LANDSCAPE ANALYSIS AND BUSINESS MODEL ASSESSMENT IN FAECAL SLUDGE MANAGEMENT: EXTRACTION AND TRANSPORTATION MODEL IN MALAYSIA

A Study funded by

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FINAL REPORT

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In collaboration with

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Preface

The Study on Landscape Analysis and Business Model Assessment in Faecal Sludge Management in Malaysia is one of several similar studies conducted in selected countries in Asia and Africa, which is funded by the Bill and Melinda Gates Foundation. The overall objective of these studies is to understand better, aspects of governance, management, business and operating models which are being applied for faecal sludge extraction, transfer, transportation and its treatment in these countries. This is with the view to identify a business model that can be applied for sustainable and effective faecal sludge management in the respective countries.

In Malaysia, the Study was undertaken by ERE Consulting Group Sdn Bhd (ERE) in collaboration with Indah Water Konsortium Sdn Bhd ("IWK"). The terms of reference and scope of work for the Study are contained in the Master Service Agreement and the Work Order which was signed between the Bill and Melinda Gates Foundation and ERE Consulting Group. The effective date for the Agreement and Work Order (Contract Number: 19745) was April 25, 2011.

PETER YUEH CHUEN HO

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About the Companies

ERE CONSULTING GROUP SDN BHD

is a full-service environmental consultancy company, registered under the Company's Act (Reg. No. 356985-X) and the Ministry of Finance Malaysia (Reg. No. 465-02008539), which provides sensible solutions to governments, industries and organizations across Malaysia and countries in Asia. Established since 1992, it has successfully completed close to 500 projects in sectors of biodiversity conservation and ecosystem management, sustainable construction and infrastructure, industrial environmental planning and management, environmental land use planning, natural resource management, and environmental training and capacity building. The firm maintains a comprehensive quality management system and has been MS ISO 9001 certified since 2000. It operates from its offices at Subang Jaya, Selangor and Kota Kinabalu, Sabah.

(website: www.ere.com.my)

INDAH WATER KONSORTIUM SDN BHD

is the national sewerage company wholly-owned by the Minister of Finance Incorporated and operates as a private company under the Company's Act (Reg. No. 211763-P). It is responsible for providing sewerage services, operating and maintaining over 5,750 public sewage treatment plants and 13,000km networks of sewerage pipelines since April 1994 when it was awarded a concession to provide nationwide sewerage services. It is also entrusted with desludging of over 1 million septic tanks and managing the sludge that is generated. The services are rendered through the company's 18 Unit Offices/Customer Service Centres located throughout the country, except Johor Bahru, Kelantan, Sabah and Sarawak. Expertise which are rendered by the company are in operations and maintenance, sludge management, planning and engineering, research and development, training and capacity development, and project management.

(website: www.iwk.com.my)

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Abbreviations

IWK	Indah Water Konsortium
SPAN	National Water Services Commission
CIDB	Construction Industry Development Board
WSIA	Water Services Industry Act 2006
SSA	Sewerage Services Act 1993
EQA	Environmental Quality Act 1974
MSIG	Malaysian Sewerage Industry Guidelines
KeTTHA	Ministry of Energy, Green Technology and Water
MNRE	Ministry of Natural Resources and the Environment
MOH	Ministry of Health
MDU	Mechanical dewatering unit
DOE	Department of Environment
JPP	Sewerage Services Department
SIRIM	Standards and Industrial Research Institute of Malaysia
FTKL	Federal Territory of Kuala Lumpur
RESP	Rural Environmental Sanitation Programme
LA	Local Authorities
DG	Director General
IST	Individual Septic Tank
PF	Pour Flush
CSTF	Centralized Sludge Treatment Facility
CST	Communal Septic Tanks
SPSS	Statistical Package for Social Sciences
FSM	Faecal Sludge Management
KPI	Key Performance Index
RM	Malaysian currency (or Ringgit Malaysia)
US$	United States Dollars (Exchange rate US$1.0 = RM3.0

EXECUTIVE SUMMARY

INTRODUCTION

1. The Revised Final Report contains the findings of the Study on Landscape Analysis and Business Model Assessment in Faecal Sludge Management in Malaysia which is funded by the Bill and Melinda Gates Foundation.

2. The Consultant for the Study was the ERE Consulting Group Co. Ltd (ERE), assisted by staff of Indah Water Konsortium (IWK), the national sewerage services company, and two other supporting consultants for socio-economic and financial analysis, respectively.

3. The Study was undertaken in three (3) model cities in Peninsular Malaysia and included Kuala Lumpur (land area 243km^2), which is the capital city; Melaka (land area 689km^2), the capital city of the State of Melaka; and Kuala Terengganu (land area 605km^2), the capital city of the State of Terengganu.

SOCIO-ECONOMIC PROFILE OF STUDY AREAS

4. The socio-economic profile of the population within the 3 cites outlined in the following is based on a socio-economic survey of 600 households (consisting of residential premises and shop-houses) undertaken for the 3 cities and from analysis of secondary data derived from the Statistics Department, IWK's database, and other sources.

5. Kuala Lumpur (2010 population 1.627 million) with an estimated 407,400 households is the most populated, while Melaka city (2010 population 484,000) with an estimated 115,600 households, is second most populated, and Kuala Terengganu (2010 population 337,000), with an estimated 71,900 households, is the least populated of the three cities.

6. About 86.7% of households (HH) or about 91.9% of the population equivalent (PE) in Kuala Lumpur is served by centralised sewerage system, while about 63.8% of HH or about 58.3% of PE in Melaka city, and about 18.1% of HH or about 13.2% of PE in the city of Kuala Terengganu is similarly served by centralised sewerage system. The remaining HHs depends on on-site sewerage systems such as communal or individual septic tanks (IST) and pour flush (PF) systems. The use of pit latrines and other open toilet systems are rare within the cities (if at all, are illegal) but may be found in remote rural areas elsewhere.

7. Treated pipe water supply is available to 100% of the population in Kuala Lumpur, about 99% of the population in the State of Melaka, and about 89% in the State of Terengganu. Within the 3 cities, public water supply is available to 100% of the HH.

8. The average monthly income of the surveyed population ranged from a high of about UD$1,940 in Melaka to about US$623 in Kuala Terengganu. The average monthly income in Kuala Lumpur was about US$1,393. On average,

water and sewerage bills constitute less than 5% of the monthly income for HH in the 3 cites.

SANITATION AND FSM SERVICES

9. Water supply and sewerage services are largely a federal responsibility for most of the states and local authorities in the Peninsular, including the 3 cities studied. The regulator for these services is the *National Water Services Commission* (SPAN) under provisions contained in the *Water Services Industry Act, 2006* (WSIA).

10. *Indah Water Konsortium* (IWK), the concession holder to provide nationwide sewerage services, has been entrusted with the task of developing and maintaining a modern and efficient sewerage system for the country. It is the national sewerage company wholly owned by the *Minister of Finance Incorporated*, but operates as a private company.

11. The provision of sewerage services is regulated and licensed by SPAN and this includes faecal sludge extraction, transportation, and treatment and disposal (FSM services). IWK is registered as *Service Licensee* for the provision of FSM services while other private service providers (or contractors) are registered as *Permit Holder.*

12. Prior to enforcement of WSIA in January 2008, FSM services for ISTs within IWK's concession areas (including the 3 cities), were scheduled by IWK and undertaken on a 2-year cycle. Although it has its own manpower and facilities to provide such services, IWK nevertheless engaged private service providers as sub-contractors to assist in its task.

13. With the enforcement of WSIA, the FSM services sector is presently open to all service providers licensed by SPAN, including IWK. As such, FSM services are now available on a demand basis and at competitive pricing although the ceiling charge for FSM service is set by SPAN. The obligation to call for such service is presently the responsibility of the owner or occupier of the premise and this is proposed at a schedule of once every 3 yrs.

14. IWK operates FSM services in all the 3 cities, while 4 private service providers in Kuala Lumpur and 3 others in Melaka are also active. Three (3) other small (1 truck) private service providers licensed by SPAN were identified in Kuala Lumpur but are presently not active. All the active FSM service providers are medium-size (2-5 trucks) to large (more than 5 trucks). IWK is the largest operator in all the 3 cities having 6 to 15 trucks.

SLUDGE COLLECTION AND TREATMENT

15. In Malaysia, FSM services are mechanically done. No manual sludge extraction is undertaken. Truck capacities used range from 2.5m^3 to large trucks of 11m^3 capacity. The smallest capacity truck is operated only by IWK and these serve premises where access is restricted by narrow roads and limited site access. Larger trucks are favoured as these have capability to service more premises

per trip and have the capacity to service large ISTs in commercial, institutional and industrial premises.

16. Almost all trucks are bought new and are locally assembled. Costs range from about US$83,300 for a 2.5$m^3$ capacity truck to about US$130,000 for one of 8$m^3$ capacity truck. The most common truck capacity used is 4.5m^3, which cost about US$95,000 per unit.

17. The overall sludge extraction and transportation cycle time (covering travel to the site, works preparation, sludge extraction, clean up, and transport to the treatment facility) has been shown to vary between 68 minutes to as high as 4 hours depending on factors including, distance of travel to the site and the treatment plant, ease of accessibility to the site, and the condition of the on-site treatment plant and sludge in the tank. Travel time constitutes between 30% to 80% or more of the total cycle time. The long cycle time represents a situation when a combination of constraints such as, remoteness of area, poor accessibility, and difficulty of sludge extraction are encountered.

18. In an effort to improve FSM performance and revenue, IWK undertook a pilot project using Geo-tubes for sludge reception. The project involved the strategic location of Geo-tubes within existing operating sewage treatment plants such that travel distances for transportation is reduced and turnaround time for trucks is improved – much like transfer stations applied in solid waste management. Results of the pilot project showed that truck performance improved by about 54%; operational cost per unit IST was reduced by about 8%; an increase in revenue of about 35%; and a 37% reduction in operational cost.

19. Sludge that is collected is not allowed to be dumped but is sent to an approved centralised sludge collection and treatment facility. These include Central Sludge Treatment Facilities (CSTF), found in Kuala Lumpur and Melaka, and Mechanical Dewatering Unit (MDU), which is available in Kuala Terengganu. These facilities serve the larger urban centres and may be distant from other sludge sources.

20. Bio-solids arising from sludge treatment plants have been shown in studies undertaken locally to have potential for use as soil conditioners or conversion into fertiliser. Presently, these are mostly disposed at landfills as commercial use of the bio-solids is limited due to the constraint of supply (small quantum generated and inconsistency of supply).

MARKET AND FINANCIAL ANALYSIS

21. More than 2 million ISTs and PF systems are still in use in the country, mostly in smaller urban centres and rural communities. Of these, some 19,420 are to be found in KL, 23,780 in Melaka, and 37,980 in Kuala Terengganu. Reliance on such on-site sewerage systems is expected to continue in view of the slow progress in changeover to centralized sewerage systems. Hence, the potential market demand for FSM services is expected to continue into the future.

22. The suggested tariff for sludge extraction, transportation and treatment is set by SPAN at a maximum of US$76.70 if undertaken by a private contractor, and a maximum rate of US$100 if undertaken by IWK. The tariffs apply to each unit of IST and PF system (up to 2 m^3), with an additional charge of US$38.30 for each additional cubic meter of sludge. Out of the amount charged, US$18.30/$m^3$ is paid to IWK for treatment of the sludge at treatment facilities operated by IWK.

23. In order to understand the economics of FSM in the 3 cities, two licensed FSM operators were selected and the income statements from a medium-size operator (operating 3 trucks) in Melaka and a large-size operator (operating 14 trucks) in Kuala Lumpur were obtained. Analysis showed that the average number of trips/truck made by the large-size operator was 219 and that for the medium-size operator was 533. Cost/trip was higher for the former (US$156.70) in comparison to the latter (US$68) – the higher cost being due probably to longer average travel distances made by the large operator.

24. Results of the analysis showed that the medium-size operator made a loss in 2010 while the large operator made a profit in the same period. The higher revenue/truck for the large operator (US$167,108) was much higher than that of the medium-size operator (US$6,300). The bulk of the former's revenue came from services rendered to commercial, industrial and government institutions with about 80% derived from the government sector. The medium-size operator derived its income mostly from servicing HHs and other premises except the government sector.

25. In an attempt to determine the feasibility and viability of a new business for a medium-size and a large-size operation, financial analysis was undertaken applying assumptions that are benchmarked closely to the existing operations of the two operators discussed above. The model assumptions included scheduled desludging (ensuring a consistent number of services each day (about 3 HH/trip) and an average of 1.68 trips in the first year of operation). New trucks are presumed to be purchased.

26. The 5-year financial analysis for the large-size operator showed an After Tax Project Internal Rate of Return (IRR) of 9%; a Pre-Tax Project IRR of 10%, and an Average Annual Return on Equity of 7%. Sensitivity analysis carried out using selected key variables of a decrease in total revenue by 5%, an increase in operating costs by 5%, and an increase in the price of fuel by 50% showed that After Tax IRR dropped significantly to 2%, 4%, and 6% respectively.

27. A similar analysis for the medium-size operator showed an After Tax IRR of 7%; Pre-Tax Project IRR of 8%; and an Average Annual Return on Equity 3%. However, the sensitivity analysis undertaken showed that when total revenue decreased by 5%, the resultant After Tax IRR fell to 0%; and when operating expenses were increased by 5%, the IRR dropped to 2%; and an increase in fuel price by 50% reduced the IRR to 4%. Under such circumstances, the project's viability becomes questionable.

28. A comparison of the projected 5-year financial analysis for the large and medium-size operations showed that while the breakeven on revenue for the medium-size operator is smaller than that of the large-size operator due to the

latter's bigger fixed overhead cost; ROE of both was below 10%; the margin of safety was close to each other (37% vs 36%); and a breakeven on number of trip for both was similar (1.1 trips/day). Under current operating conditions, a medium-size operation (with 3 trucks) is not viable (NPV is in the negative). However, this is not so for a large operator (with 14 trucks).

29. In an attempt to determine if the medium-size operations in Melaka can be made more attractive, the Geo-tube extension to the model was incorporated. The basic premise of the model is to reduce the maximum distance of travel (this being identified as a major factor for improving FSM services performance), by locating Geo-tube systems at strategic locations within existing sewage treatment plants. In this case, a maximum distance of travel of not more than 15km from a Geo-tube or a sludge treatment centre was the objective.

30. Results of the modeling with the Geo-tube extension showed that the viability of the medium-size operation significantly improved and it would make a profit from the first year of operation (compared to a loss over the first 2 years without the Geo-tube extension). It is expected the project will achieve US$347,767 in revenue and a profit after tax of US$8,767 in the first full year of operation. The revenue is expected to reach US$0.46 million on the fifth year with an after tax profit of US$44,267.

31. The financial sensitivity analysis for the Geo-tube model extension indicates that the performance of the operator is sensitive to the tested parameters of a decrease of 5% in revenue, an increase of 5% in cost, or an increase of 50% in fuel cost. After Tax IRR fell most from 18% to 10% for a decrease in total revenue of 5%. The reduction in IRR for the other parameters tested was less. These results show that the IRR estimate for the medium-size operator is sound and remains acceptable under the three tested scenarios.

CONCLUSIONS AND RECOMMENDATIONS

32. Results of the five-year financial projection for each of the operators to evaluate and determine a possible scale of operation that is both manageable and realistic for the private sector to invest into the FSM business, show that under present Malaysian conditions, the large-scale operator has the distinct advantage over the medium-size operator, being able to operate profitably, whereas the latter would not. The financial sensitivity analysis undertaken showed that financial viability was significantly affected by a 5% drop in revenue or a similar increase in operating cost. An increase of 50% in fuel cost would also affect profitability but not as seriously as the former two situations.

33. Nevertheless, the large-scale operations also entail higher resource commitments, both in terms of investments, and human resources, all of which are not always and easily available in developing countries. The high cost of an FSM service truck is a major capital investment for all operators but affects more the medium-size sludge emptying operator. A reduction in cost (which is due to the high duty and taxes imposed by the government) would have positive impact on the viability of desludging business.

34. A model that incorporates the Geo-Tube extension is recommended to reduce a major technical constraint caused by large travel distances. The model when applied to the medium-size operator in Melaka demonstrated that the Geo-tube extension into the “standard” FSM service model is a key determinant in improving the financial viability of the medium-size business.

35. The above business model is premised on a key assumption that FSM services are to be scheduled as past performances of existing service providers, pre- and post-WSIA, clearly showed that a responsive approach to desludging services is not desirable. In addition, the level of tariff that is set has to be realistic and based on sound assumptions of costs that determine its value, as the FSM business is sensitive to even a small change in the tariff.

1. COUNTRY FSM BACKGROUND

1.1 HISTORICAL PERSPECTIVE

Sewerage development and management (including sludge management) has traditionally been the responsibility of local authorities. The power to manage sewerage was provided under the *Local Government Act, 1976* and the *Street, Drainage and Building Act, 1974*, two laws which were enforced by local authorities. These laws, however, were generally inadequate and did not have relevant provisions to regulate the maintenance of septic tanks or the management of sludge that has accumulated in the system. Hence there was no compulsion for owners of septic tanks to desludge regularly and it was left to the individual owners to determine when desludging was needed.

The capabilities of local authorities to implement more modern sewerage systems varied depending on their financial and manpower capabilities. As a result, sewerage development in many of the smaller and poorer local authorities was largely neglected. Individual septic tanks and communal septic tanks were the most common systems in use for residential, commercial as well as in many industrial developments. It was largely left to private developers to initiate more modern sewerage systems for new (generally large) developments where centralised treatment systems are applied.

In 1993, a new legislation, the *Sewerage Services Act* (SSA), was promulgated to amend and consolidate existing laws relating to sewerage development and management in Peninsular Malaysia for the purpose of improving sanitation and the environment and promoting public health. The traditional responsibilities of local authorities to look after sewerage effectively ended and the responsibilities taken over by a federal regulatory agency, the *Sewerage Services Department* (JPP). While JPP retained regulatory function, the Government of Malaysia in 1994 awarded *Indah Water Konsortium Sdn Bhd* ("IWK"), the concession for providing nationwide sewerage services. It was entrusted with the task of developing and maintaining a modern and efficient sewerage system for the country. IWK is presently the national sewerage company wholly-owned by the Minister of Finance Incorporated. Nevertheless, it operates in all intent and purposes as a private company.

However, recent events saw the revocation of the SSA with a new set of laws for the joint administration of water supply and sewerage services in the country. The *Water Services Industry Act 2006 (Act 655)*, also known as 'WSIA', has been conceived to consolidate the administrative aspects of water supply and sewerage since both are interlinked and closely relatd. The main objective of WSIA is to establish a framework for regulatory intervention and to promote the *National Policy Objectives* for the water supply and sewerage services industries (see **Annex 1.1.1**). The Act came to force on 1 January 2008.

Within the same period, a new administrative body, the *Water Services Commission* ("SPAN"), was formed in April 2007 by virtue of the *Water Services Commission Act 2006 (ACT 654)* to regulate and enforce the provisions of WSIA.

WSIA opened up the water and sewerage sector to private sector involvement as provided for in the National Policy Objectives. Specifically, one of the policy objective aims "*to facilitate the development of competition to promote economy and efficiency in the water supply services and sewerage services industry*". Enterprises, like IWK, were often perceived to be "monopolistic" and it was the believe that a competitive environment, which allowed the participation of other private enterprises, would promote economy and efficiency. Sludge extraction and transportation is one of the areas that have been open to private enterprises other than IWK.

