (year/ThB million)	14.01
OPEX (THB million)	13.3	DBO milestones payment paid to operator (year/THB million)	19.91
Contract term O&M contract (years)	10		
DBO milestones payment to operator (years)	2		

4.2 Sensitivity Analysis

The purpose of the sensitivity analysis is to deepen the understanding of how realistic and robust the calculated annual revenues payment to the concessionaire are if adverse conditions appear. Note that in this DBO structure, all investments are financed by the Municipality and the concessionaire then receives an annual payment during the 2 years. The concessionaire pre-finances CAPEX and this mechanism leads to sensitivities in the RoE of the investments done in addition to the OPEX.

As can be expected, the OPEX have a crucial impact on a landfill's performance as in our PPP structuring the majority of costs paid by the concessionaire are running costs. Remember that all CAPEX (both in moveable and immoveable assets) are folded into a DBO structure. OPEX has a high impact on the RoE as can be expected from running a landfill site with mostly variable costs. CAPEX levels have a medium impact on RoE as the concessionaire receives his milestones payment according to the agreed fixed price quotations. Cost variations in the construction phase, if any, are for the concessionaire's own account as he cannot invoice the municipality for these.



- **Figure 4-1 Sensitivity to Equity IRR for Changes in CAPEX and OPEX**

4.3 Key Risks

The nature of any Public-Private-Partnership structure is to allocate risks to those with the most competence to bear them. For the Landfill construction, operations and maintenance, the economics of the concessionaire should be driven almost wholly by performance and cost management. The concessionaire should be shielded as much as possible from risks it cannot control, such as changes of law or policies of the Municipality of Mahasarakham. The following table lays out many of the most important risks for a business of this type and provides a suggested allocation:

- **Table 4-2 Risk Matrix Covering Landfill Development and Operation Concession Risks**

Category	Description	Allocation	Mitigation
Construction Risk	On Time, On Specification, On Budget Performance	Concessionaire	Concessionaire agrees to fixed price, fixed term contract for Landfill Upgrading Scope of Work
Operating and Maintenance Performance	Defined Performance Targets not being met	Concessionaire	Liquidated Damages Penalties as Deduction from Operating Fee. Accumulation of [XX] days of Performance Shortfall within quarter year period triggers a Concessionaire contract default and gives the Municipality the right to terminate contract
Domestic inflation risk	Operating cost increase due to inflation	Municipality	Contract price will be adjusted yearly based on official inflation rate
Private Operator Working Capital Bank Debt Interest Rate	Any floating interest rate on Concessionaire bank debt increases	Concessionaire	Municipality has no relationship to the Private Developer's lenders. This issue is for the Private Developer to manage.
Cost Overrun on Operations and Maintenance	Project Costs Exceed Project Budget	Concessionaire	Concessionaire receives a fixed fee with an adjustment only for domestic inflation rate. Fixed fee is not adjustable for any other reason.
Waste volume risk	Monthly volume exceeds maximum contracted volume	Municipality	Concessionaire would require excess volume per ton fee. This event would be likely due to other LGU access to the landfill which would compensated by per ton fees paid to Municipality or improved local collection efficiencies.
Natural Force Majeure	Weather events, fire, etc.	Commercial Insurance	Physical Loss Insurance to cover equipment losses should be purchased by Municipality for Landfill Facility Concessionaire is relieved of Performance obligations for time of relevant force majeure
Political Force Majeure	Municipal contract frustration risk, change of law, expropriation	Municipality	Concessionaire is relieved of Performance obligations for time of relevant force majeure Concessionaire can terminate contract after prolonged period and received contractually determined compensation

5. PPP Commercial Structure

5.1 Proposed PPP Model

Given the potential liabilities involved with an existing landfill, concessionaires do not want to be involved in ownership. However, outsourcing of landfill construction and operations on a limited liability basis is common.

Design-Build-Operate Contracts generally are more effective if the Concessionaire's return is based on both technical and commercial performance together. If only technical performance was required, then there is risk of little cost control. If cost control were the main objective, then performance could be low.

6. Implementation Plan

6.1 Next Steps

Project Approval – The Municipality of Mahasarakham has the authority to either (i) seek approval under the existing Thailand PPP law regulations or (ii) avail of its own powers to enter into a design, operate and maintain agreement (as is common for LAO's in Thailand). The Policy and Regulatory Reform paper will address areas of ambiguity in these approval processes for this project in particular.

Draft Bidding Documents and Draft Contract – Should be undertaken by professional advisors.

6.2 Time Table

- Prequalification and Bid Document Drafting…….... [4] months
- Prequalification Stage……. [2] months
- Bid period…….. [4] months
- Evaluation……. [3] months
- Contract finalization with preferred bidder and Award…….. [2] months
- Financial Close…… [6] months

Annex 1: Financial model

- **A: Macro economic**

No.	Item	Unit	Value
1	Corporate income tax	%	25%
2	Inflation CPI	%	3.0%
3	USD/THB	THB	34.96
4	Escalation revenues	%	3.0%
5	Escalation OPEX	%	3.0%
6	Operating days per year	#	365

- **B: Project Timetable**

Item	Unit	Value
Construction period	years	2
Year -2	%/total construction	0%
Year -1	%/total construction	50%
Year 0	%/total construction	50%
O&M contract team	year operations	10

- **C: CAPEX**

No.	Item	Unit	Quantity	Cost (USD)	THB (million)
CAPEX financed by the operator (excluded from the DBO contract)					
Landfill Operating Equipment					
1	Dozer (Caterpillar D6 or equivalent with landfill blade)	Item	1	$200,000	
2	Excavator/ end Loader - assume Caterpillar D200 or equivalent	Item	1	$150,000	
3	10 wheeler tipping dump truck	Item	1	$70,000	
4	8,000L Water tank with pump	Item	1	$12,000	
	TOTAL			**$432,000**	**15.103**
	Sensitivity			1	

No.	Item	Unit	Value
1	Equipment	Years depreciation	7
2	Civil works	Years depreciation	N/A
3	Annual depreciation equipment	US$	60,000
4	Annual depreciation equipment	THB	N/A
CAPEX included in the DBO contract			
5	Total CAPEX in DBO contract	US$	1,006,130
6	Total CAPEX in DBO contract	THB million	35.174
7	Years repayment DBO to operator	years	2
8	Annual payment DBO to operator	US$	569,627
9	Annual payment DBO to operator	THB	19.914

- **D: OPEX**

Item	Description	Hours/ day	Number	No of Days/year	Rate (US$)	Unit	Annual Cost (US$)	Assumptions
Staff Salaries								
	General Manager (office based mainly)	8	1	312	1750.00	month	21,000	
	Site Engineer (Part time)	8	1	52	1200.00	month	14,400	5 year experienced engineer with overall day to day responsibility for technical aspects of landfill operation and implementation against Operations Manual and EMMP. Works 1 day a week only
	Site Supervisor	8	1	365	800.00	month	9,600	8 hour working day with landfill open from 6AM to 6PM and operating 7 days a week. Staff only work 6 day week and schedule overlap between various staff members. Skeleton staff only on Sunday.
	Dozer Driver	8	1	365	350.00	month	4,200	Will do general maintenance and site supervision activities when not operating equipment
	Excavator Driver	8	1	365	350.00	month	4,200	"
	Truck Driver	8	1	365	300.00	month	3,600	"
	Gate keepers/clerk recording waste loads	8	2	365	260.00	month	6,240	Need 2 shifts
	General Hands	8	8	365	260.00	month	24,960	Litter patrols, moving litter fences, traffic direction, load inspections when dumping, moving leachate irrigation pipes, etc. Need 2 shifts
Equipment								
Dozer	Caterpillar D6 or	6	1	312	25	hour	46,800	Includes fuel and general maintenance

Item	Description	Hours/ day	Number	No of Days/year	Rate (US$)	Unit	Annual Cost (US$)	Assumptions
	equivalent							costs but not replacement sinking fund costs
Excavator /Loader	Caterpillar 200 series or equivalent	2	1	312	20	hour	12,480	Includes fuel and general maintenance costs but not replacement sinking fund costs
Truck	Rigid body 6 X 4 10 wheel tipper	2	1	312	20	hour	12,480	Includes fuel and general maintenance costs but not replacement sinking fund costs
					15			
Dewatering pump for cell internal rain	5L/s relocatable diesel motor sump pump	24	1	40	2	hour	1,920	Running Cost for diesel. Assuming 24 hour operation after periods of moderate rain only when the impounded water nears the advancing waste mound.
Leachate Pumps	5kW electric motor driving a submersible progressive cavity pump	4	1	365	2	hour	2,920	Running Cost for electricity and maintenance
Materials (Cubic Metres/year)								
Cover soil	Assume 10% soil to waste volume on average	4140			12	Cubic Metres	49,680	Assumes soil cannot be won on site based on mound footprints occupying almost all of the site
Miscellaneous								
Topographical Survey of landfill	Annual		1			Item	5,000	Yearly cost
Minor items and utilities	Allowance for general office power, water, phone and other minor		1			Item	18,000	Yearly cost. Allowance for surface and groundwater sample collection and analysis, phone and other minor items, such as