1.2 CURRENT STATE OF SEWERAGE DEVELOPMENT AND MANAGEMENT

1.2.1 Urban Sewerage Services

Sewerage development and management in most areas of the country is the responsibility of the federal government and this task lies within the function of the *Ministry of Energy, Green Technology and Water*. The regulation of sewerage services is undertaken by SPAN which is responsible for enforcement of WSIA. Nevertheless, IWK retains its responsibility for operation and maintenance of the sewerage infrastructure in the country as provided for under the concession agreement with the Government. In the longer term it has the responsibility for planning and rationalizing the public sewerage facilities to reduce the number of treatment plants and septic tanks using the "multipoint concept" or regionalization approach. This will involve the development of new sewerage pipeline networks to convey sewage from individual systems to modern secondary treatment facilities.

The responsibilities of IWK are mainly directed at the public sewerage system which are found within its service areas[1] and does not include on-site sewerage systems such as individual septic tanks (ISTs), pour flush (PF), and other systems which are found outside of these service areas. Prior to the coming into force of WSIA, the responsibility of IWK included the provision of scheduled desludging services for ISTs within its service areas. It could also provide desludging services on a responsive basis for other on-site sewerage systems within and outside of these service areas. However, the new WSIA legislation opened up FSM services to any contractor, including IWK, which is licensed by SPAN. Hence, sludge extraction and transportation is no more undertaken as a scheduled service by IWK and is only available on a responsive basis and the owner or occupier of the premises has the option to select

[1] Covering 88 local authority areas within Peninsular Malaysia and Labuan but excludes the states of Kelantan, Sabah and Sarawak, and the local authority of Johor Bahru.

the contractor to undertake the services. Nevertheless, the responsibility for sludge treatment and disposal remains with IWK.

1.2.2 Rural Health and Sanitation

Traditionally, rural health and sanitation has been the responsibility of the *Ministry of Health* (MOH). Since the 1970s, the Ministry has worked hard to engage with rural communities (those outside of local authority or urban areas) to ensure clean water supply, proper latrine and sewage disposal, and solid waste management. These were undertaken as part of its Rural Environmental Sanitation Programme (RESP), as approximately one third of the country's population then lived in rural areas.

The RESP encouraged the conversion of traditional bucket, pit or overhang latrines to either ISTs or PF systems. Assistance to do this included technical advice and other forms of incentives including subsidies where appropriate. As a result of this programme, the majority of rural communities are now served with ISTs or PF systems and significant improvement in rural health sanitation has been achieved. RESP has since been effective in helping to control the occurrence of diseases related to excreta and poor sanitation. However, there is no specific programme for desludging of such systems when this is required. Services to undertake desludging from such rural communities were provided on a responsive basis and this could be undertaken either by IWK or a private contractor.

1.2.3 Current FSM Services

As highlighted in the earlier section, prior to the coming into force of WSIA in 2008, FSM services, including the operation of sludge treatment facilities, came within the purview of IWK. Although IWK had the overall responsibility over desludging of ISTs, it nevertheless could not manage all such works by itself in view of the 88 local authority areas it had to service. It currently has a customer base of about 1.2 million ISTs and more than 800,000 PF systems. It also operates sludge treatment facilities at various central locations to treat sludge that is generated from ISTs and PF systems, as well as other sewerage systems.

This responsibility required high capital investment in new equipment, additional manpower, and incurred additional operating costs. To assist the company to manage sewerage services within its concession areas, it invited private sub-contractors, which hold approved permits from SPAN, to undertake some of the desludging works where it was logical to do so. This provided opportunities for other private contractors to participate in the provision of FSM services.

The enforcement of WSIA in January 2008, and repealing of the SSA, has since changed the business environment for FSM. Scheduled desludging of ISTs has since been revoked and is now only available on a responsive basis to requests for such services by the owners or occupiers of on-site sewerage systems. Besides IWK,

private contractors who are permit holders from SPAN may also provide such services independently and not necessarily as sub-contractors to IWK. Hence, sludge extraction and transportation is now offered on a competitive basis and the owner or occupier of the premise can select the contractor to undertake the services. Under WSIA, the owner or occupier of the premise has the responsibility to desludge such on-site sewerage systems on a regular basis that is prescribed by SPAN (presently proposed at 2-3 year intervals).

Sludge that is collected is required to be disposed at central sludge receiving and treatment facilities that are found at various strategic locations throughout the country. Within the three cites studied, central sludge treatment facilities (CSTF) are found in Kuala Lumpur and Melaka, while Kuala Terengganu is served with mechanical dewatering unit (MDU). These facilities are operated and maintained by IWK under its concession agreement with the Government.

2. STUDY METHODOLOGY

2.1 INTRODUCTION

The general methodology and approach taken by the Study has been guided by the Common Analytical Framework that was issued by the Foundation and reviewed and adopted during the Kickoff Workshop in New Delhi in May 2011. Nevertheless, specific changes and adaptations were made in the Study in Malaysia to take account of local circumstances and situations which are influenced by existing legal provisions and institutional arrangements, level and distribution systems within the study areas, local faecal sludge management market and operations, and the character of households in Malaysia.

Primary data for the Study generated from various surveys, interviews, discussions, and site visits and inspections constituted the bulk of information used in the Study. These were undertaken in the three selected cities, Kuala Lumpur, Melaka and Kuala Terengganu. The three represented respectively, a large capital city, a mid-sized city and a smaller city which was required of the Study. The locations of the three cities are shown in **Figure 2.1.1**. A fuller description and characteristics of each of the cities are outlined in **Annex 2.1.1** of this report.

2.2 HOUSEHOLD SURVEY DESIGN

The focus of the Study in Malaysia was on sludge management from living quarters with toilet facilities linked to on-site sanitation systems such as individual septic tanks (ISTs) and pour flush systems (PF). Other sewerage systems, such as pit latrines, are rare (and are being phased out), hence were not included in the survey. Living quarters refer generally to residential units and shop-houses used partly for residential use and business. The residential units comprise a variety of types ranging from single-storey to multiple storey structures, which may be linked or detached from one another.

2.2.1 Sampling Population and Size

The total household sampling frame comprised 159,699 living quarters or premises with ISTs and pours flush in the three cities. A sample of 600 was selected which was above the minimum size of 384, based on 95% level of confidence, a margin of error of 5% and a response rate of 50%. It was decided to distribute the sample equally among the three cities, resulting in each having a sample of 200 cases. Each complied with the minimum size based on a margin of error of 5.8% at a confidence level of 90%, and a response rate of 50% **(Table 2.2.1).**

Table 2.2.1: Distribution of Household Survey Sample

	Total On-Site Facilities (IST and PF)	Minimum Sample Size	Confidence Level %	Margin of Error %	Response Rate %
Kuala Lumpur	58,252	200	90	5.8	50
Melaka	44,338	200	90	5.8	50
Kuala Terengganu	57,109	200	90	5.8	50

Source: Household Survey of Fecal Sludge Management Study, Malaysia (June 2011)

2.2.2 Sampling Design

The first stage of sampling design involved the identification of areas to be sampled. This was determined from an analysis of maps and information from IWK's database. Residential zones that have ISTs were determined and ground inspections made to confirm the areas with ISTs and PF systems. Due to the scattering and proliferation of housing areas with IST across the cities, wide variations in number of ISTs among residential areas presented logistic and organizational problems for the survey. A cut-off level was used to reduce the number of housing areas for sampling and to reduce logistical problems. The housing areas in the lists were assigned numbers and selected through random sampling based on a table of random numbers.

It is common in Malaysia for housing areas to have a mix of residential and commercial premises. In addition, villages are commonly found at the fringes or edges of towns and cities, and are deemed to be semi-urban developments. For the purpose of the survey, they were included in the sampling frame. Quotas were allocated for commercial centers, residential areas and villages in each city. The target distribution is given in **Table 2.2.2**. In Kuala Terengganu, the high incidence of pour flush facilities demanded a higher allocation of the sample to villages.

Table 2.2.2: Target Distribution of Sample

	Kuala Lumpur		Melaka		Kuala Terengganu	
	No	%	No	%	No	%
Residential Premises including villages	160	80	180	90	180	90
Commercial Premises	40	20	20	10	20	10
Sample Size	200	100	200	100	200	100

Source: Household Survey of Fecal Sludge Management Study, Malaysia (June 2011)

The second stage sampling design was at ground level when the premises were selected for interviews. This was carried out by enumerators on the field, who were briefed on the use of systematic random sampling. Training of enumerators was carried out prior to the launch of the survey. In each city, a one-day training session was carried out for the enumerators by an experienced field supervisor. The survey supervisor also had a part in reviewing the standard questionnaire, in the sampling

process, and was responsible for organizing the survey and ensuring the integrity of the completed questionnaires.

A pre-test exercise was held prior to actual start of survey. The pre-test highlighted a need to brief the enumerators carefully on some of the questions which respondents were not able to respond adequately. The common standard questionnaire was used However, adaptations were made to suit the Malaysian context as some questions could not be applied directly and had to be modified or restructured. There were situations whereby additional response types were added to questions to be able to adequately capture the responses. The final version of the questionnaire used for the survey is shown in **Annex 2.2.1**.

2.2.3 Constraints and Operational Issues in Survey

The sampling of housing areas was entirely dependent on existing maps and listings for the three cities. Whilst each listing is relatively good, it could not be exhaustive or sufficiently detailed, as it was difficult for enumerators to differentiate clearly between premises with direct connections to centralised sewer systems or on-site sanitation facilities. In such cases of doubt or uncertainty, the enumerators were instructed to stop the interview.

A second constraint faced by enumerators in the highly urbanized area was the level of cooperation from households. Safety issues in the certain housing areas sometimes led to situations when enumerators were refused entries into homes. In addition, some housing areas are perceived to be unfriendly and unsafe, causing problems for some enumerators.

Another issue was that, although the listings identified areas which are residential and commercial centers, there were instances where commercial premises were found in adjoining streets to houses or even along the same street, resulting in more commercial premises being picked up in the survey. As a result, there were some adjustments made to the final sample within each city although the total for each was maintained at 200 cases (**Table 2.2.3**)

Table 2.2.3: Final Distribution of Samples in Kuala Lumpur, Melaka and Kuala Terengganu by Type of Premise

	Kuala Lumpur		Melaka		Kuala Terengganu	
	No	%	No	%	No	%
Residential Premises	131	66	141	71	94	47
Villages	25	12	12	6	85	43
Total -Residential	156	78	153	77	179	90
Commercial Premises	44	22	47	23	21	10
Total	200	100	200	100	200	100

Source: Household Survey of Fecal Sludge Management Study, Malaysia (June 2011)

2.2.4 Data Analysis

The household questionnaire was coded and fed into Statistical Package for Social Sciences (SPSS) for processing. The tabulations are generated and transferred into excel format for ease of reference. The analytical indicators are percentages, ratios, medians, and means which are also subject to analysis of variance, where relevant.

2.3 FSM PRACTICES AND DATA COLLECTION

Faecal sludge service providers refer to the group of operators (or contractors) who are engaged in the provision of extraction and transportation of sludge from such on-site sewerage systems as ISTs, PF, and other communal or centralised sewage treatment systems. Such services are provided by IWK, the "*service licensee*" and concession holder for the provision of sewerage services (operations and maintenance), as well as other private contractors (as "*permit holders*"), who may act as sub-contractors to IWK or as independent contractors. The operations of independent contractors may also include sludge extraction and transportation for industrial premises and large commercial complexes such as hotels, business complexes, as well as communal septic tanks and treatment plants.

2.3.1 FSM Practices – Extraction and Transportation

The survey that was undertaken focussed on those service providers who are mainly engaged in sludge extraction and transportation from households and commercial premises. The identification and listing of service providers was a task that took some time to confirm due to difficulties in establishing the actual status of the companies, whether they were still in operation or not. Changes in recent years, since the enforcement of WSIA in 2008, resulted in a situation of uncertainty when scheduled desludging of ISTs was not implemented. As a result, lower number of ISTs and PF systems were being serviced as the need for such services became optional. This resulted in many service providers going out of business and stopped operation although still listed as permit holders.

From the original list of registered contractors with the National Water Services Commission (or SPAN), only about 12 active service providers are still engaged in sludge extraction and transportation for the 3 cities surveyed. While both IWK and independent service providers were engaged in the provision of FSM services in Kuala Lumpur and Melaka, only IWK operates in Kuala Terengganu. The market in the latter city did not seem to attract independent service providers to undertake FSM services, apparently due to the low charge rates and poor returns on such investments.

The survey of service providers was undertaken using a modified questionnaire form that was developed to suit local conditions (**Annex 2.3.1).** All the 12 active service

providers identified in the listing exercise were included in the survey. The survey consisted of 3 sections covering, general information about their business structure, and information about their business operations, and the last section on their perspectives. Financial information about their business was also requested.

Prior to the carrying out of the survey, a dialogue session was organised and invitation was sent to all service providers that were listed. The purpose of the dialogue was to provide a brief introduction to the Study and to outline its main objective. A brief review of the questionnaire form was also made and feedback from the service providers was obtained to modify or improve the questionnaire for easier understanding and to ensure that the forms would be completed without due delay. Although the questionnaire survey was given or sent to the listed service providers earlier, interviews were also conducted with some of the service providers and forms were directly gathered at the end of these interviews. However, as information about financial aspects of their operation required time to obtain, these were requested to be returned by mail, courier or by hand.

Besides the above surveys, observations of actual sludge extraction and transportation operations were made. A series of field trips were undertaken and the process of sludge extraction and transportation was followed through with the service providers during their normal routine operations. In addition, some of the employees of selected service companies were also interviewed during the survey to provide feedback on their work related experiences and to gather personal information relating to their salary and personal experiences. A different questionnaire form was prepared which closely reflected the situation in Malaysia and used in the survey (**Annex 2.3.2**). For this, interviews were conducted with the employees and the survey forms filled up there and then.

2.3.2 FSM Practices – Treatment and Disposal

All the three cities studied are equipped with centralised sludge receiving and treatment facilities. Kuala Lumpur or the Federal Territory of Kuala Lumpur (FTKL) is a city-state with a total land area of about 243 km^2. Sludge that is extracted is transported either to the Centralised Sludge Treatment Facility (CSTF) at Pantai (close to the heart of the city) or other similar sludge treatment facilities in adjacent municipalities (such as the in Klang, about 35km away) for treatment.

Melaka City is the State Capital of Melaka State occupying a total land area of about 689 sq. Km. A modern CSTF facility for treatment of the sludge generated from the state has been constructed and commissioned recently at Sungai Udang about 17km from the city centre.

Kuala Terengganu City is the State Capital of Terengganu State in the East Coast of Peninsular Malaysia. It has a total land area of 605 sq.km and the city is made up of the city centre of Kuala Terengganu and 6 other smaller district centres. A new

Mechanical Dewatering Unit (MDU) services the area and is located at Gong Badak, some 18km from the city centre.

Investigations into the operations of sludge receiving and treatment facilities were made for the centralised facilities within each of the three cities. Discussions were also held with the operators of these facilities to understand their operations.

2.4 IDENTIFYING KEY STAKEHOLDERS

Key stakeholders in faecal sludge management (FSM) in Malaysia (specifically Peninsular Malaysia where the 3 cities are located) have been identified to include various authorities which may operate at federal, state or local level; service providers engaged in sludge extraction, transportation, treatment and disposal; and waste generators, such as households, business premises and others.

Information about the role, responsibility and function of the various authorities and the legislative provisions relevant for their operation were the focus of the survey that was undertaken for the authorities identified. The information were obtained from meetings and discussions with relevant personnel of the authorities, review of information from publications and annual reports, and information gathered from the websites of the departments and authorities concerned.

Information from surveys undertaken for households, service providers and employees, and discussions with operators of sludge treatment facilities provided additional information on these stakeholders. Published data by the Department of Statistics as well as unpublished data maintained by various agencies and authorities constituted information sources which were used for the assessment.

2.5 FINANCIAL FLOW OF FSM SERVICE PROVIDERS

Income statements from FSM service provider companies to assess their current financial performance were requested at the same time of the survey on service providers. Request was made for the companies to provide income statements that are audited statements of income and expenses that have been declared by the companies for income tax purposes. As such, income statements obtained are considered reliable and valid as these have been audited by independent auditors of the company in compliance with Malaysian tax authorities. Where there were doubts or difficulty of interpretation of the statements, direct communication with the companies were made to seek clarification. However, due to the reluctance of some to reveal so called ‘confidential’ information, limited responses on their financial performance could only be obtained.

Financial statements were also requested for two periods in time, one for 2007 and the other for the latest period (2009 or 2010). This is in view of the change from scheduled

desludging (prior to 2008) to one that was unscheduled (post-2008). The intent is to be able to compare and determine if there is an impact on the desludging business as a result of changes prior to and after WSIA.

As for other information needed for the financial analysis, certain information related to vehicles and equipment cost were obtained from equipment suppliers, while banking and finance rates were obtained from commercial bank sources.

2.6 MARKET SIZE PROJECTIONS

There are differences in the levels of sewerage development between the 3 cites which are being studied. About 92% of the population equivalent of Kuala Lumpur is connected to centralized or municipal treatment systems, while slightly more than 58% of the population equivalent of Melaka and about 13% of population equivalent of the City of Kuala Terengganu is served by similar systems. The rest of the population depends on on-site sewerage systems, such as ISTs, PF and communal septic tanks (**Table 2.6.1**).

Table 2.6.1: Types of Sewerage Systems and Population Equivalent (PE) Served

Sewerage System	Kuala Lumpur City		Melaka City		Kuala Terengganu City	
	Number	PE Served	Number	PE Served	Number	PE Served
Centralised Systems		3,451,713		332,325		44,270
Communal Septic Tanks	18	13,110	141	15,941	57	6,448
Individual Septic Tanks (IST)	53,252	266,260	37,975	189,975	23,509	117,545
Pour Flush (PF)	5,000	25,000	6,363	31,815	33,600	168,000
Total	**58,270**	**3,756,083**	**44,338**	**570,056**	**57,166**	**336,263**

Source IWK, 2011

2.6.1 FS Production Criteria Establishment

Direct quantitative data on faecal sludge production is generally lacking, hence indirect means were applied to estimate such quantities. The approach that was adopted included a study of the criteria applied for the standard design of on-site sanitation systems, sewage generation from households, household size, desludging frequency, and studies undertaken by IWK in conjunction with a local university on the quality of discharge from ISTs which have been desludged over various periods.

IST Systems Design

In Malaysia, planning and design of an IST is currently governed by:

i. MS1228:1991 – The Malaysian Standard Code of Practice for the Design and Installation of Sewerage Systems, published by the Standards and Industrial Research Institute of Malaysia (SIRIM); and

ii. Guidelines for Developers on the Design and Installation of Septic Tanks, Vol. 5 (2nd Edition), published by the Department of Sewerage Services (DSS) in 1995.

The general capacity of an IST is designed based on a per capita wastewater generation rate of 225 litres per day (consisting of toilet waste and sullage) and a household size of 5 persons per residential premise (household survey results shown that this is generally true for the 3 cities studied). The minimum volumetric capacity of a septic tank should not be less than 2cu.m and consists of at least 2 compartments to allow for effective settlement of solid and retention of floatables (see **Annex 2.6.1** for details).

Experience has shown that in order to provide sufficiently quiescent conditions for effective sedimentation of the sewage solids, the liquid retention time should be at least 24 hours. Hence, 'free' liquid tank volume of about 1130 litres is to be maintained in order to meet this condition whilst allowing a 'sludge storage volume' of about 870 litres (2,000L – 1,130L).

Recent study carried out jointly by IWK and a local university has shown that effluent quality from an IST is not adversely affected by a desludging frequency of 3 years. Based on these findings, back computation shows that a sludge generation rate of about 0.06cu.m/capita/year is likely[2]. This rate is more consistent with those adopted internationally of between 0.04cu.m to 0.06cu.m/capita/year. Hence, the value of 0.06 cu.m/capita/year (or 0.82 L/HH/day) will be adopted to estimate sludge generation for ISTs.