Item	Description	Hours/ day	Number	No of Days/year	Rate (US$)	Unit	Annual Cost (US$)	Assumptions
	items, such as signage							signage
TOTAL							**$237,480**	

- **E: O&M Contract Payment to Operator**

No.	Item	Unit	Rate	Value
1	Annual payment from municipality	THB million	14.010	15%
2	Annual payment from municipality	USD	400,744	

- **F: Funding**

No.	Item	Unit	Value
Funding			
1	Required Return on Equity	%	15%
2	gearing ratio debt	%	70%
3	gearing ratio equity	%	30%
4	net working capital/% total revenues	%	10%
Senior debt			
5	Interest rate	%	8%
6	Loan tenor	years	2
7	Grace period interest payment	years	0
8	dividend pay out ratio available cash	%	1
9	WACC	%	8.70%

- **Income Statement**

INCOME STATEMENT (THB million)		Year													
		-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10
1	**Revenues**					**33.924**	**34.777**	**14.863**	**15.309**	**15.768**	**16.241**	**16.729**	**17.231**	**17.747**	**18.280**
1.1	Annual O&M contract payment					14.010	14.863	14.863	15.309	15.768	16.241	16.729	17.231	17.747	18.280
1.2	DBO milestone payment					19.914	19.914								
2	**Operating expenditures**					**13.701**	**14.112**	**14.112**	**14.536**	**14.972**	**15.421**	**15.884**	**16.360**	**16.851**	**17.356**
2.1	Total O&M					13.701	14.112	14.112	14.536	14.972	15.421	15.884	16.360	16.851	17.356
3	**Operating Results (EBITDA)**					**20.223**	**20.665**	**0.751**	**0.773**	**0.797**	**0.820**	**0.845**	**0.870**	**0.896**	**0.923**
4	**Other costs**					**1.970**	**0.985**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.1	Depreciation equipment					0	0	0	0	0	0	0	0	0	0
4.2	Interest loan					1.970	0.985	0	0	0	0	0	0	0	0
5	**Net profit/loss before corporate income tax**					**18.25**	**19.68**	**0.75**	**0.77**	**0.80**	**0.82**	**0.85**	**0.87**	**0.90**	**0.92**
6	**Corporate income tax**					**4.56**	**4.92**	**0.19**	**0.19**	**0.20**	**0.21**	**0.21**	**0.22**	**0.22**	**0.23**
7	**Net profit/loss after corporate income tax**					**13.69**	**14.76**	**0.56**	**0.58**	**0.60**	**0.62**	**0.63**	**0.65**	**0.67**	**0.69**

- **Sources and Application of Funds**

Sources and Application of Funds (THB million)	Year													
	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10
Cashflow operating activities														
Net profit					13.6898	14.7601	0.5631	0.5800	0.5974	0.6153	0.6338	0.6528	0.6724	0.6925
Depreciation					0	0	0	0	0	0	0	0	0	0
Net cash flow Operating Activities	**0**	**0**	**0**	**0**	**13.6898**	**14.7601**	**0.5631**	**0.5800**	**0.5974**	**0.6153**	**0.6338**	**0.6528**	**0.6724**	**0.6925**
Cashflow investment activities														
Total investments	0	0	17.5872	17.5872										
Net cashflow investment activities	**0**	**0**	**-17.5872**	**-17.5872**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Cashflow financing activities														
Loan Disbursements	0	0	12.311	12.311										
Equity Contributions	0	0	5.276	5.276										
Principle Debt Servicing					12.3110	12.3110	0	0	0	0	0	0	0	0
Net cashflow Financing Activities	**0**	**0**	**17.5872**	**17.5872**	**-12.3110**	**-12.3110**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Free Cashflows	**0**	**0**	**0**	**0**	**1.3788**	**2.4491**	**0.5631**	**0.5800**	**0.5974**	**0.6153**	**0.6338**	**0.6528**	**0.6724**	**0.6925**
Free Cashflow Accumulated	**0**	**0**	**0**	**0**	**1.3788**	**3.8278**	**4.3909**	**4.9709**	**5.5683**	**6.1836**	**6.8174**	**12.7216**	**13.3940**	**14.0865**