Pour Flush System Design

The Engineering Services Division of the *Ministry of Health Malaysia* (MOH) has issued a manual that provides guidelines for the construction of PF toilets. The recommended reception tank volume of such systems is about 2cu.m (internal volume) and consists of a constructed rectangular tank. However, observations show that most PF systems consist of precast cement rings which are between 900-1200mm internal diameter. Commonly, three rings of 900mm diameter (each of depth 600mm) are used to create the storage tank, hence providing a storage volume of about 1cu.m (allowing

[2] Calculated based on 'sludge storage volume' = 870L divided by 3 years storage time for a 5 persons household. Sludge is taken to include bottom sludge and surface scum.

for piping, etc.). Where the larger rings are used, the storage volume would be about 2 cu.m.

Sludge accumulation rate in pour flush (PF) systems has not been established from present studies. However, it is known that such systems generally only receive toilet wastes while sullage (from kitchen and bathrooms) is discharged separately. Toilet waste comprises about 45% of the total sewage generation although it may be expected to have a higher concentration of solids per unit volume. This is in view of the lower volume of water used in flushing.

Sludge accumulation includes both bottom sludge and surface scum; the latter is more likely to be contributed from kitchen and bathroom wastewater due to the disposal of oil (from food) and soap material used in washing. Bottom sludge is more likely to be due to the accumulation of faecal material, sand, grit and other non-floatables. Unfortunately, local data is not available to ascertain the proportion of sludge contribution from toilet wastewater and sullage. However, for purposes of the current study, it is assumed that sludge contribution is similar for both sources of wastewater. Hence, sludge accumulation in PF systems is taken to be proportionate to the wastewater generation rate, which is given by the following computation:

Total sludge generation rate (bottom + scum) = 0.06cu.m/capita/yr (estimate for IST)
Proportion of toilet wastewater to total sewage generation = 45%
Hence,

Sludge generation rate for PF system = 0.06 x 0.45 cu.m/capita/yr
= 0.027cu.m/capita/yr

Based on the above, a factor of 0.03 cu.m/capita/yr (or 0.41 L/HH/day) is applied to estimate sludge generation for PF systems.

2.6.2 FS Production Computation

Potential total FS production for the 3 cities computed based on the established sludge generation rates is shown in **Table 2.6.2** below.

Table 2.6.2: Computation of Potential Sludge Generation by City*

City	No. of IST	No. of Pour Flush (PF)	Sludge Generation/Year[3] (cu.m/year)		
			IST	Pour Flush	Total
Kuala Lumpur	53,252	5,000	15,976	750	**16,726**
Melaka	37,975	6,363	11,393	954	**12,347**
Kuala Terengganu	23,509	33,600	7,053	5,040	**12,093**

**Sludge here refers only to the 'solids' fraction, and excludes the liquid fraction*

It is to be noted that the sludge generation quantities indicated above are estimates for the fraction that contains most of the settleable solids that is found in an IST or PF. In mechanical sludge extraction, it is the case that the total content of the tank is emptied (sludge plus liquid fractions) and not the sludge fraction alone. Hence total volume of sludge-water during emptying is governed by the total volume of the tank in question. For an IST, this is about 2cu.m, while that for PF is generally from 1 - 1.5cu.m. More often than not for PF systems, this is about 1cu.m, as borne out from operational experiences of IWK and other private service providers carrying out sludge extraction.

In the context of Malaysia, the rate charged for FSM is based on the total volume (sludge plus liquid) extracted and this rate of fee has been set by SPAN. Hence, information on the total volume of extraction is more relevant for purposes of determining cost for the FSM service (see Section 3.10 for details on rates).

2.7 FINANCIAL ANALYSIS METHODOLOGY

2.7.1 Business Case Financial Analysis

The business cases financial analysis will be based on two scenarios involving financial situations for years 2007 and post-2007. As explained in the earlier section, the proposed scenarios are taken to reflect the two situations when desludging business demand was high, as it was scheduled, and when such demand fell as a result of changes in the legal requirement making it unscheduled. The pre- and post-2007 situations provide good case studies for assessing viability of the business of sludge extraction and transportation for a regulated service as opposed to one that is demand or responsive driven. In addition, as all sludge emptying in Malaysia is carried out by companies using only mechanical means, the financial analysis for manual emptying of faecal sludge will be excluded.

The financial analysis of a mechanical service provider (sludge emptying and transportation) in each of the three cities identified will be based on all the revenue and

[3] Computed by multiplying respective sludge generation rate (Litres/HH/yr) x (no. IST or PF)/1000, assuming each household (HH) has either one IST or PF system.

expenditures of the relevant company in a year. For the post-2007 cases, analysis will be carried out using the latest financial information made available from service providers. The revenue can be from both formal and informal[4] sources. The expenditures are grouped as follows:

1) Capital Investment, which involves fixed assets like trucks, building, furniture, etc.
2) Operating Expenses, which include depreciation, salary and wages, travelling expenses, etc.

The financial analysis will generate an Income Statement for the service company under review. The intention in doing this is to determine the profitability of the company. This Income Statement will provide the basis for undertaking further analysis, resulting in Ratio Analysis and Sensitivity Analysis which will test various business parameters to determine the robustness of the financial models.

In the event that the service company has sufficient information on its cash flow situation, the financial analysis will be extended to include a Cash Flow Statement which will allow an evaluation of the financial position of the said company in terms of liquidity and sustainability of operating the desludging business in the three cities. At the same time, it would enable a Breakeven Analysis to be carried out, highlighting the breakeven point of the company's operation.

2.7.2 Model Case Study Using Geo-tube

A model case study was also made for the use of Geo-tube in improving the efficiency of desludging services especially for areas which are remote or where premises are scattered over large areas (for details on the system, see section 3.8.2). The use of Geo-tube has been conceived to provide a solution to overcome the logistics problems faced in providing desludging services to these areas. Recent pilot studies undertaken by IWK in the State of Kedah, in the north of the country, has shown that the application of Geo-tube at strategic locations, other than existing centralised sludge reception and treatment facilities, was able to achieve the following:

a. Reduction in cost per kilometre travel due to reduction in travel distance from source to the disposal site;
b. Reduction in cost per unit volume of sludge handled as a result in tanker performance and reduction in cost per IST desludged;
c. Reduction in operations cost compared to mechanical dewatering units;
d. Increase in tanker performance (due to better turnaround time); and
e. Increase in total desludging capability.

Application of the Geo-tube model was extended to include an assessment of performance for the case in Melaka by modification of the case model for a medium-

[4] Formal refers to official income reported in audited account, while informal refers to unofficial income not reported in official account.

sized service provider operation in the city. In order to derive the theoretical model set-up, the following procedures and steps were carried out:

a. Extension of the service area to cover the whole State of Melaka in order to achieve the purpose of the use of Geo-tube to overcome logistics problems associated with remote and scattered service areas.

b. Distribution and location of the Geo-tubes in strategic sites so as to reduce distances travelled from the source to the Geo-tube locations (a maximum radius of about 15km travel distance for trucks from the source to the Geo-tube locations as compared to the present average travel radius of about 35km). The identified sites and the estimated radius covered are shown in **Figure 2.7.1** (attached).

c. Location of the Geo-tubes within existing sewage treatment plant sites so as to enable treatment of leachate that is generated from the Geo-tubes using available treatment plant facilities.

A financial analysis for the case of a medium-sized operation with Geo-tube in place was run to determine if the improvements, as observed from the Kedah case study, could be applied to improve profitability and viability for such an operator. It is anticipated that the business model recommendation to be made from the Study will be enhanced by the application of the Geo-tube model extension.

3. RESULTS AND ANALYSIS OF URBAN FSM PRACTICE

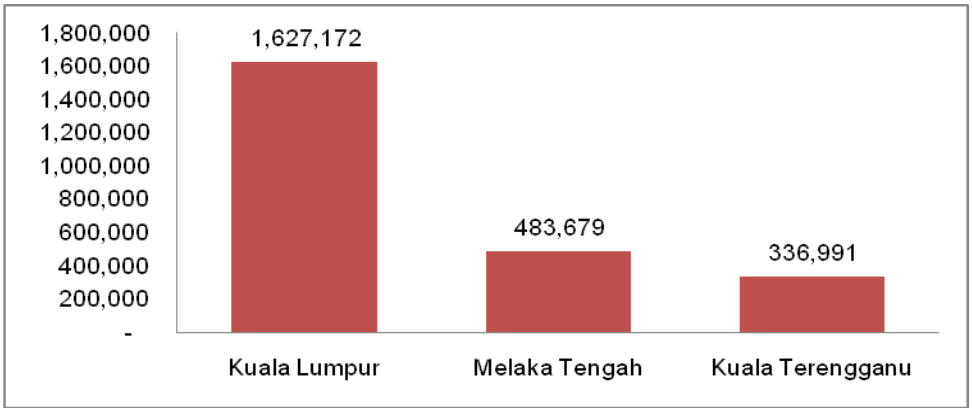
3.1 DEMOGRAPHICS OF STUDY AREAS

3.1.1 Demographic Analysis of Kuala Lumpur, Melaka and Kuala Terengganu

Population in Malaysia increased from 22.2 million in 2000 to 27.6 million in 2010, increasing at an average annual growth of 2.2%. It experienced an even higher growth of 2.9% per annum in its household formation as a result of rapid urbanization, rural-urban migration, and a decline in average household size. This led to a rapid expansion of living quarters, comprising housing units and collative living quarters, which by 2010 rose to 7.4 million.

Among the three urban centres selected for the study, Kuala Lumpur, as the national capital, is the largest city in the country with a population of slightly above 1.6 million people in 2010 (**Figure 3.1.1**) . The other two cities of Melaka and Kuala Terengganu are capitals of their respective states. Melaka town located in the district of Melaka Tengah is also highly urbanized, with a population of about 483,700 within its municipality.

Figure 3.1.1: Population in Kuala Lumpur, Melaka and Kuala Terengganu, 2010



Source: 2010 Population and Housing Census, Preliminary Count (Dept. of Statistics Malaysia, May 2011)

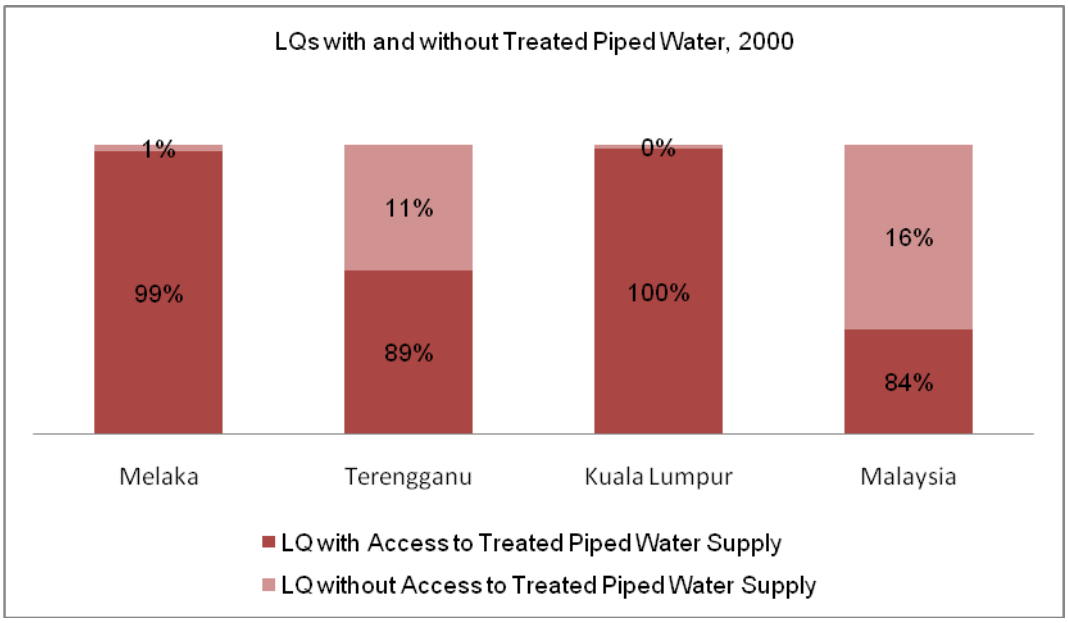
Kuala Terengganu is the smallest of the three cities, having a population of about 337.000 in 2010. Its town centre is small and surrounding it are villages, reflecting a relatively rural environment compared to Kuala Lumpur and Melaka, both of which are highly urbanized with good sanitation infrastructure.

3.2 DRINKING WATER SUPPLY COVERAGE

Over the past three decades, Malaysia has made significant progress in providing piped treated drinking water to its population. In 1980, it was estimated that only 65% of its population had access to piped drinking water and by 2000, the proportion with access to treated piped water in Malaysia had risen to 84% (**Figure 3.2.1**).

This progress at the national level was reflected in the states where the three selected cities are located. By 2000, 100% of the population in the three states had access to water but the level of access to treated piped water varied from 100% for Kuala Lumpur to 99% for Melaka and a lower 89% for Terengganu. The lower level of access to piped water for Kuala Terengganu was attributed to the fact that it is relatively rural, with villages that do not access treated piped water for various reasons and continue to rely on other water sources such as rivers, well, canals, etc.

Figure 3.2.1: Occupied Living Quarters with and without Access to Drinking Water Supply in Malaysia, Kuala Lumpur, Melaka and Terengganu, 2000



Sources: Population and Housing Census, Characteristics of Living Quarters 2000 (Department of Statistics Malaysia)

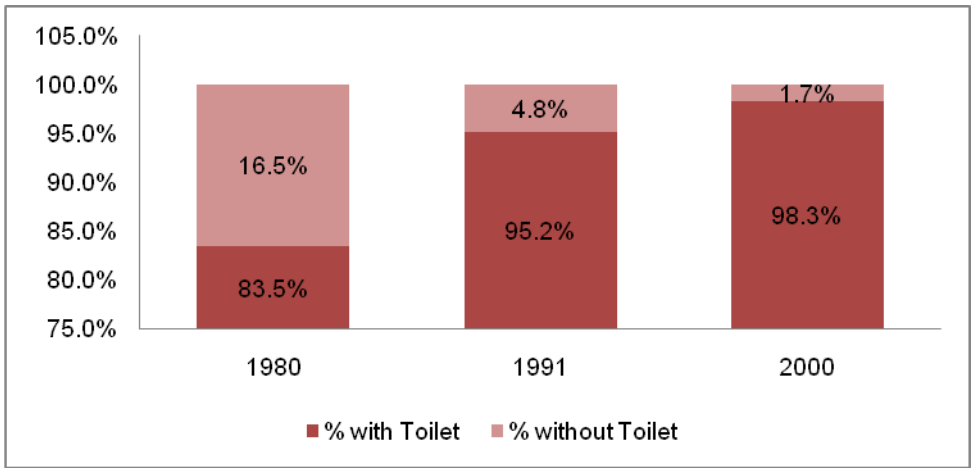
3.3 SANITATION COVERAGE

3.3.1 Sanitation Services in Malaysia, Kuala Lumpur, Melaka and Terengganu

People in living quarters are the major users of sewerage services in the country. Over the past 20 years, Malaysia has made considerable progress in providing sanitation to its population. In 1991, 95% of the living quarters in the country already had access to

toilets. Nine years later, this proportion has risen to 98%, and only less than 2% of its population was believed to have no access to toilets (**Figure 3.3.1**).

Figure 3.3.1: Living Quarters with and without Toilet Facilities in Malaysia in 1980, 1991 and 2000



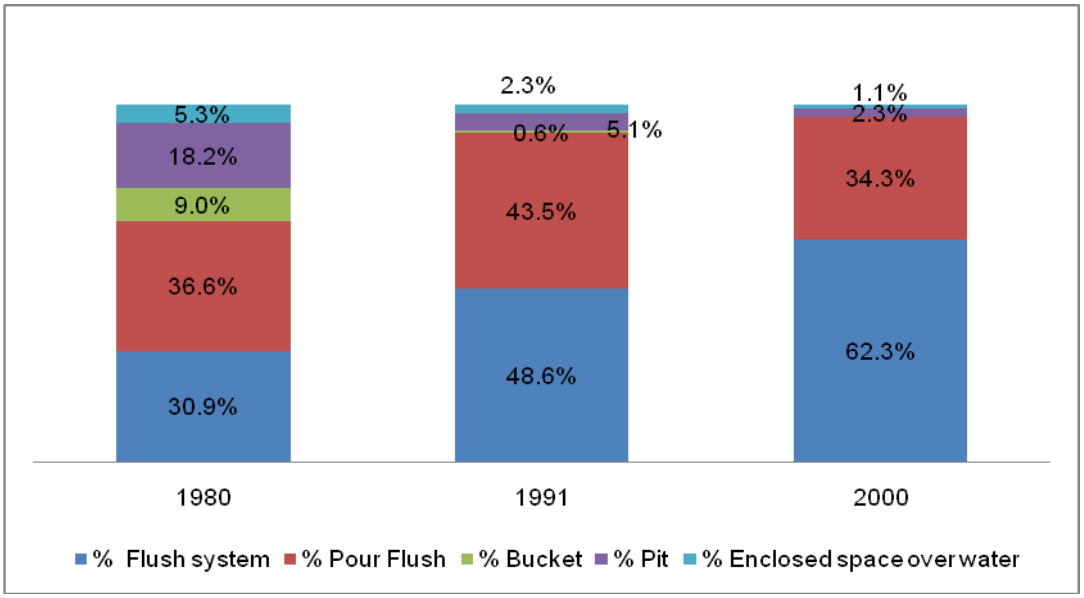
Sources: 1) Population and Housing Census, Characteristics of Living Quarters 2000
2) Population and Housing Census, General Report of the Housing Census, 1991
(Department of Statistics Malaysia)

There are no published figures available from the recently completed 2010 Population and Housing Census but it is anticipated that the level of sanitation coverage in the country would have risen considerably or at least be sustained at 98 -99%, leaving a very small percentage of them located in remote or inaccessible areas still not having access to toilet facilities.

Improvements in sanitation facilities are also reflected in the increasing use of flush system as opposed to other form of sanitation. In 1991, 46% of the living quarters with toilets had flush systems and 42% had pour flush facilities. By 2000, 62% of living quarters in the country used the flush system while the percentage with pour flush declined significantly to 34% (**Figure 3.3.2**). The trend is towards a decline in the use of pour flush facilities. One significant progress during the period 1991-2000 was the complete removal of the bucket system from the country's overall sanitation system.

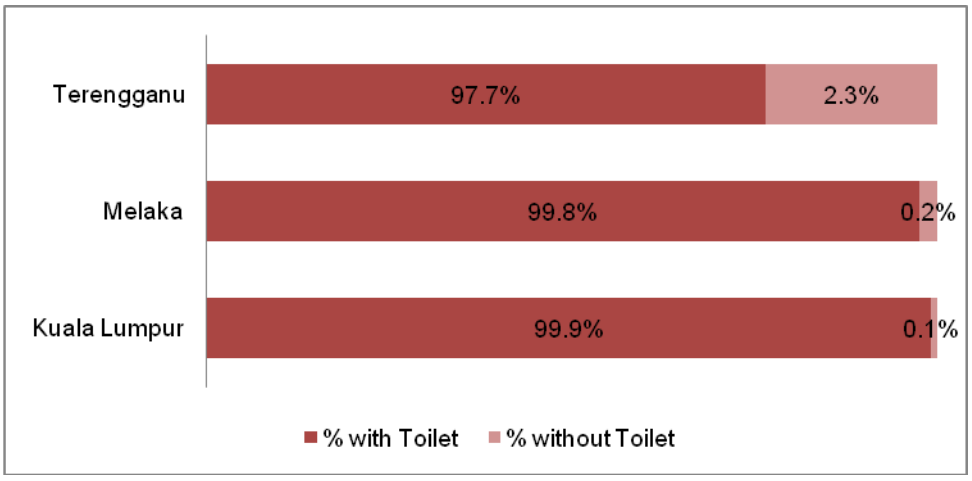
There were some variations in the level of sanitation coverage within the three states where the cities are located. Kuala Lumpur, being highly urbanized, has attained almost 100% coverage of services throughout the state cum city. Melaka state also appeared to have made considerable progress by achieving 99.8% coverage of its population (**Figure 3.3.3**). With the three states showing extensive coverage, it is inevitable that the cities within them such as Kuala Lumpur and Melaka will also experience similar coverage. The state of Terengganu has also achieved considerable progress in its sanitation coverage but at about 98% it still lags behind the other two cities.