Annex 2: Value for Money Analysis (VfM)

Given the constraints of the current PFS, a quantitative VfM assessment has been prepared and has excluded other qualitative decision making variables such as Government funds availability, contract management and bidding capacities. The NPV of total revenues minus total life cycle costs (CAPEX and OPEX) gives an indication of the VfM in both procurement strategies.

In the public procurement options, due to some non-transparencies and in-efficiencies of public entities in general, both CAPEX and OPEX distortions were assumed and are presented below. VfM then equals the difference in NPV between both procurement strategies and we can observe below that the PPP procurement has a clear VfM advantage vis-a-vis the public procurement.

- **Value for Money PPP vs Public Procurement**

Value for Money PPP vs Public Procurement *Cashflows to project discounted @ WACC*	
CAPEX distortion in public sector procurement	50%
OPEX distortion in public sector procurement	20%
NPV (THB million) PPP procurement	-11.6
NPV (THB million) public procurement	-31.2

Annex 3 Performance Criteria for Landfill Contract

Performance Measures	What is measured?	How is it measured?	Where is it measured ?	How often is it measured ?	By whom is It measured ?	Basis for sanction?
Quantity of waste received for landfill	Waste quantity per shift Waste quantity per day	Weighbridge records (if weighbridge installed) Landfill inspection reports Landfill records Vehicle log books	Landfill	Daily	City	No
Construction of landfill base according to design	Compaction of base soils at optimum moisture Slope of base soils Placement and sealing of impermeable liners Placement and slope of leachate collection system	Survey instruments observed to be used during construction Construction inspection reports	Landfill	During Constructi on	City	Yes
Construction of landfill cell according to design	Daily delineation of working face boundaries Survey of coordinates and elevations of daily cell construction, including slope of working face Continuous on-site availability of design drawings and O&M manual Closure of cell	Survey instruments observed to be used daily Marking up of daily progress in cell construction on design drawings Topographic survey map of completed cell area when final design elevation is	Landfill	Daily	City	Yes

Performance Measures	What is measured?	How is it measured?	Where is it measured ?	How often is it measured ?	By whom is It measured ?	Basis for sanction?
	when final design elevation is reached Respect of maximum angle for side slopes Respect of minimum requirement for base slopes	reached				
Remediation of open dump areas	Survey of coordinates and elevations of cell construction, including slope of working face Continuous on-site availability of design drawings Closure of cell when final design elevation is reached Respect of maximum angle for side slopes Respect of minimum requirement for base slopes if waste is removed and not covered in-situ	Survey instruments observed to be used daily Marking up of daily progress in cell construction on design drawings Topographic survey map of completed cell area when final design elevation is reached	Old dump areas/site	Weekly	City	Yes

Performance Measures	What is measured?	How is it measured?	Where is it measured ?	How often is it measured ?	By whom is It measured ?	Basis for sanction?
Adequacy of internal access roads	Roads free of waste Roads usable in all weathers Adequate drainage to keep roads free of flooding	Vehicle log books (Operational delays of collection vehicles at landfill) Landfill inspection reports	Landfill	Daily	City	No
Cleanliness of access routes to landfill	Litter Clandestine waste piles Waste in drains Improperly placed waste bins	Zone inspection reports	Service Zones	Daily	City	Yes
Residents' and private haulers' satisfaction with landfill	Perception about environmental acceptability of landfill operation Willingness to pay Willingness to participate with service requirements	Surveys of customer satisfaction Surveys of willingness to pay	Area around landfill All haulers	Semi-annually	City Local districts	No
Residents' dissatisfaction with landfill	Complaints about landfill noise, dust, odor, traffic, appearance and increase in vectors	Inspection reports Records of complaints	Area around landfill	Monthly	Districts	Yes