Figure 3.3.2: Malaysia-Distribution of Types of Sanitation in Living Quarters in 1980, 1991 and 2000



Sources: 1) Population and Housing Census, Characteristics of Living Quarters 2000
2) Population and Housing Census, General Report of the Housing Census, 1991 (Department of Statistics Malaysia)

Figure 3.3.3: Living Quarters with and without Toilet Facilities in FSM Study Areas, 2000



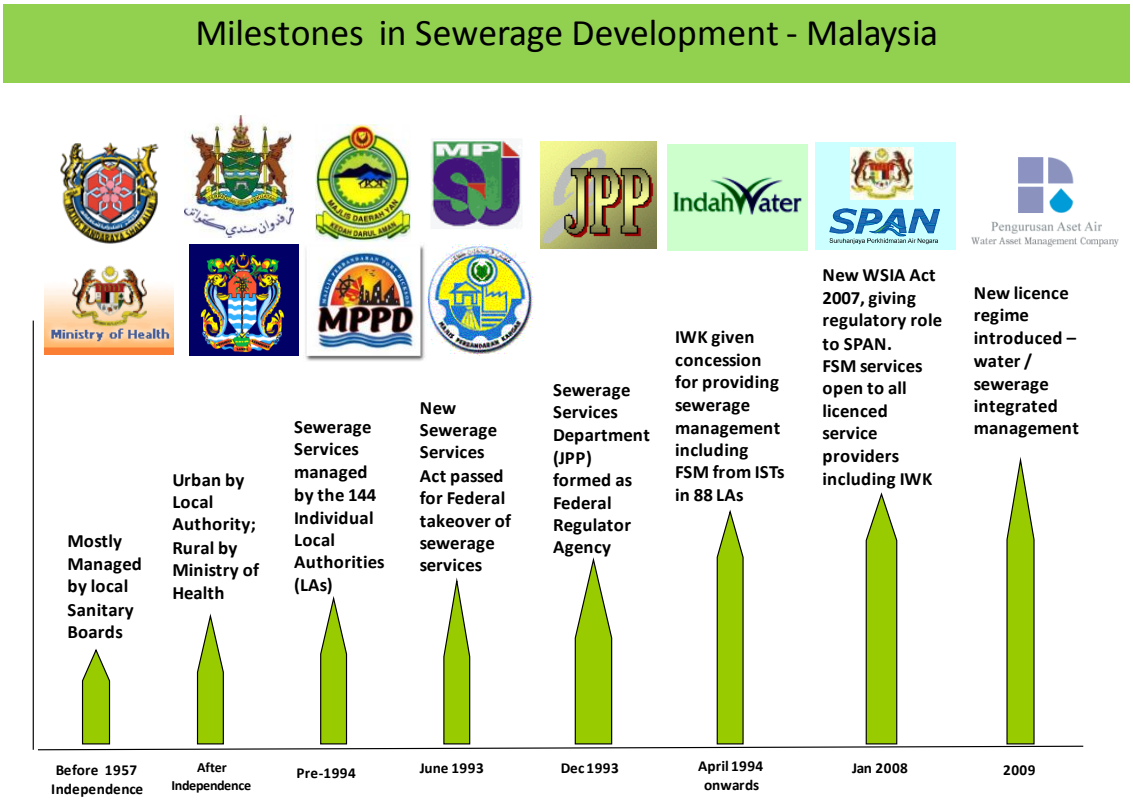
Sources: Population and Housing Census, Characteristics of Living Quarters 2000 (Department of Statistics Malaysia)

3.4 INSTITUTIONAL AND LEGAL FRAMEWORK

3.4.1 Overview of Sewerage Development and Management in Malaysia

Sewerage development and management in the country has seen a transition over the years, from one where the jurisdiction for such responsibility rested with local authorities, to the present situation where it has become a federal responsibility (**Figure 3.4.1**).

Figure 3.4.1: Milestones in Sewerage Development



Source: Modified from IWK

The changes took place initially with the promulgation of the *Sewerage Services Act 1993* (SSA) which empowered the Federal Government to take over responsibility for development and management of the sewerage sector in the country. This has since been superseded by two new legislations which were passed by the Parliament in 2006, the *National Water Services Commission Act 2006* and the *Water Services Industry Act 2006 (WSIA)*, and enforced as of January 2008. The new legislations have paved the way to a new direction for integration of the water and sewerage industry in the country. Responsibility for these two sectors is presently under the purview of the new *Water Services Commission* (SPAN), whereas previously, these

have been under a spread of agencies. Sewerage, for example, was the responsibility of the *Sewerage Services Department* (JPP).

3.4.2 Institutional Arrangement for Regulation of FSM

FSM is regulated by SPAN under provisions within WSIA, with the *Department of Environment* (DOE) playing a secondary regulatory role through the enforcement of the *Environmental Quality Act 1974* (EQA). The latter has responsibility for protection of the environment through the control of pollution from sewage and faecal sludge discharge or disposal. The other main players in FSM are the service providers which include the Service Licensee (IWK) and Permit Holders (private contractors), who are licensed by SPAN.

The relationship between SPAN, the DOE, the Service Licensee and Permit Holders engaged in FSM may be summarised in **Figure 3.4.2**. IWK occupies a special position within the arrangement in view of its position as a national sewerage company given the responsibility (concession) to operate and maintain the public sewerage facilities in the country.

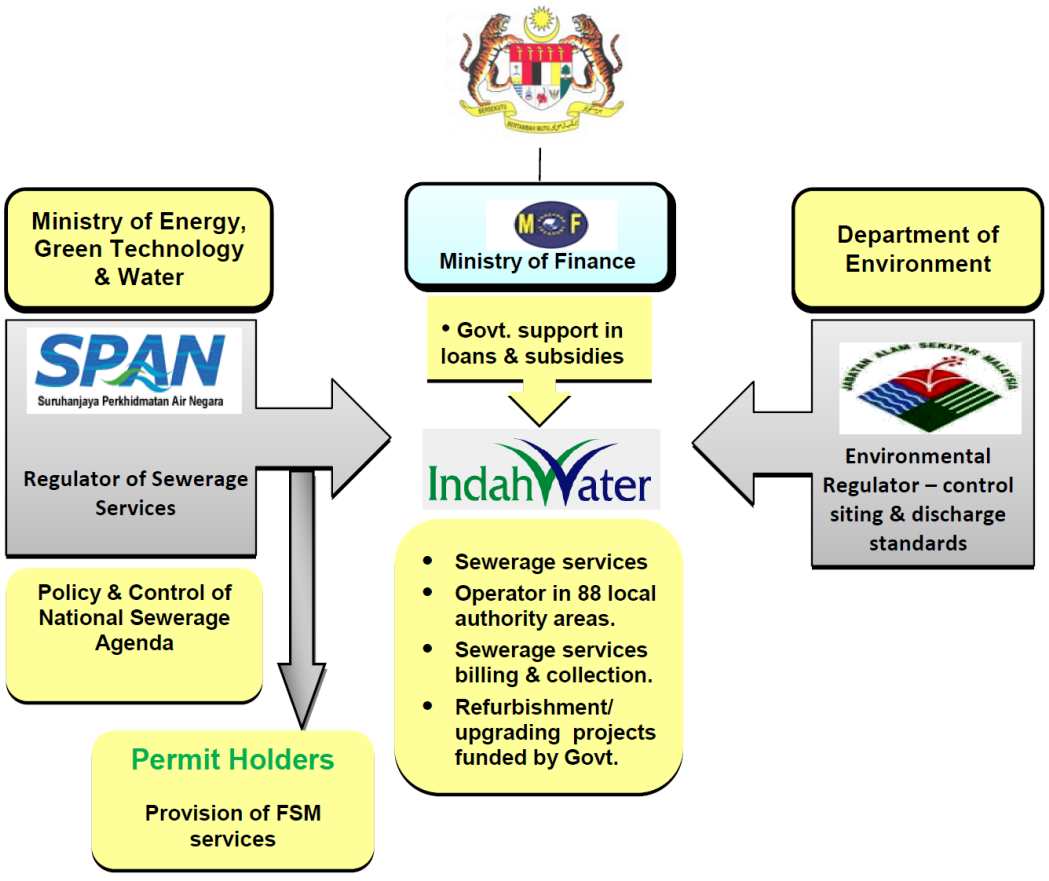


Figure 3.4.2: Institutional Arrangement for Sewerage Management in Malaysia

3.4.3 General Role and Function of Stakeholders

The role and general function of each of the key stakeholders relevant to FSM are described in the following.

3.4.3.1.1 National Water Services Commission (SPAN)

The *National Water Service Commission* (SPAN) is a federal statutory body formed to regulate and oversee the treated water and sewerage services in the country. The Commission operates within the ambit of the *Ministry of Energy, Green Technology and Water* (KeTTHA). It was formed to regulate and enforce the provisions of the *Water Services Industry Act 2006*, or WSIA, and any subsidiary legislation created under it.

As a regulator for the water supply and sewerage services sector SPAN, with respect to FSM, has responsibilities for the following:

i. Appointment and registration of Permit Holders (licensing);
ii. Monitoring of desludging of premises performance according to prescribed cycles;
iii. Monitoring the activities of Permit Holders and Service Licensees on desludging
iv. Monitoring septage collection by Permit Holders and collection by Service Licensees; and
v. Oversee fair pricing of desludging charges.

Department of Environment Malaysia (DOE)

The *Department of Environment* (DOE) of Malaysia is responsible for the prevention, control and abatement of pollution in the country through the enforcement of the *Environmental Quality Act of 1974* and its subsidiary legislation. The DOE is a federal agency within the *Ministry of Natural Resources and Environment* and has powers relating to the siting of new sewage and sludge treatment and disposal facilities, and control over discharges and emissions from such facilities.

Hence, the role of the DOE in relation to FS Management is to ensure that potential treats to the environment posed by treatment and disposal facilities are minimised. This is achieved by ensuring proper siting of such facilities and effective treatment of any emission or discharge that emanates from these facilities. .

FSM Service Providers

FSM services are presently provided by both IWK (the Service Licensee) and other independent contractors (as Permit Holders). IWK operates as a private company although it is a wholly-owned company of the Minister of Finance Incorporated. Although desludging activities have in the past been dominated by IWK, as a result of the concessionaire agreement signed during the privatisation of sewerage services in

1994, the main core business of IWK is the operation and maintenance of sewerage facilities (including sludge treatment and disposal facilities), for which it derives more than 90% of its revenue. Desludging activities only bring in about 10% of its revenue and the bulk of it comes from servicing of government buildings and premises.

The enforcement of WSIA in 2008 opened the desludging business to other independent service providers who comprise of entrepreneurs who have invested into equipment to undertake sludge extraction and transportation services. While they have a choice to operate independently, many operate as sub-contractors to IWK due to the security provided by the latter in securing work for them. The drop in demand for desludging services after the enforcement of WSIA affected many of the registered permit holders due to the drop in demand for such services. As a result many stopped operations while those that are still operating are known to rely on other income and work to survive.

Waste Generators

According to IWK's National Statistics for 2011, more than 2 million ISTs and PF systems are still operating in the country. ISTs are widely used as a method of treating domestic sewage in the absence of connected or centrally organised sewerage systems. They are used within domestic, commercial and industrial premises.

Under WSIA, the owners or tenants of premises with ISTs are responsible for the maintenance of their systems. The *Malaysian Sewerage Industry Guidelines* (MSIG) for Septic Tanks (Volume V), state that desludging of an IST must be done not less than once every 2 years to restore the designed treatment capacity of the system. Nevertheless, more recent studies by IWK in conjunction with a local university have indicated that the actual interval for desludging by households can be longer and a 3 year interval is now proposed.

Other Stakeholders

Prior to 1993, sewerage development and management came under the jurisdiction of local authorities. However, this role had since been rescinded with the enactment of the SSA. All the 3 cites being surveyed are within this group. Nevertheless, some states and local authorities (such as states of Kelantan, Sabah and Sarawak, and the local authority of Johor Bahru), have not given up this responsibility to the federal authority and retain their respective roles for sewerage development and management.

The *Department of Sewerage Services* or JPP was formed in 1994 under the *Sewerage Services Act 1993* (SSA), as a federal department under the *Ministry of Housing and Local Government.* In the light of the formation of SPAN, it is now a department within KeTTHA, and has as its main function the planning and sourcing of funding for new sewerage capital works and the rehabilitation of existing sewerage systems. The Department's role is mainly administrative and it does not play any direct role in the regulation or management of sewerage services.

3.4.4 Legislation Applied to Faecal Sludge Management

Two sets of legislations are relevant to faecal sludge management and these are described in the following.

Water Services Industry Act 2006 (WSIA)

WSIA provides the legal framework required for regulation of the water and sewerage service industries in the country. The Act came to force on 1 January 2008. One of the objectives for WSIA is to promote the National Policy Objective for water supply and sewerage services industry for the country.

Various changes have been made in terms of the approach and manner in which FSM will be undertaken with the implementation of WSIA. These changes which have been recorded in the period prior to and after the implementation of WSIA are summarised in **Table 3.4.1.**

Table 3.4.1: Comparison of Pre and Post WSIA Situations

	Pre-WSIA	Post-WSIA
1	Rates ▪ Rate charges are based on types of property i.e. commercial, government, domestic or industrial	▪ Flat rates for all classes based on the volume of sludge removed
2	Desludging frequency ▪ Scheduled desludging on two year intervals for domestic, commercial, government within the local authority (LA) service areas	▪ Property owner to call for service based on interval to be prescribed by regulator (SPAN)
3	Responsive service ▪ Carried out for IST outside of LA area, private IST and non standard IST ▪ Charges for non-standard IST – RM48 ▪ Charges for private IST – RM 150 ▪ Charges for domestic – RM 220	▪ Responsive and charges to be based on rates prescribed which are not to be exceeded.
4	Operational or service area ▪ Customers within the LA area are provided with scheduled desludging based on two years interval. ▪ Outside the service area, responsive service is provided	▪ All desludging service will be on responsive basis
5.	Payment term ▪ Billing for domestic – 6 monthly ▪ Billing for commercial – monthly ▪ Billing for others – monthly	▪ To be determined (by instalment or one-off payment)
6.	Repeat customers ▪ Free between service cycle	▪ Every service rendered to be charged
7	Warranty for responsive customer ▪ 3 months warranty given to responsive	• Not stated

	Pre-WSIA	Post-WSIA
	customer	
8	Maintenance of IST ▪ Owner's responsibility to maintain cover, tee pipes, internal circulation including blockage clearance	▪ Status quo (as before)
9	Level of service ▪ 24 hours for scheduled desludging ▪ 48 hours for responsive/demand	▪ Based on the owner's request and service provider's schedule
10	Confirmation of service rendered ▪ For scheduled service – dockets will be issued ▪ For responsive service – invoice/receipt will be issued	▪ A certificate of completion will be issued
11	Communal septic tank (CST)/ centralised sewage treatment plan ▪ CST is considered as an STP and charged as connected service ▪ Desludge once every 6 months for catchment A area and others on 2 years interval	▪ CST is considered as an IST and charged as IST ▪ Status quo
12	Sludge management ▪ In-house and desludging term contractor dispose at IWK site ▪ Private contractors are charged RM110 for 2 m^3 to RM 460 for 11.5 m^3 for disposing at IWK site ▪ No standard detail monitoring or documentation for sludge disposal	▪ Status quo ▪ Permit holder/private contractors need to sign agreement to dispose at IWK designated site – charge rate is RM55/m^3 ▪ Proper documentation and record keeping is required for Regulator to monitor
13	Licensed contractor for desludging ▪ IWK is the sole service provider for septic tanks owners in LA area ▪ Private contractors can carry out work as IWK contractors or service private ISTs (industry, complexes, hotels, etc)	▪ Service Licensee (IWK) and Permit Holders can carry out desludging work from any source (competitive bidding).
14	Penalty for failure to service ▪ No penalty was stated in Sewerage Services Act (SSA)	▪ Service licensee (IWK) can be fined up to maximum RM 50,000 for failure to carry out service.
15	Penalty to owner for failure to desludge ▪ Under SSA, owner of a septic tank can be fined maximum of RM 10,000 for not maintaining their septic tank	▪ Owner can be fined up to maximum RM 50,000
16	Others ▪ Charitable buildings or places of worship are given free services	▪ Likely to be status quo

Source: Fecal Sludge Management Study, 2011 (Malaysia))

In relation to FSM, the main features of WSIA include the following:

i. Owner, occupier or management corporation responsible for septic tanks (ISTs) has the responsibility to ensure desludging of the ISTs.
ii. IST and communal septic tank (CST) owners have a choice to engage services of Permit Holders or Service Licensee.
iii. Service Licensee is obliged to provide desludging service in its service area from time to time as may be prescribed.
iv. Competition is allowed among Service Licensee and Permit Holders.
v. Service Licensee (IWK) to accept and treat septage, as well as to operate sludge treatment facilities and arrange for final disposal of treated sludge.

Environmental Quality Act 1974

The Environmental Quality Act 1974 (EQA), provides various powers to the Minister (of the Ministry of Natural Resources and the Environment) to make regulations or give orders with respect to any matters relating to the protection of the environment. The responsibility for enforcement of these legislations rests with the Department of Environment (DOE). Two legislations pertinent to FSM in the country are:

i. Environmental Quality (Sewage) Regulations 2009

The Regulations relate to control over sewage and sewage sludge treatment and disposal and apply to any premises which discharge sewage onto or into any soil, or into any inland waters or Malaysian waters. Disposal of sludge onto land is restricted unless with the prior written permission of the Director General (DG). Approval of the DG of the DOE is required for any such acts under the law. The Regulations also specify the acceptable limits for discharges of effluent from such facilities and allow the DG to impose conditions for operation of such facilities and for monitoring of their impacts to the environment. Fees may also be charged in the event that a licence is required to allow for contravention of the imposed conditions, where this is approved.

ii. Environmental Quality (Environmental Impact Assessment) (Prescribed Activities) Order 1987

The above Order identifies the construction of municipal sewage wastewater treatment plants (taken to also include sludge treatment facilities) as a “prescribed activity” for which approval of the DG is required. This approval is subject to the submission of an environmental impact assessment (EIA) report which is to identify the potential impacts from the project and the measures that are to be taken to minimise negative effects on the environment. Construction and operation of such facilities are subject to approval of the EIA report.

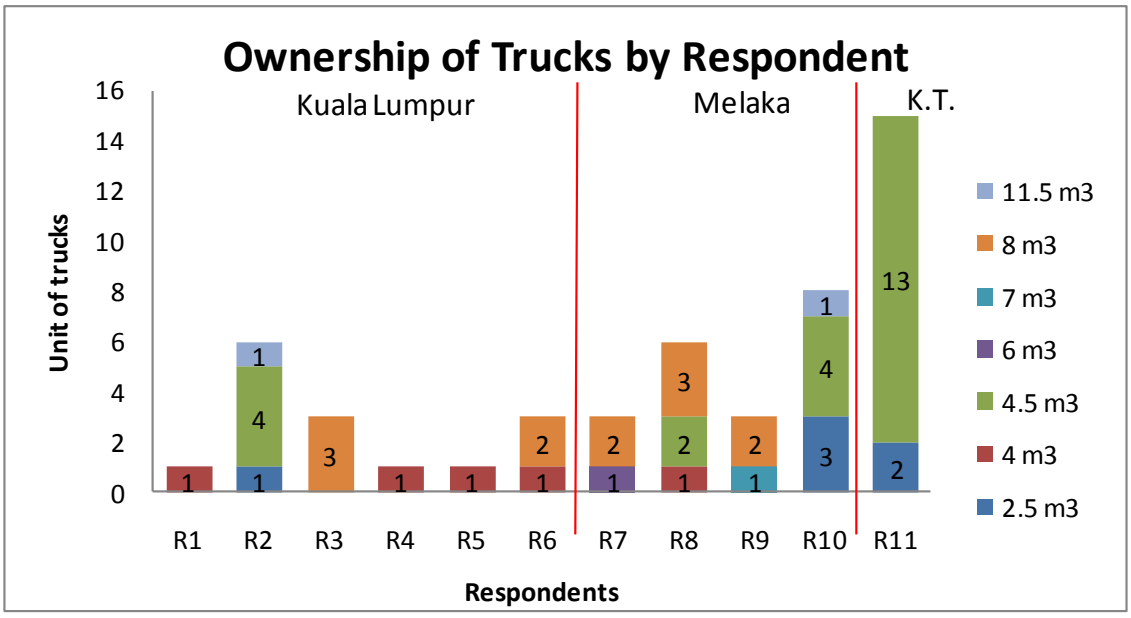
3.5 FS EMPTYING BUSINESS OWNERS' PROFILE

The service provider survey was carried out to obtain a profile of the business owner providing FSM services in the three study areas, to understand the business operation of desludging services, and to study the financial aspects of their operations. The results for the survey are discussed in two different sections namely, the company's business structure, and challenges and prospects of the industry in the future. The results discussed here represent the responses received from 8 out of the 12 companies' surveyed[5].

3.5.1 Service Provider Business Structure

This portion of the survey focuses on the background of the company such as, years of experience, the number of asset owned (focusing on the desludging truck), source of financing for the asset and the relationship with other industry player. Results of the survey showed that in terms of assets, there was wide variation in terms of the number and type of trucks owned as shown in **Figure 3.5.1**.

Figure 3.5.1: Ownership of Trucks by Respondent



Source: Faecal Sludge Service Provider Survey, July 2011

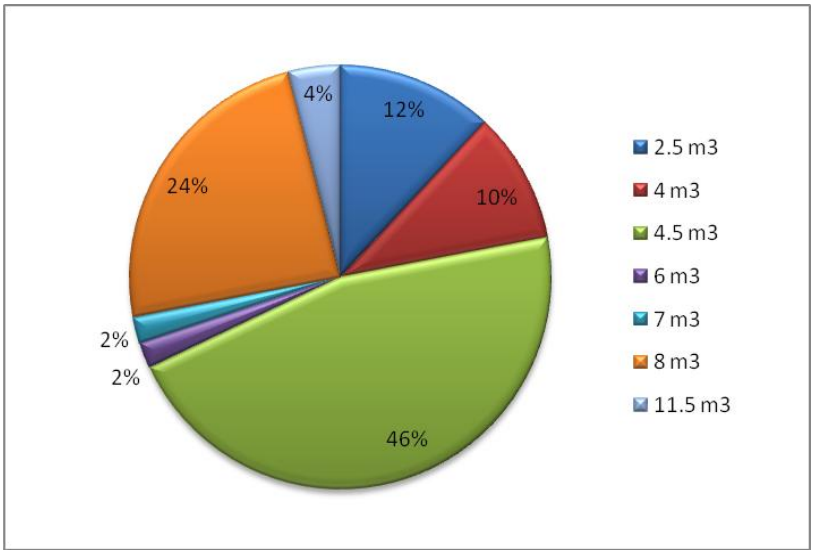
The survey showed that the existing active operators were those with at least 3 trucks. Respondents with a single truck were inactive or not yet in operation. The highest number of trucks is owned by IWK units operating in all the 3 cities, with IWK Terengganu having 15 trucks as the largest, and only service provider, in Kuala Terengganu. There were no private operators in the city apparently due to the more

[5] Feedbacks were obtained from 3 more respondents by telephone to obtain information on the number of trucks and their capacity even though the companies did not respond to the survey questionnaire.

difficult operating conditions in the city and low charges for services as the city has a high population of PF systems which are also remote or difficult to access.

The capacity of the trucks used by operators varied widely between the respondents, with the smallest truck capacity at 2.5 m^3 and the largest at 11 m^3. Overall, truck capacity of 4.5 m^3 is the most common (**Figure 3.5.2**). Generally, IWK owned trucks with capacity ranging from 2.5 m^3 to 4.5 m^3 and 11 m^3. Other private service providers, on the other hand, owned trucks within the middle range capacity of 4 m^3 to 8 m^3. Only IWK operates the smallest size truck as private service providers do not find it economical to operate such capacity trucks.

Figure 3.5.2: Distribution of Truck by Capacity, 2011



Source: Faecal Sludge Service Provider survey, July 2011

In relation to whether the trucks were bought new or second-hand, only one respondent acquired brand new imported[6] trucks, while the remaining respondents either purchased new locally assembled or second-hand trucks. All the respondents stated that bank loans are the main source of financing for the desludging trucks except for one respondent who used its own funds and lease agreement to purchase the trucks.

In order to establish if there's any relationship with the authorities in charge of water supply and sanitation services, the companies were asked regarding their relationship with government agencies and the local authorities. Three of the respondents answered 'yes' to having a good relationship with either SPAN or IWK or the local authorities. All respondents answered 'yes' when asked if there is any competition with other desludging service providers within their area. Only one respondent is a member of a contractor association.

[6] Imports are rare and there is no real advantage as the price paid, inclusive of fees, taxes and charges, tends to be higher than locally assembled trucks. The government's incentives favour locally assembled over imports.

3.5.2 Business Challenges and Perspective

Some of the challenges or difficulties faced by private desludging service providers included:

i. pricing is very competitive and generally low (maximum rate is set by SPAN but actual rate charged may be lower due to competitive bidding),
ii. breakdown of the sludge treatment facilities and the need to find alternatives further away,
iii. transportation and pumping system breakdown,
iv. competition from other desludging company
v. difficulty of access to premises, and
vi. low number of households requesting for desludging service since the introduction of WSIA.

In the experience of IWK, the difficulties faced included:

i. the lack of public awareness and 'don't bother' attitude to carry out the desludging service,
ii. inability to cut service to non-paying customer,
iii. limited area of disposal site,
iv. low charges for pour flush and latrine customer, and
v. lack of enforcement of the law to desludge septic tanks.

The expectations from the respondents regarding FSM in the country were also assessed from the survey. Response from private service providers indicated that:

i. there is a need to increase rates for the desludging service,
ii. reduce the fee (presently about RM55/M^3 (about US\$18.30/M^3)[7] for the disposal of sludge (to treatment facilities), and
iii. more systematic management by SPAN for the desludging industry including the need to ensure that public response to FSM improved.

The expectations gathered from IWK in the survey showed similar sentiments and the full and effective enforcement of WSIA is needed to ensure that public response is improved. In addition, the need to control illegal sludge disposal is needed. In summary, service providers needed sufficient business to survive and this has to be achieved by enforcement and improving public awareness regarding the importance of desludging services. The effectiveness of SPAN in enforcing the provisions of WSIA is thus important.

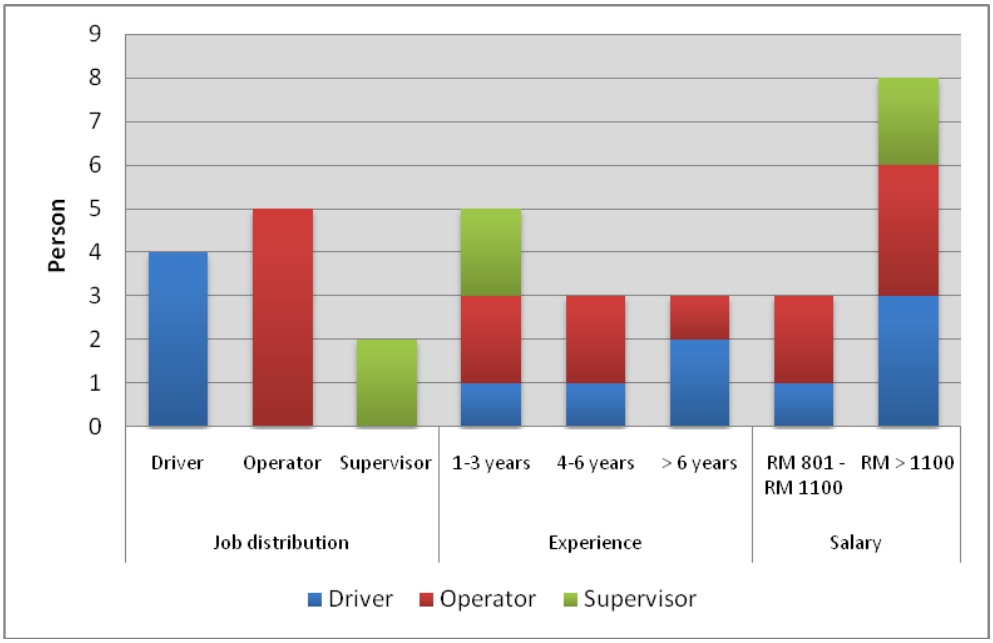
[7] Exchange rate is taken to be: US\$1.0 = RM3.0. Figures are rounded to nearest 10 cents.

3.5.3 Service Provider Employees' Survey

Some of the employees of selected service providers were interviewed to obtain feedback on their work related experiences and to gather personal information relating to their salary and work conditions. A total of 11 respondents were interviewed and these respondents are employees of desludging companies in Melaka and Kuala Lumpur. These included employees of IWK and other Permit Holders.

Results showed that FSM jobs are generally male dominated and 100 percent of the respondents interviewed were males. There are mainly three main job positions i.e. driver, operator and supervisor (**Figure 3.5.3**).

Figure 3.5.3: Analysis of FSM Employees



Source: Faecal Sludge Employee survey, July 2011

In general, a working team consists of 2 staff, a driver and an operator for undertaking desludging services. Workers are overseen by a supervisor whose role is to plan and organise daily FSM operations. The feedback received from the survey indicated that most of the workers have more than 5 years experience in the desludging service business and are permanently employed. Overall, the basic monthly salary of the respondents range from RM800 (US$267)[8] to RM2,000 (US$667) excluding allowances such as telephone, living, outstation, food and travel expenses and overtime claims. Typically, a supervisor's starting basic salary (with diploma or degree) is in the region of about RM2,000 (US$667) per month.

[8] US$ amounts are rounded to nearest dollar.

Allowances for workers range from about RM150 (US$50) to RM300 (US$100) per month, but with overtime this may be as high as RM700 (US$233) per month. In general, salaries paid by IWK are higher than those paid by private contractors and this is in part is due to the longer period of service of these workers.

The FSM service sector is one area where workers are almost wholly local and no foreign workers are employed. There does not seem to be any social stigma associated with this sector of service, and this in part may be due to the operations being mostly mechanical and does not generally involve 'dirty' work such as would be expected of manual sludge extractors. Except for grouses regarding salary (higher salary being asked), there were no issues with regards to the work that they are engaged in.

Employees Perspective

Difficulties faced by employees involved in desludging services included:

i. identifying the location of the premise (especially in rural areas or unplanned residential areas),
ii. blockage during pumping operation,
iii. long distance from one location to other location to conduct desludging service, and
iv. difficulty dealing with customers (such as wanting to reduce the total payment for the desludging services).

The employees interviewed had some ideas for improving FSM and these included:

i. Public knowledge and response about desludging is deficient as most consumers do not perceive desludging as important. They believe that the service cost them more than necessary. It was proposed that the amount for sewerage be incorporated into the water bill to ensure that customers make payment;

ii. Some of the employees proposed to increase desludging worker per team to reduce time for desludging operations; and

iii. For the authorities to open up more treatment and disposal facilities and sites in order to boost their efficiency by way of a reduction in travel distance and time.

3.6 HOUSEHOLD SURVEY RESULTS AND ANALYSIS

3.6.1 Household Survey Analysis

Household surveys were undertaken in three cities, Kuala Lumpur, Melaka and Kuala Terengganu, all in Peninsular Malaysia. The survey covered residential and commercial premises in housing areas and villages where the use of ISTs and PF facilities are the common form of sanitation services.

3.6.2 Social Profile of Respondents

The social profile of the respondents may be summarized in the following:

i. The majority of premises surveyed in the three cities were owner-occupied.
ii. Most of the household heads interviewed were employed in both the private and public sectors or they were self-employed, running their own businesses. In Kuala Terengganu, more household heads were employed in the public sector compared to Kuala Lumpur and Melaka.
iii. The average household size was 5 persons, with a slightly higher size of 5.4 persons per household in Kuala Terengganu. The median household size was 5 persons in all three cities.
iv. The majority of commercial operators surveyed were small retailers, providing local services to the surrounding households. The average number of persons in a commercial premise is 5.1 persons with Kuala Lumpur having a higher mean of 5.7 persons per commercial premise compared to 4.7 in both Melaka and Kuala Terengganu.

3.6.3 Mean Monthly Household Income and Monthly Business Turnover

Across the three cities, the mean household incomes were above the national poverty level (RM691 equivalent to US$230) (**Figure 3.6.1**), suggesting that households were not poor. However, compared with the mean monthly household income of national mean monthly household income (RM4,025 equivalent US$1,342), the mean monthly income in Kuala Terengganu households was lower. Furthermore, it was less than half that of Melaka and Kuala Lumpur. A possible reason for this was the household survey in Kuala Terengganu captured a large number of pour flush users, many of who were living in villages at the outskirts of the city centre. Even in Kuala Lumpur, the estimated mean household income was not significantly higher because the areas surveyed are old housing areas where it was not

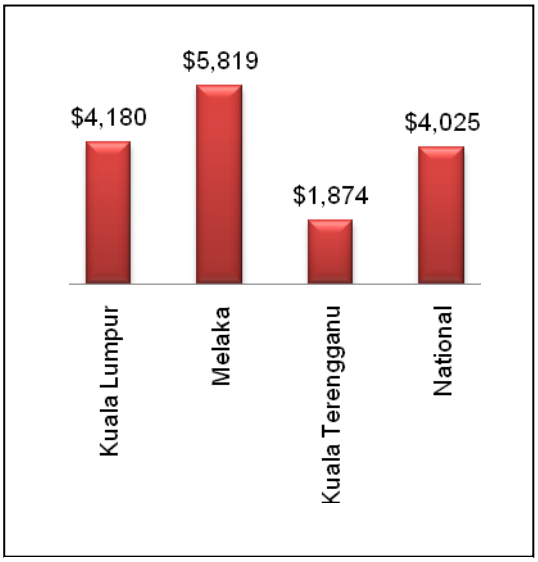


Figure 3.6.1: Mean Monthly Household Income (in RM)

Source: Faecal Sludge Management Study, Household Survey (Malaysia, July 2011)

easy and relatively expensive to connect to centralized sewerage systems. Some of these areas included urban villages established in the late 1940s.

The business consumers were studied in terms of their monthly turnovers. Across the three cities, businesses in Kuala Lumpur had higher monthly turnovers which were almost double Melaka's and Kuala Terengganu's (**Figure 3.6.2**). Kuala Lumpur had a large number of large firms, some of whom reported monthly turnovers in excess of RM100,000 (US$33,300). In Kuala Terengganu, its higher mean monthly turnover was due to the large presence of retailers compared to Melaka which had a higher concentration of motor service workshops.

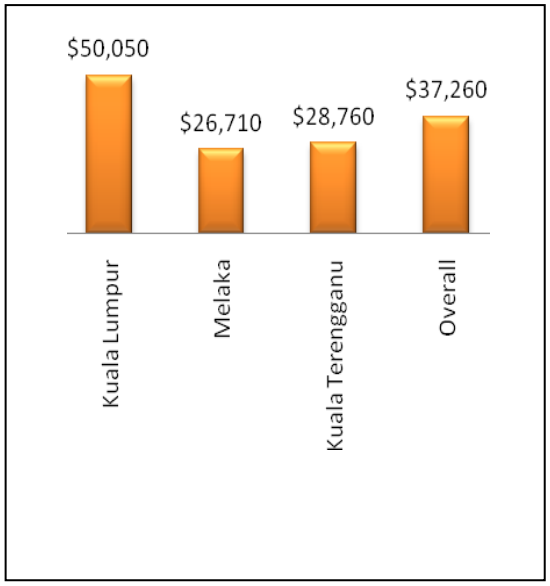


Figure 3.6.2: Mean Monthly Business Turnover (in RM)

*Source: Faecal Sludge Management Study, Household Survey (Malaysia, J*Figure 3.6.3 &

3.6.4 Access to Water Supply and Sanitation

All three cities enjoy good water supply connections, with 99.8% dependent on public connections. The exception was in Kuala Terengganu where a surveyed household indicated that he extracted ground water. The use of ground water is not common but can be found in rural villages in the eastern states of Peninsular Malaysia. Throughout most Malaysian cities, public treated water supply is easily available upon payment of connection fees, and almost all households have access to water supply. Some poor households have access to alternative sources of untreated water provided under the Ministry of Health Rural Water Supply Programme and they may opt not to buy treated water via direct pipe connections.

All three cities have access to sanitation facility consisting of a mix of direct sewer pipes; septic tanks and pour flush (**Figure 3.6.3**). The survey was undertaken in areas that use ISTs and PF systems. In Kuala Lumpur and Melaka, direct sewer pipe connections are more common than septic tanks. In Kuala Terengganu, households rely heavily on septic tanks and pour flush facilities. With good access to sanitation, the majority of respondents were satisfied with their sanitation facility although a higher proportion in Kuala Lumpur indicated they were not satisfied with available sanitation service (**Figure 3.6.4**).

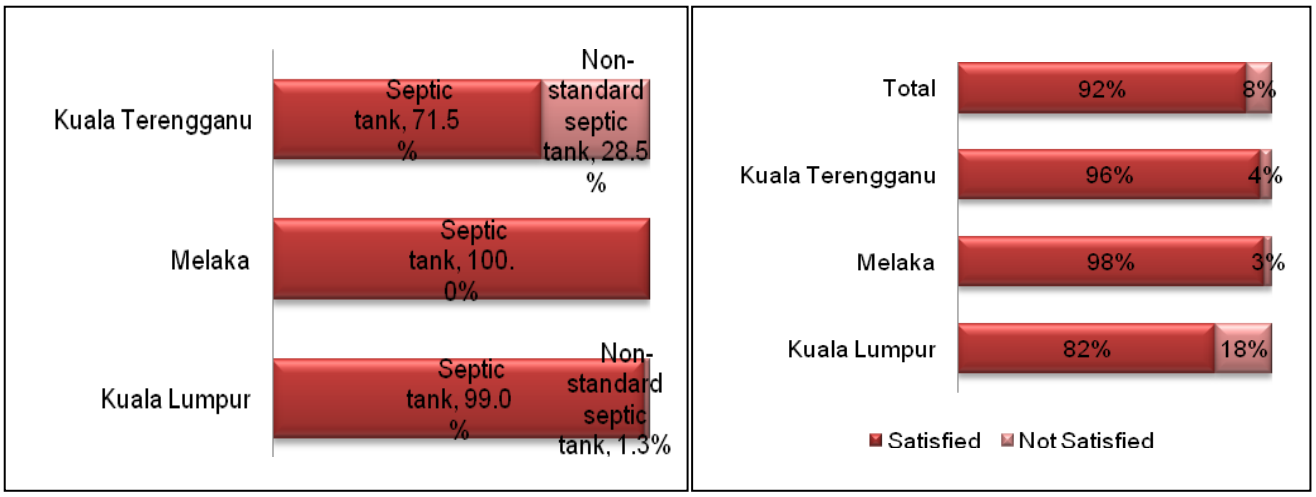


Figure 3.6.3 & 3.6.4: Access to Sanitation and Satisfaction with Sanitation Facility
Faecal Sludge Management Study, Household Survey (Malaysia, July 2011)

3.6.5 Number of Users per Latrine

The number user per latrine was estimated based on number of toilets by type of premise. It is common for residential areas to have more than one toilet per premise while a commercial premise may only have one latrine if it occupies one level of a shop-house. The mean for each city varies from a low of 3.3 to 3.4 users per latrine for Kuala Lumpur and Melaka and 4.1 users per latrine for Kuala Lumpur (**Figure 3.6.5**). The commercial establishments had higher mean users per latrine compared to households.