Performance Measures	What is measured?	How is it measured?	Where is it measured ?	How often is it measured ?	By whom is It measured ?	Basis for sanction?
Private haulers' dissatisfaction with landfill	Complaints about landfill noise, dust, odor, traffic, appearance Complaints about delays suffered by collection vehicles at landfill, damage to vehicles and tires, inappropriate tipping fee charges, operation of weighbridge, difficulty in driving to working face	Inspection reports Records of complaints Records of follow-up to complaints	All haulers	Monthly	City	Yes
Worker productivity	Number of workers in service Waste quantity per worker and shift Absenteeism	Landfill inspection reports Records at landfill	Landfill	Monthly	City	No
Equipment productivity	Number of equipment units in service Waste quantity per equipment unit each shift Waste quantity per equipment unit each day Equipment downtime	Landfill inspection reports Records at landfill	Landfill	Monthly	City	No

Performance Measures	What is measured?	How is it measured?	Where is it measured ?	How often is it measured ?	By whom is It measured ?	Basis for sanction?
Recycling achievements	Types of secondary materials recycled Quantity of secondary materials recycled	Landfill inspection reports Records from sales of recyclables	Landfill	Monthly	City	No
Environmental controls	Control of equipment exhaust emissions Windblown litter Dust Noise Control of area of working force Daily compaction of deposited waste Use of adequate daily cover at the end of each day's work Washing of equipment Flies, rodents, birds Leachate treatment and discharges Control of landfill gas Drainage of surface water-adequacy and maintenance Presence of unauthorized people or	Equipment emission inspection reports Landfill and area inspection reports Complaints about emissions, noise, dust and litter Fly count, rodent count, bird count Pesticide application records Size of daily refuse cell Monitoring of leachate treatment plant discharges Groundwater and surface water monitoring Monitoring of landfill gases Records of incoming waste loads	Landfill and surrounding area	Weekly	City Districts	Yes

Performance Measures	What is measured?	How is it measured?	Where is it measured ?	How often is it measured ?	By whom is It measured ?	Basis for sanction?
	Records of incoming animals Presence of hazardous wastes Recording of all collected waste loads Provision and maintenance of an attractive vegetative buffer around operational areas					
Hazardous waste segregation	Refusal to accept industrial or commercial hazardous waste Provision of special collection and storage area for household hazardous waste	Landfill inspection reports Inspection of loads at disposal sites	Landfill Disposal sites Records from service provider	Monthly	City	Yes
Fair labor practices	Wage paid - minimum or above Payment for overtime Medical expenses coverage Vacation and holiday allowances Adequacy of work breaks Proper hiring and justifiable termination procedures	Landfill inspection reports Survey of workers	Landfill Records from service provider	Monthly	City	Yes

Performance Measures	What is measured?	How is it measured?	Where is it measured ?	How often is it measured ?	By whom is It measured ?	Basis for sanction?
Occupational health and safety controls	Use of gloves and boots Use of respiratory masks Functioning air conditioning on all equipment units Adequacy of roll-bars Replacement of filters on air conditioners Use of uniforms Annual medical checks Provision of vaccinations Control over size and weight of lifted loads Number of accidents Health and safety training of all landfill personnel Practice of emergency and evacuation procedures Continuous presence and functionality of fire protection and other emergency equipment Continuous on-site presence of health & safety manual	Landfill inspection reports Survey of workers Medical records Accident records Inspection of equipment units Insurance policies	Landfill Records from service provider	Monthly	City	Yes

Performance Measures	What is measured?	How is it measured?	Where is it measured ?	How often is it measured ?	By whom is It measured ?	Basis for sanction?
	Posting of health & safety telephone numbers Adequate accident liability coverage Operational night-time illumination Reversing lights and audio signals on all equipment					
Fuel consumption	Fuel records on consumption – per hour and per ton Maintenance records on engine calibration	Equipment log books Equipment maintenance reports	Landfill Records from service provider	Monthly	City	No
Reliability	Downtime of equipment Number of accidents Number of slides, erosion events	Equipment log books Landfill inspection reports	Records from service provider	Monthly	City	No

Performance Measures	What is measured?	How is it measured?	Where is it measured ?	How often is it measured ?	By whom is It measured ?	Basis for sanction?
Communication	Notification of service problems Continuous accessibility by radio	Correspondence files Landfill inspection reports Radio functioning between landfill and central offices	Letters from service provider	Monthly	City	No
Finance	Payment of government property, income, VAT, and corporate taxes, etc., as required Regular payment of fair wages and benefits to workers	Financial records Independent auditor reports	Records from service provider	Yearly	City	Yes