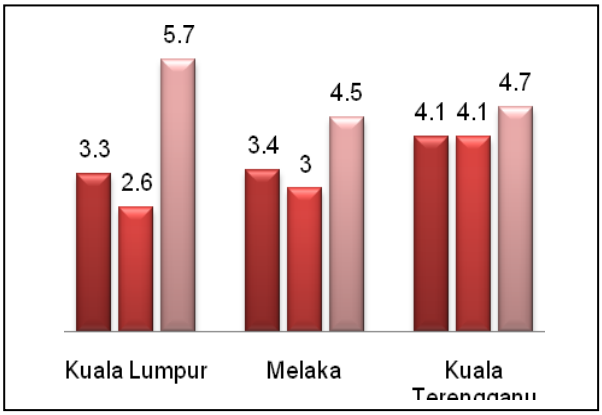


Figure 3.6.5: Average Users per Latrine

Source: Faecal Sludge Management Study, Household Survey (Malaysia, July 2011)

3.6.6 Cost of Water and Sanitation

The average monthly water bill for the three cities was RM 32 (US$10.70), with Kuala Lumpur having a higher mean water bill of RM43 (US$14.30) per month compared to RM29 (about US$9.70) for Melaka and RM23 (about US$7.70) for Kuala Terengganu (**Figure 3.6.6**). The monthly water bill was higher for commercial operators who, on the

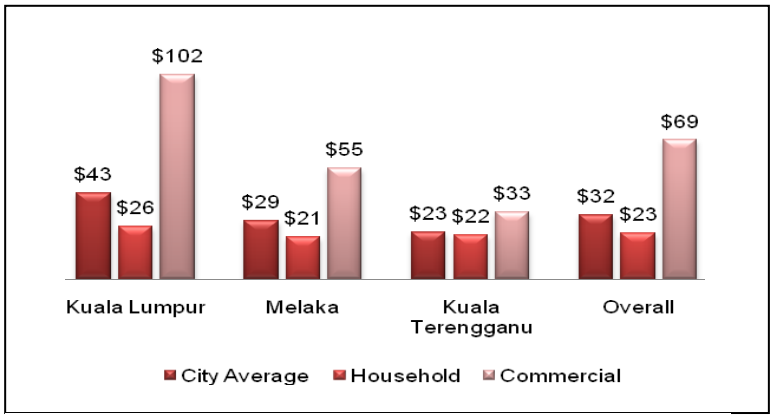


Figure 3.6.6: Mean Monthly Water Bill (in RM)

Source: Faecal Sludge Management Study, Household Survey (Malaysia, July 2011)

average, paid RM69 (US$23) a month for water, three times the average water bill for households. The payment scheme for sanitation comprised 2 modes, either a one-off payment or a monthly installment. This practice had ceased when WSIA came into force on January 2008. Between then and now, the emptying practice among consumers is based on a need basis. The sanitation costs presented here reflected the previous practice, and most consumers were not able to recall with accuracy their payments.

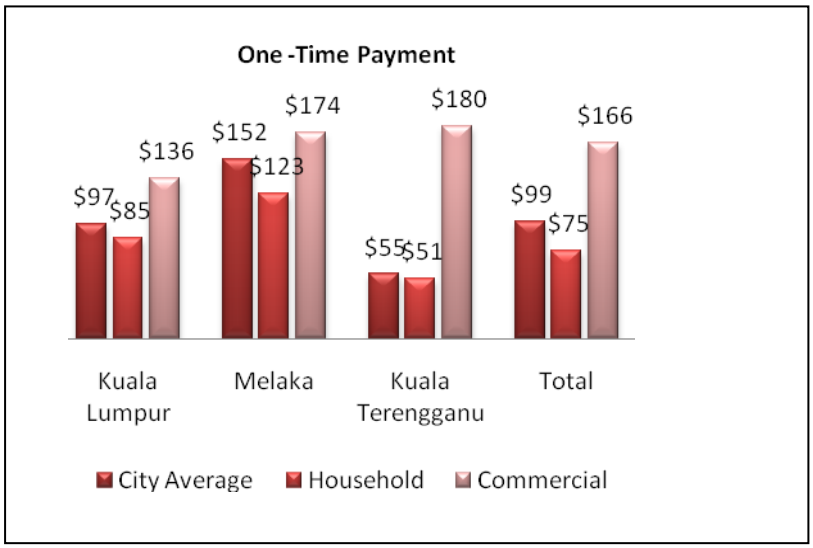


Figure 3.6.7: Mean One-time Payment Sanitation Bill (in RM) *Source: Faecal Sludge Management Study, Household Survey (Malaysia,* July2011)

For the one-off payment, the average was RM99 (US$33) with variations among households and commercial operators across the three cities (**Figure 3.6.7**). The households indicated a range of RM51 (US$17) for Kuala Terengganu to RM123 (US$41) for Melaka whereas among the commercial operators, the cost varied from RM136 (US$45.30) for Kuala Lumpur to RM180 (US$60) for Kuala Terengganu.

The monthly installment scheme was to relieve any financial burden on consumers and to dispel the general dissatisfaction over paying for sludge removal among consumers (**Figure 3.6.8**).

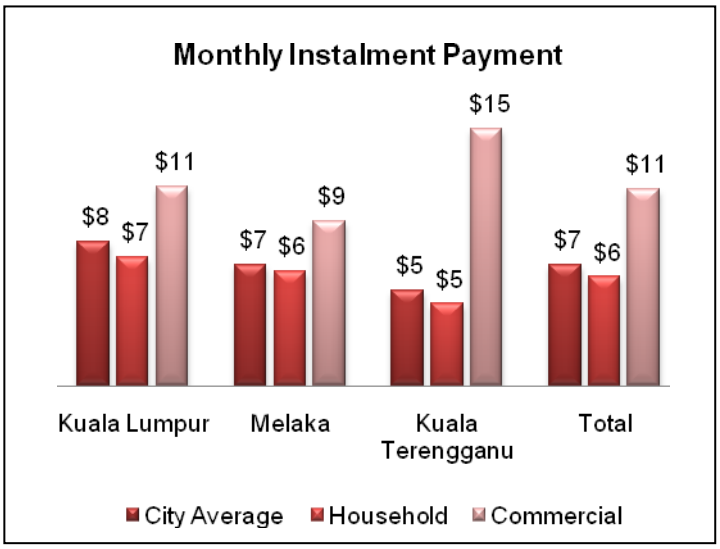


Figure 3.6.8: Mean Monthly Installment Sanitation Bill (in RM)

Source: Faecal Sludge Management Study, Household Survey (Malaysia July, 2011)

On the average, payment per month was around RM7 (US$2.40). There was a variation between households and commercial operators; the latter paid more at RM11 (US$3.70) whereas the former paid RM6 (US$3) a month. Variation was also observed across cities, with Kuala Terengganu having a mean payment of RM5 (US$1.70) and Melaka paid an average of RM7 (US$2.30) per month while households in Kuala Lumpur paid

RM8 (US$2.70) per month.

On annual basis, combining charges for households and business operators using septic tanks and pour flush, the average annual cost in Kuala Lumpur is RM91 (US$30), in Melaka, it is RM78 (US$26), and in Kuala Terengganu, the average annual cost is RM56 (about US$19).

3.6.7 Emptying Practice and Frequency of Emptying

In the three cities, the most common method of desludging is mechanical.

When their tanks were full, most consumers would desludge immediately (65%) when their tanks were full (**Figure 3.6.9**). About 30% indicated that their tanks were not full; an occurrence common in Kuala Lumpur and Melaka because of IWK scheduled desludging prior to 2008.

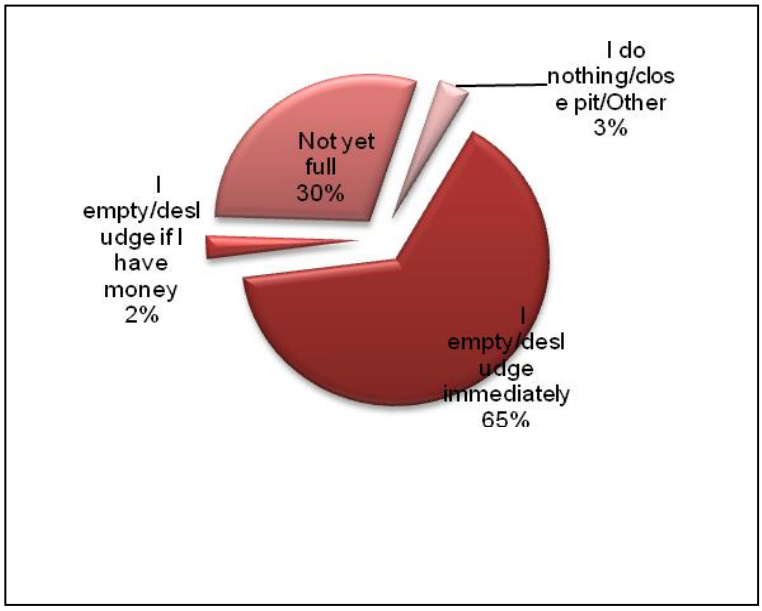


Figure 3.6.9: Emptying Practice

Source: Faecal Sludge Management Study, Household Survey (Malaysia, July 1201)

The frequency of empting averaged once in every two years (**Figure 3.6.10**), which would be in accordance with IWK previous schedule on desludging. Other variations in frequency were observed and they could arise because of the presence of pour flushes where more frequent desludging may be required given the smaller capacity of such tanks, and in the absence of the IWK schedule, many consumers were uncertain now on the emptying frequency.

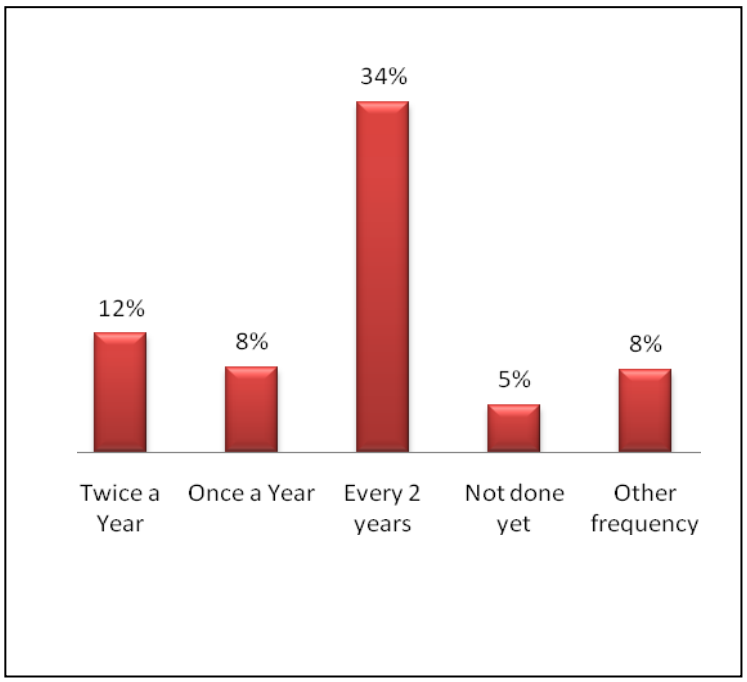


Figure 3.6.10: Emptying Frequency

Source: Faecal Sludge Management Study, Household Survey (Malaysia July 1201)

3.6.8 Service Providers

The majority of consumers in the three cities would use IWK for

service when their tanks are full - 93% on the average across the three cities (**Figure 3.6.11**). In Kuala Terengganu, the response rate was 98% as there were no alternative service providers in their area. In Kuala Lumpur and Melaka, where there were private licensed service providers, 14% in Melaka and a tiny fraction in Kuala Lumpur opted for their services.

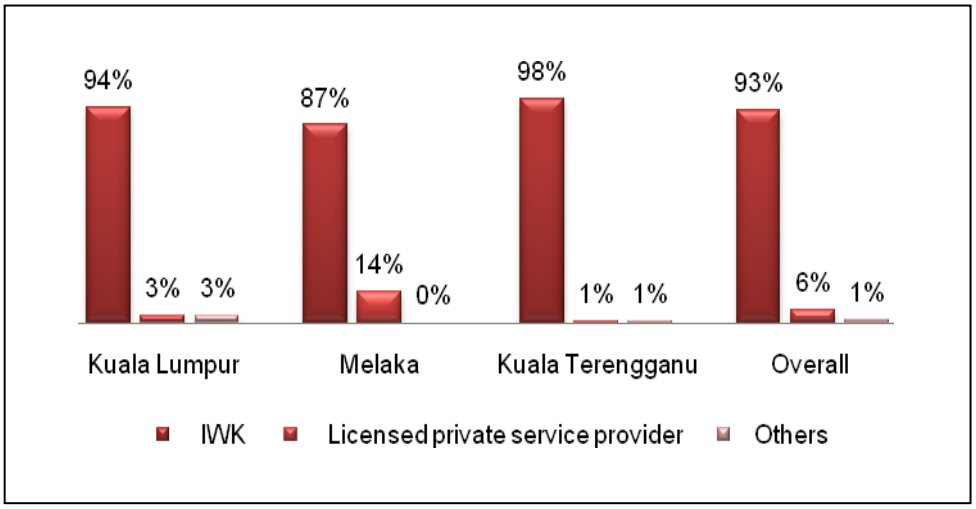


Figure 3.6.11: Choice of Service Provider

Source: Faecal Sludge Management Study, Household Survey (Malaysia, July 2011)

Generally, consumers are guided by cost (36%), availability of services (34%), and quality of service (28%) (**Figure 3.6.12**). Some variations across cities were observed. Kuala Lumpur tended to favour quality of services more than cost and availability,

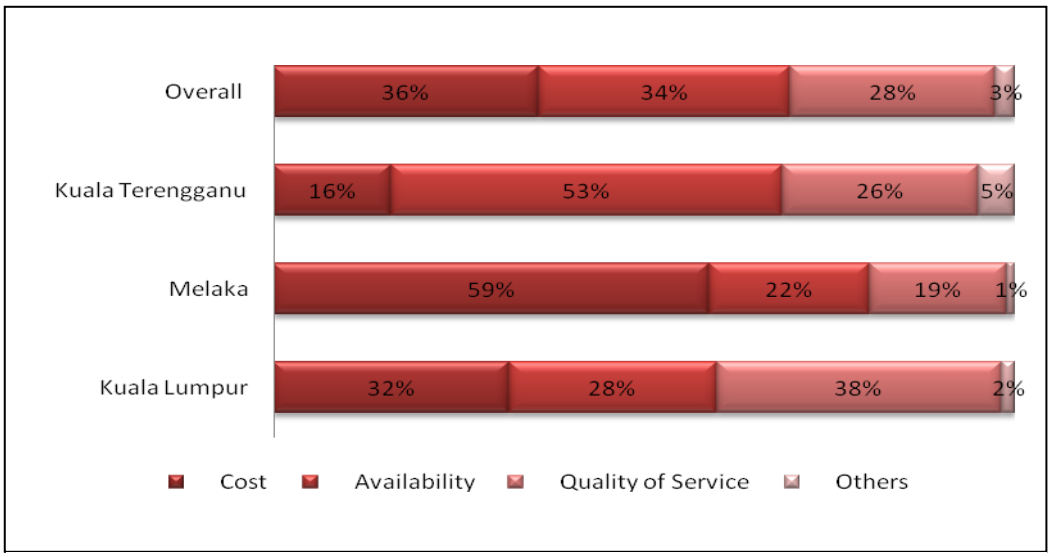


Figure 3.6.12: Criteria in Choice of Desludging Service

Source: Faecal Sludge Management Study, Household Survey (Malaysia, July 2011)

Melaka prioritized cost over availability and quality and in Kuala Terengganu, the emphasis was on availability which is attributed to the more pour flush facilities here which require frequent emptying.

3.6.9 Willingness to Pay

The existing rates had been based on types of premises, with lower rates for cheaper housing and higher rates for commercial premises, under an implied cross-subsidization approach. WSIA, when fully implemented, will change the landscape by imposing fees based on volumetric consumption, with a minimum rate of minimum use and therefore, an increased rate for additional removal. The rates are under proposal and have yet to be finalized. The preliminary proposals indicate IWK would charge a minimum rate of RM300 (US$100) for first cubic meter sludge removed whilst other private providers would start off with a lower fee of RM230 (US$76.70), and are allowed to give discounts.

The feedback from the survey naturally showed that consumers were reluctant to pay more for sewerage services. Almost all wanted to pay below RM250 (US$83.30) for service provided and this feedback pattern was similar across the three cities (**Figure 3.6.13**).

On this note, it would be difficult for IWK to uphold proposed minimum charge of RM300 (US$100) without raising consumers' anger and undo much of its previous efforts on public relations to forge a better understanding of sewerage services among consumers. Private providers would have a distinct advantage over IWK under these

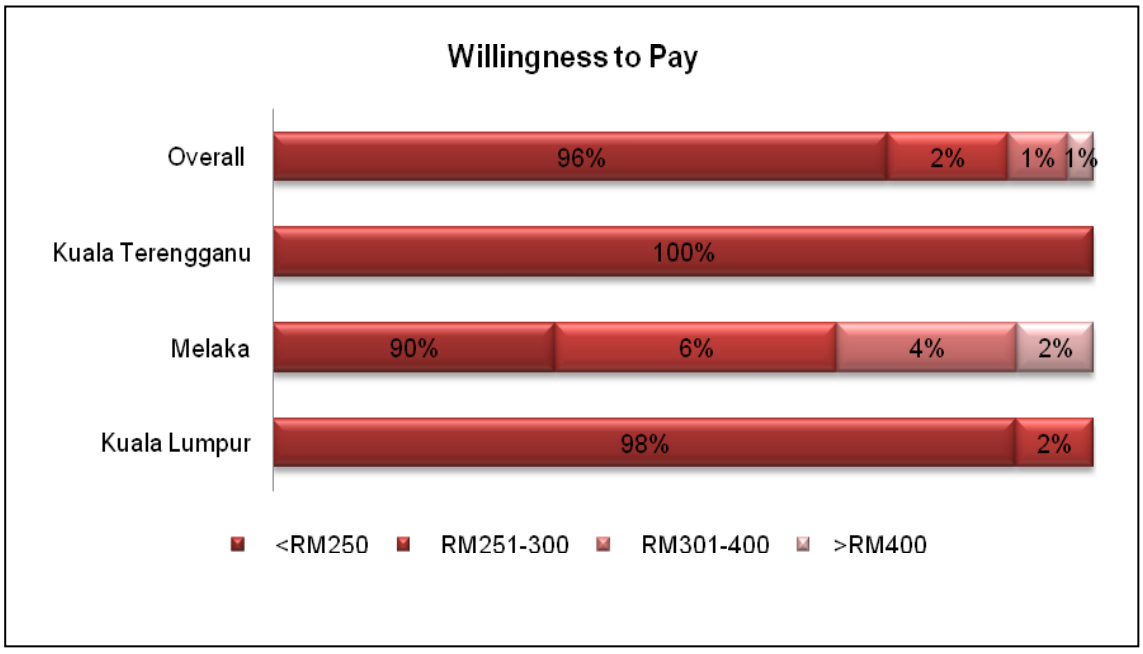


Figure 3.6.13: Willingness to Pay

Source: Faecal Sludge Management Study, Household Survey (Malaysia, July 2011)

circumstances as their fees are lower and they are allowed to give further discount. Furthermore, more than 60% of respondents preferred a one-time payment and another 18% opted for other mode which in fact was the present mode of monthly installment. Only 20% would consider paying a scheme of part deposit (50%) and the balance paid after completion of service. It would seem that more consumers prefer to have a payment mode that reflects what they get rather than any installment scheme.

3.7 FSM EMPTYING PRACTICES AND TECHNOLOGIES USED

3.7.1 Business Operations

An essential part of the survey was to find out the number of ISTs and volume desludged per day for each of the respondents. The findings are based on the types of property i.e. household, commercial, government institution or others.

The results showed that the smaller private service providers (medium-sized with 3 trucks) desludge between 3 to 7 household units per day, and one contractor (large with 6 trucks) desludge about 20 household units per day. IWK serviced between 6 and 15 household units per day. The findings showed that IWK had the highest volume of sludge collected per day for household units. This can be attributed to the larger number of trucks and the capacity of the desludging trucks own by IWK which is higher than the other private service providers. Under present conditions where desludging is unscheduled, on average, each truck services about 2-3 households/day.

As for commercial premises, all respondents desludge between 1-3 commercial premises per day. However, the volume of sludge collected is higher for private service providers compared to IWK. Desludging services for government buildings are undertaken by IWK (between 2-5 units/day), and only one private contractor surveyed carried out desludging service for this type of property under contract from IWK. The volume of sludge collected from government building was higher compared to other property types as recorded by IWK desludging team. One respondent serviced mainly IWK treatment plants (interworks) which can consist of communal sewage treatment plants and individual sewage treatment plants owned by IWK.

The function of the desludging trucks in providing other kinds of services was also surveyed. Three respondents used the desludging truck solely for desludging services while two of the respondents are involved in providing other services using the same trucks. The other services indicated were grease trap cleaning, desludging of public sewers and cleaning of sewer lines.

3.7.2 Manpower

In the operational section of the survey, results indicate that most respondents generally have 2 crew members (a driver and an operator) per truck to carry out FSM services although some indicated only 1. Hence, the total number of workers required per company depended generally on the number of operational trucks that each had.

In general, operations are managed by a Supervisor who is responsible for planning and managing the daily FSM operations and providing instruction to service teams on the work to be undertaken for the day. In the case of IWK, a Manager is appointed to manage the entire operations of the Unit for the area in question.

Overall, manpower is kept to a minimum in order to reduce overheads. The higher numbers of workers are from the IWK as their operations are on a larger scale in contrast to the smaller private companies. IWK Terengganu had the highest number with 30 workers in total. All respondent surveyed operated 6 days a week except for one respondent which operates 7 days a week on demand basis.

3.7.3 Permits and Licences

Operation of FSM services using vacuum trucks requires various licences, permits or levy from different authorities enforcing their respective legislations. However, not all respondents indicated that all these are fulfilled by them although it is known that most, if not all such licences and permits are likely to be required for all operators. Licences and permits from the following authorities apply.

i. SPAN – permit for desludging services
ii. Road Transport Department – road tax (and insurance)
iii. Department of Occupational Safety and Health – permit for operation of pressure vessel
iv. Construction Industry Development Board (CIDB) – registration of contractors

Besides the above, costs that are incurred by such companies include the following expenses for employees:

i. Employees Provident Fund (EPF) – retirement fund contribution
ii. Social Security Fund (SOCSO) – compensation scheme for workers who are injured or disabled
iii. Medical insurance (optional) – cover for medical expenses in case of hospitalisation

The fees and cost involved are discussed in subsequent sections of the final report in relation to the financial analysis for FSM.

3.7.4 Truck Types

A few types of desludging trucks with varying capacity were observed to be used for desludging services by private service providers and service licensee (see **Figure 3.7.1**).

The smallest tank capacity is 2.5 m^3 and the advantage of this tank is the ease of accessibility to premises served with narrow roads, lanes and back alley. However, due to its small capacity, the truck is generally only able to desludge not more than 2

ISTs per trip, hence a need to make more frequent trips to the treatment plant for disposal of the extracted sludge. The medium and larger sludge tanker (between 4.5 m^3 and 11 m^3) is normally used for areas which are more accessible and where larger volume of extraction is expected such as commercial, institutional and industrial premises. These have ability to service more premises or cater to larger volumes of sludge before a need to proceed to the treatment plant for disposal of the sludge.

Figure 3.7.1: Types of Mechanical Desludging Trucks

		
2.5 m^3	4.5 m^3	11 m^3

Source: Faecal Sludge Management Study, 2011 (Malaysia)

Trucks that are used in Malaysia are mainly locally assembled as imported trucks are in general more expensive due to higher import taxes. The various components for assembly include the vehicle chassis and engine which are imported, as are the vacuum pump motors. The unfired pressure vessel (2-compartment container for water and sludge) is locally made.

Typically, such trucks cost about RM265,000 (US$83,300) for 2.5 cu.m capacity, about RM285,000 (US$95,000) for a 4.5 cu.m capacity, about RM348,000 (US$116,000) for a 6 cu.m capacity, and about RM390,000 (US$130,000) for 8 cu.m capacity truck. Costs are inclusive of vehicle chassis and engine, vacuum pump system, pressure vessel or container and assembly, government taxes and insurance (1st year).

3.7.5 Desludging cycle

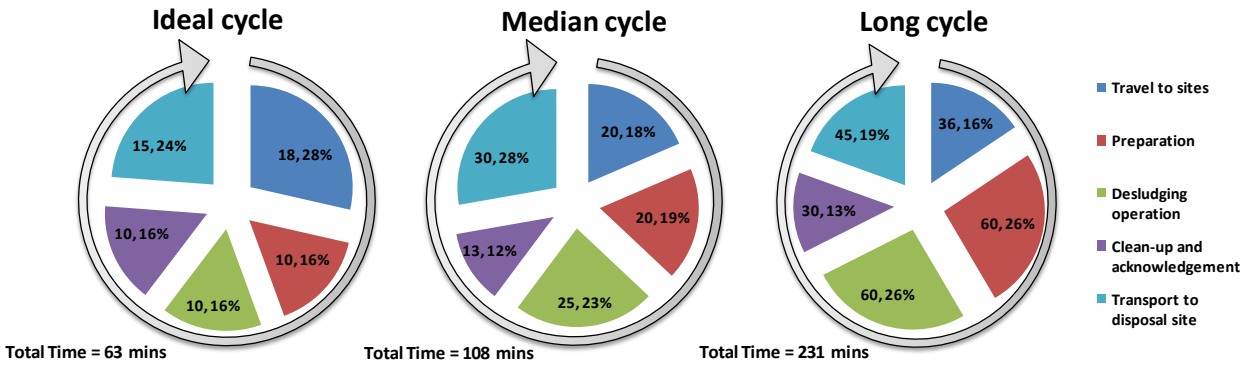
An important part of the survey is to find out the desludging cycle based on the service provider survey. **Figure 3.7.2** shows the complete desludging cycle from travelling to the premise[9], preparation, desludging operation, clean-up and acknowledgement and lastly transportation to treatment and disposal facility. The activities associated with a typical desludging cycle is shown in picture in **Annex 3.7.1**.

Based on the feedback received, the time needed to carry out the desludging work varies widely from the short cycle of 68 minutes to long cycle of 4 hours per visit. The short cycle is based on an ideal situation where the site is easily accessible and there are no constraints on the ground for sludge extraction (such as inability to locate IST or PF, or man-hole is sealed over, etc). The long cycle of about 4 hours) depicts the worst

[9] The questionnaire did not include travelling time to the desludging premises, therefore an estimation was made to complete the cycle based on the average speed of desludging trucks (40 km/h) and average distance of travel.

case scenario where the site is remote and not easily located, and there are constraints to access the IST or PF. The median cycle for the desludging process is roughly about two hours.

Figure 3.7.2: Desludging Cycle for Various Situations



Source: Faecal Sludge Management Study, 2011 (Malaysia)

In most cases, travelling to the site and to the treatment/disposal centre consumes the largest portion of time for a sludge extraction and transportation cycle. Sludge extraction is normally fast and takes about one fifth of the time in an overall desludging cycle. Within most urban areas, a service operator may be able to service up to 6 or more premises/truck-day based on an 8-hour working day operation. The higher number of services is achieved under ideal conditions when premises needing service are located in close proximity to one another or within the same area or housing estate.

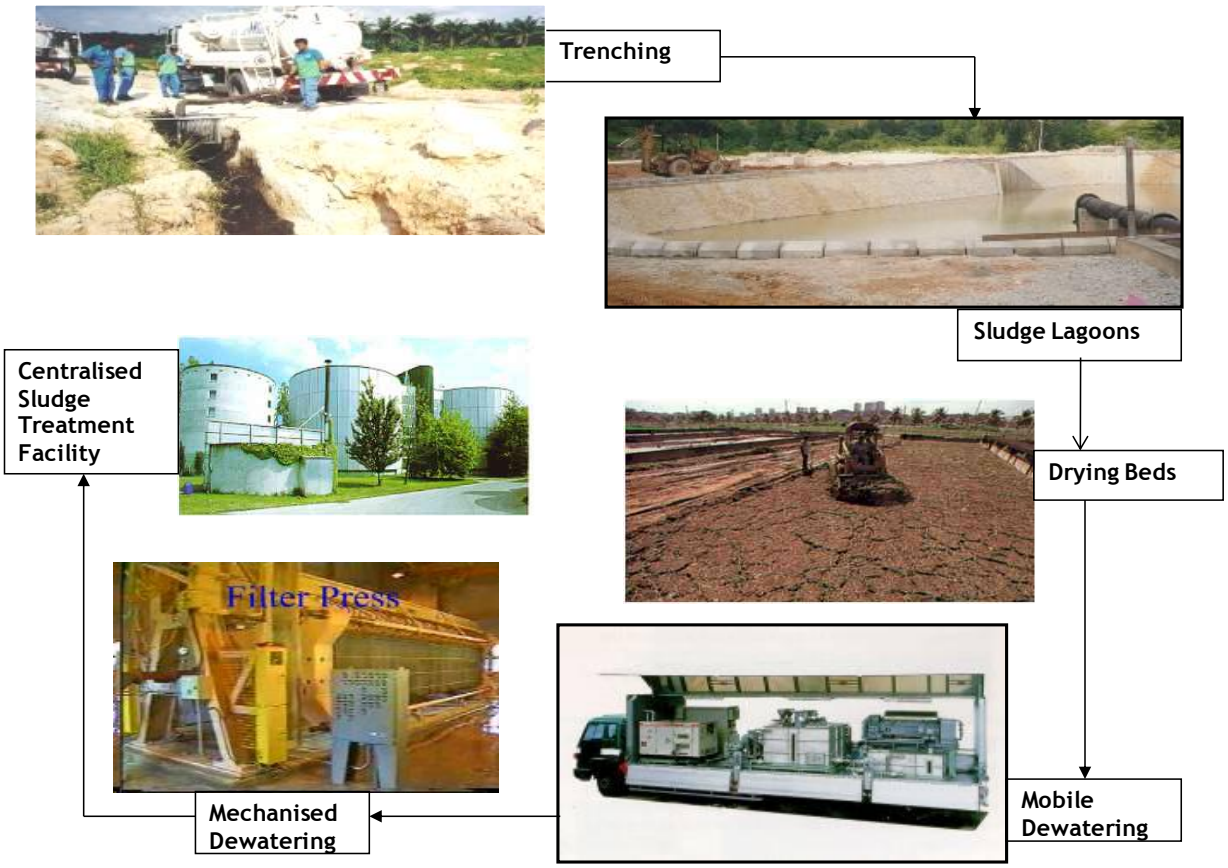
Feedback from operators indicate the preference for scheduled desludging as this allows for more efficient planning and effective service to customers. For example, it allows the service operator to plan the desludging work on a daily basis such that desludging may be focused at specific areas, which reduces travel and improves turnaround time. One can also maximize utilization of the full capacity of the desludging tanker in a single trip. Operators also indicated that with scheduled desludging, larger trucks (8-11m^3 capacity) may be used with advantage as several (4 or more) premises may be serviced per trip and hence reduces overall cost for transportation.

The common challenges experienced by employees of service companies are the long travel distance to some sites; narrow road access especially in poorly planned or squatter areas; poor road conditions (outside of urban areas); difficulty locating and accessing the premise; and difficulty of reaching the IST or PF sites. In addition, sludge extraction operations are delayed when thickened hard sludge in tanks are encountered (this occurs when tanks have not been serviced previously or only after long intervals), or when there are obstructions to man-hole cover which may be sealed over and the seal require to be broken.

3.8 SLUDGE TREATMENT AND DISPOSAL

There has been significant progression in the types of technology that is applied for sludge treatment and disposal. Progressively, the move is for mechanical systems particularly for large urban areas where land is a constraint and sludge generation and collection is significant as to render traditional methods to be less desirable. This progression in sludge treatment technology in Malaysia is shown in **Figure 3.8.1.**

Figure 3.8.1: Progress of Faecal Sludge Treatment Technology in Malaysia



Source: IWK

3.8.1 Sludge Treatment Facilities within Cities

In Malaysia, sludge that is collected is not allowed to be dumped but is sent to designated and approved collection and treatment facilities. For most large urban centres, centralised reception and treatment facilities include Central Sludge Treatment Facility (CSTF), such as in Kuala Lumpur and Melaka, and Mechanical Dewatering Unit (MDU), which is available in Kuala Terengganu. These facilities have

been constructed to cater to the large amounts of sludge that is generated within the 3 cities.

Typically, an MDU can handle between 80-160 cu.m/day of sludge while a CSTF is able to handle larger volumes of between 300-400 cu.m/day. Operating costs are much higher compared to non-mechanical systems and the present rate of fee (set by SPAN) for treatment at such reception facilities is RM55/cu.m (about US$18.30/cu.m).

3.8.2 Application of Geo-tube for Sludge Management

Sludge transportation has been known to present challenges when large distances have to be travelled where the source of the sludge is in remote areas and far from the disposal facility. This is especially true when the desludging services carried out are for premises that are widely scattered or when the centralized sludge treatment site is located more than 50-100 km away from these sources. It is generally uneconomical and inefficient for FSM operations and many private service providers are reluctant to undertake services for such areas. This is due in part to the fixed desludging rates set by SPAN which is not attractive to private service providers. Often this service is undertaken by IWK as a social responsibility under its obligations to the government in its concession agreement.

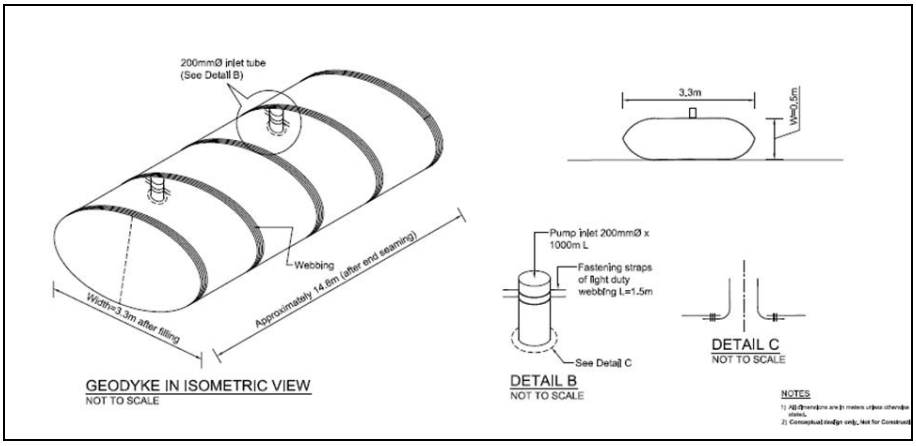
In an attempt to find a solution to the above issue, a pilot project was undertaken by IWK to improve FSM performance and desludging revenue through the introduction of the Geo-tube (also called Geo-bag) to reduce travel distances for transportation. The project involved the strategic location of Geo-tubes within existing sewage treatment plants that are equipped with sludge drying bed facilities and which enable filtrate to be treated on the spot and no double handling is involved. A maximum radial travel distance of between 30km and 40km was applied and the location is to be accessible to tankers. It is also not to be too near to residential property (preferably more than 200m).

Design and Operation of Geo-tube

The Geo-tube is shaped like a large bag and is made of porous geo-membrane material. It is normally installed over the sand drying bed of the selected sewage treatment plant. The general dimensions for a Geo-tube is schematically shown in **Figure 3.8.2** while **Figure 3.8.3** shows the arrangement of the Geo-tubes within a sand drying bed.

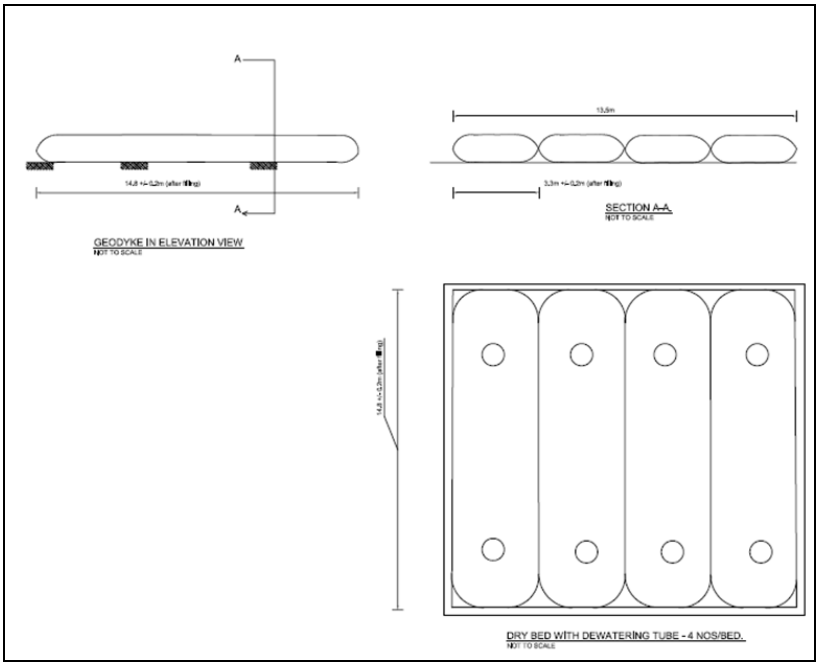
Sludge that is received is directed to the Geo-tube through an acceptance hose that can be linked to the truck outlet. Discharge to the Geo-tube may be by gravity or by pumping. Typically a Geo-tube can take in many truckloads of sludge depending on the capacity of the Geo-tube. In the pilot study in Kedah, the Geo-tubes (size 14.8m x 3.3m) have received more than 90 truckloads of sludge since their use.

Figure 3.8.2: Typical Size of Filled Geo-tube



Source: IWK

Figure 3.8.3: Typical Arrangement of Geo-tube on Site



Source: IWK

The sequence of activities involved in the disposal of sludge to the Geo-tube is shown in **Figure 3.8.4**. As can be seen, the Geo-tube when empty lies flat on the ground, but when filled, takes the shape of a large sausage (**Figure 3.8.5**).

Sludge in the Geo-tube is slowly dewatered by leaching of the liquid fraction through the porous membrane but solids are retained inside the bag. Leachate from the Geo-tube is collected and directed to the nearby sewage treatment plant for treatment to meet regulatory standards before it is discharged. Over time, solids build up within the bag and fill it up. Exposure to the heat from the sun helps to further dry the sludge and

frees space in the Geo-tube for additional input of sludge. Upon filling to capacity, the whole Geo-tube can be lifted onto a truck and transported out and be replaced by a new Geo-tube.

Figure 3.8.4: Pumping of Sludge into the Geo-tube/ Geo-bag

Source: IWK

Figure 3.8.5: Geo-tube when it is filled

Source: IWK

Advantages of Geo-tube Use

It has been found that Geo-tubes are durable, of low maintenance (less manpower needed), low energy or fuel usage, and there is generally no need for additives or chemical compounds such as flocculating agents. The Geo-tube may be used under

all weather conditions as it is not affected by rain while heat from the sun aids drying of the sludge. It presents no aesthetic, odour or pest issue as the sludge is not exposed but enclosed within the Geo-tube. More importantly, the Geo-tube is environmentally friendly as the dewatered sludge is amenable to handling and may be recovered for multiple uses. The Geo-tube including its entire content may be transported out to a landfill for disposal or sent to a waste recovery facility for conversion to fertilizer or as soil conditioner, after further treatment (normally by thermal treatment). It has also been suggested that the entire bag may be used in slope protection and erosion control as the bag is made of durable and tough geo-synthetic material.

In the pilot study by IWK using Geo-tube, preliminary results showed that the following could be achieved:

a. Truck performance improved by about 54% as a result of shorter distances for travel ;
b. Operational cost per unit IST was reduced by about 8%;
c. An increase in revenue of about 35%; and
d. A 37% reduction in operational cost.

The findings of the pilot study showed that the Geo-tube is a practical solution and substitute for a traditional transfer station which would require permanent structures and higher operating costs. Unlike the latter, there is no asset creation or high operating and maintenance cost with the use of Geo-tube.

3.8.3 Faecal Sludge Reuse

Untreated faecal sludge is not directly used or applied for any beneficial purposes due to health concerns. As such, all sludge that is generated from on-site sewerage sources is channelled to treatment facilities. Bio-solids, generated as a dry by-product from sludge treatment, has typically been disposed off at approved landfill sites. However, in recent years, more interest has been shown for its reuse and various studies and pilot projects on bio-solids re-use and its application for different economic activities have been carried out. The various possibilities identified include those shown in **Figure 3.8.6.**

Characterization studies by a local university has shown that bio-solids typically contain between 70 per cent to 85 per cent moisture and between 15 per cent to 30 per cent dry solids that are mostly organic microbial cellular material. Besides being rich in organic material, the bio-solids also contain macronutrients such as nitrogen (N), phosphorus (P), potassium (K) at about 3-6 per cent of the solids content along with the presence of micronutrients such as calcium, magnesium and sulphur which are beneficial for plant growth.

In a study by the local university, bio-solids when tilled into the land, performed equally well to fertilize and promote plant growth compared with inorganic fertilizer. The bio-

solids were able to accelerate growth to produce twice the yield (girth) of timber and rubber trees. The quality of rubber wood was then investigated and it was found that there was no significant difference in physical, mechanical and chemical properties between those that had accelerated growth with bio-solids to those rubber trees on

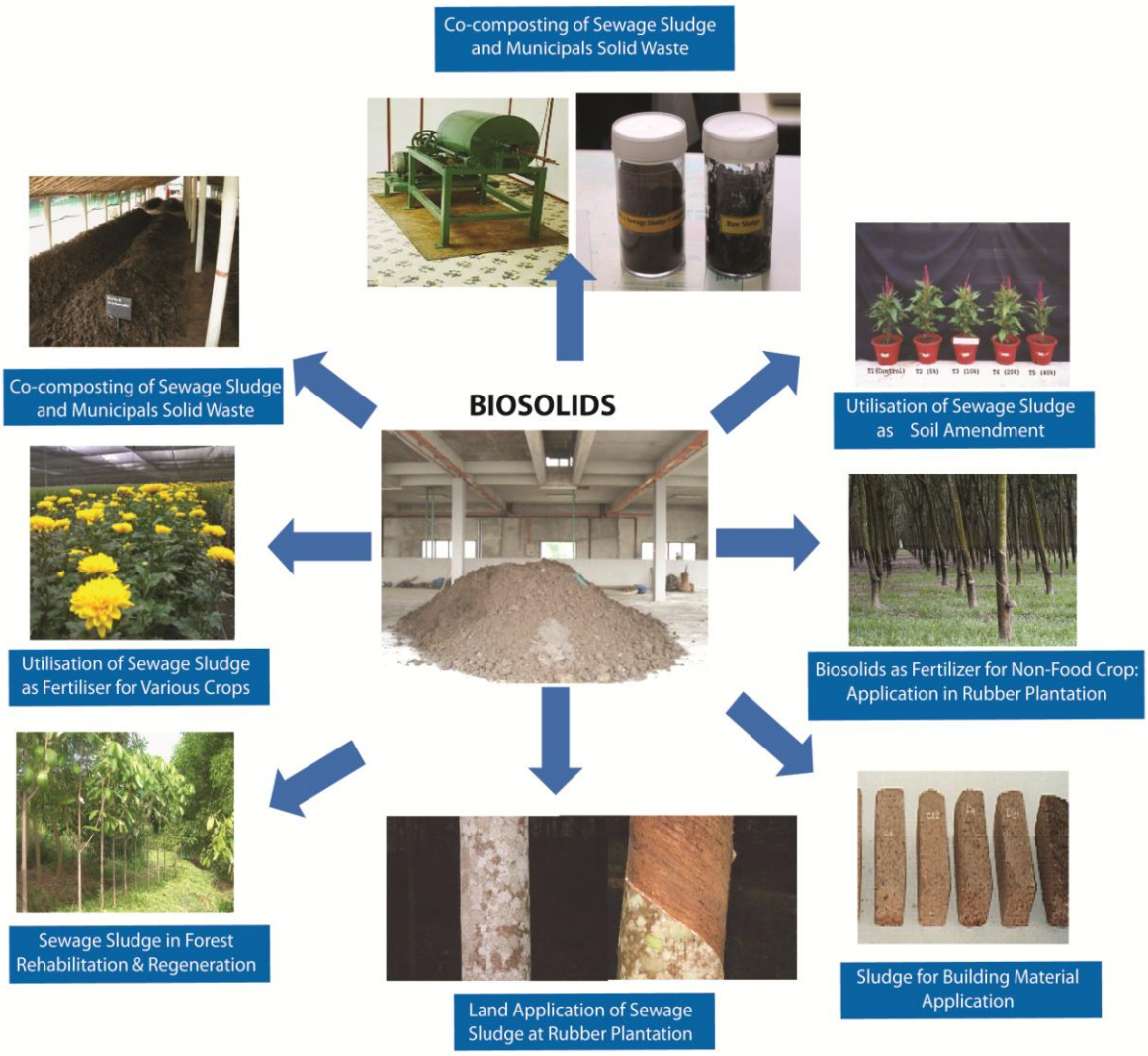


Figure 3.8.6: Potential Reuse of Bio-solids Derived from Sludge

Source: IWK

control plot (without bio-solids).

Commercial interest in the use of bio-solids for fertiliser production has increased in recent years and there are at least two operations that take such bio-solids generated from sludge treatment facilities. Presently, the constraint faced by such commercial operations is the small quantity of bio-solids that is available for large scale commercial operations.

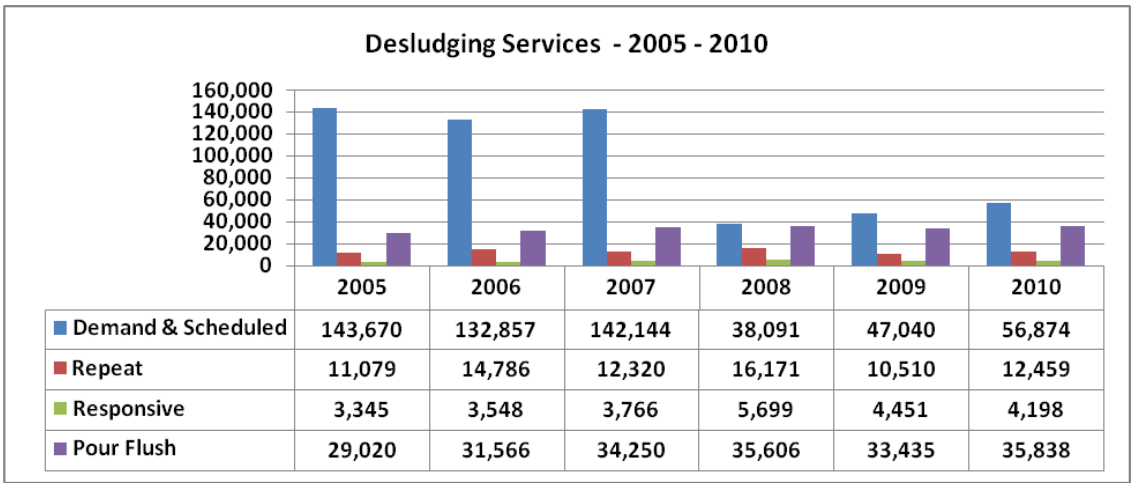
3.9 MARKET ANALYSIS

The potential market for FSM in the country may be indirectly derived from information about the development of sewerage systems in the country. Even as the nation progresses from on-site sewerage systems (such as ISTs and PF units) to the more modern connected systems of centralised treatment, this process of development is expected to be largely focussed in the urban areas and rural communities are likely to remain status quo for some time to come. This is in view of the slow pace of development of connected sewerage systems in the country to replace existing individual systems that are still found in the urban areas. Hence FSM services to serve fringe urban areas and rural communities are likely to continue in the future.

3.9.1 Market Analysis – Past Trend

The information on the market for FSM is available from IWK based on its past history of services that it provided since its takeover of the operation and maintenance services of sewerage services from the local authorities. This information is limited to the 88 local authorities that it has taken over and not on a national basis. However, for the 3 cities under study, all the 3 states in which they are located are within the service area of IWK. Data for the year between 2005 and 2010 has been analysed and displayed in **Figure 3.9.1**.

Figure 3.9.1: Desludging Services Undertaken by IWK



	2005	2006	2007	2008	2009	2010
Demand & Scheduled	143,670	132,857	142,144	38,091	47,040	56,874
Repeat	11,079	14,786	12,320	16,171	10,510	12,459
Responsive	3,345	3,548	3,766	5,699	4,451	4,198
Pour Flush	29,020	31,566	34,250	35,606	33,435	35,838

Note :

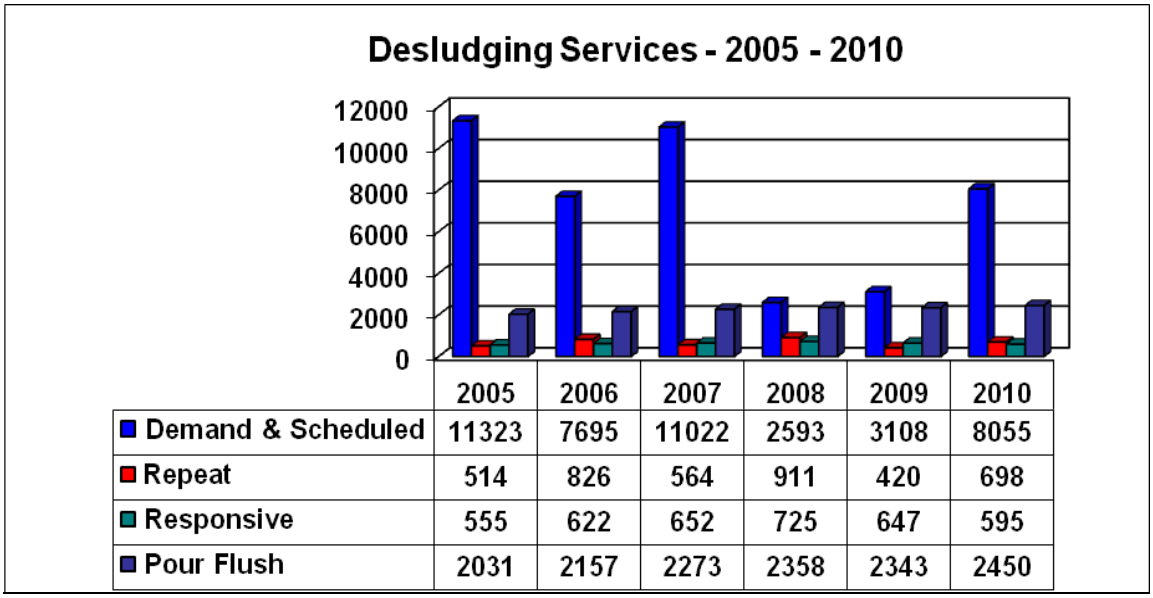
1 *Scheduled - include customers who are programmed for regular service within the 2 year cycle (due notice is given 1 month before their due date to fix date for service). Also include are those customers who call for service from the 18th months onwards after their last desludging service.*
2 *Demand - are first time customer (never desludge before or have refused service before).*
3 *Repeat - customers are those who request for service before the due date (18th months and below). Likely to be under capacity tank*
4 *Responsive - are non customers who have to pay cash on service eg hotels, factories, and other privately owned ISTs and PF systems.*

Source: Faecal Sludge Management Study, 2011 (Malaysia)

The data showed that between 2005 and 2007, the total number of FSM services provided nationwide by IWK annually averaged between 180,000 to 190,000. However, this significantly dropped in 2007 to about 95,000 and the weaker demand continued even to 2010 when there was a slight increase in service to about 100,000. The drop in the number of services is attributed to the change in legal requirement for services from one that was scheduled and demand-based to one that was purely demand and request based. This coincided with the change in requirement from the older *Sewerage Services Act 1993* to the present legal requirement under WSIA. Under WSIA, the responsibility for desludging rests with the owner and occupier of the premise, while previously desludging services were scheduled by IWK. This change, and the weak enforcement by SPAN, resulted in fewer request for sludge extraction services to IWK.

Analysis of the demand for FSM services for each of the 3 states in which the cities are located, reflect the same trend, a significant fall in demand for services from 2008 onwards with the enforcement of WSIA (**Figures 3.9.2, 3.9.3** and **3.9.4**). This trend was more pronounced in Melaka and Kuala Lumpur where the population of ISTs is higher compared to numbers in Terengganu (refer to Table 2.2.1). Nevertheless, it is quite evident that the change in requirement, from one that is scheduled to one that is demand or request-based has its drawback, in that the public tended to be complacent about the need to service their IST or PF system at regular intervals.

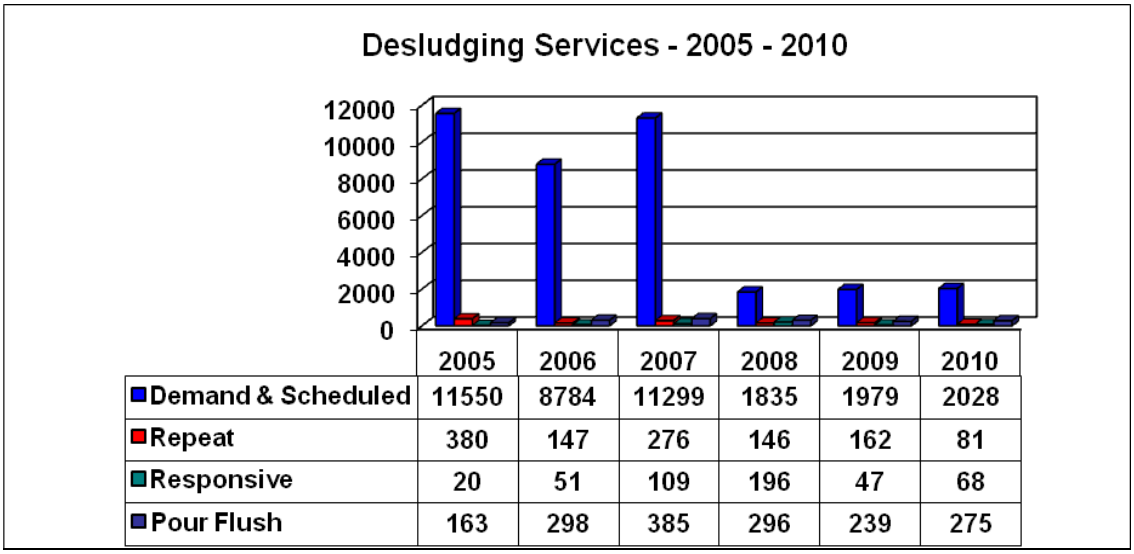
Figure 3.9.2: FSM Service Trend for Melaka



	2005	2006	2007	2008	2009	2010
Demand & Scheduled	11323	7695	11022	2593	3108	8055
Repeat	514	826	564	911	420	698
Responsive	555	622	652	725	647	595
Pour Flush	2031	2157	2273	2358	2343	2450

Source: Faecal Sludge Management Study, 2011 (Malaysia)

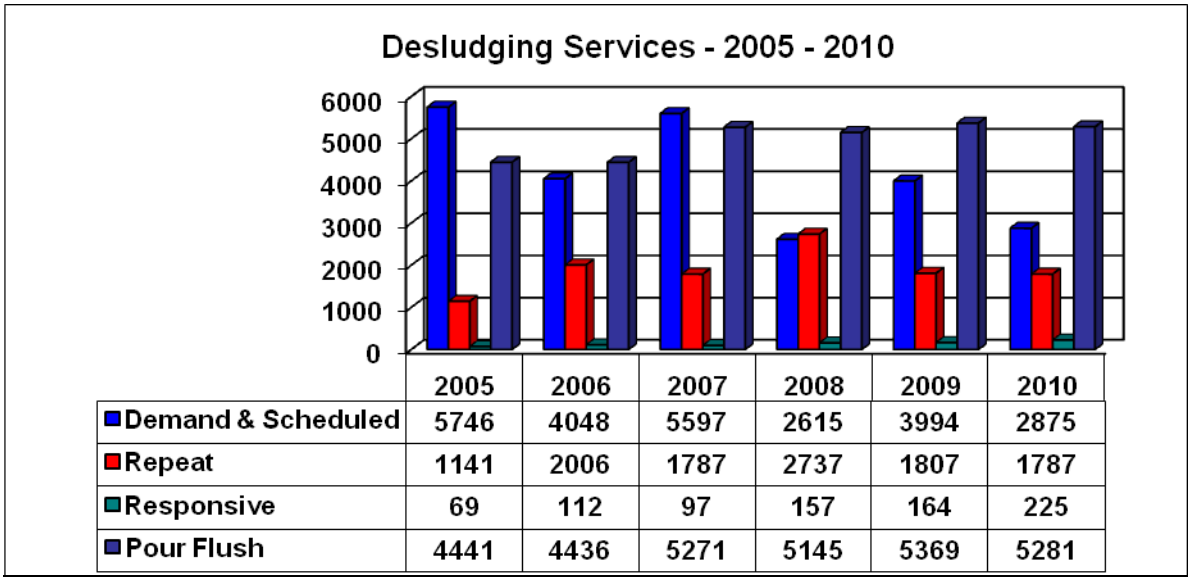
Figure 3.9.3: FSM Service Trend Kuala Lumpur



	2005	2006	2007	2008	2009	2010
Demand & Scheduled	11550	8784	11299	1835	1979	2028
Repeat	380	147	276	146	162	81
Responsive	20	51	109	196	47	68
Pour Flush	163	298	385	296	239	275

Source: Faecal Sludge Management Study, 2011 (Malaysia)

Figure 3.9.4: FSM Services for Kuala Terengganu



	2005	2006	2007	2008	2009	2010
Demand & Scheduled	5746	4048	5597	2615	3994	2875
Repeat	1141	2006	1787	2737	1807	1787
Responsive	69	112	97	157	164	225
Pour Flush	4441	4436	5271	5145	5369	5281

Source: Faecal Sludge Management Study, 2011 (Malaysia)

3.9.2 Market Potential for FSM Services

An assessment of the market potential for sludge extraction, transportation and treatment services may be gauged from the data that IWK has in its database. As mentioned earlier, IWK maintains statistics on IST and PF systems in the 88 local authorities currently under their care. These statistics are shown in **Table 3.9.1** for all

the states in Peninsular Malaysia (except for Kelantan and the local authority of Johor Bahru), and for Melaka and Terengganu and the Federal Territory of Kuala Lumpur.

Table 3.9.1: IST and PF Systems by Area or State

Area / State	ISTs	Pour Flush	Total
Total for IWK service areas	1,221,831	826,388	2,048,219
Kuala Lumpur	53,252	5,000	58,252
Melaka State	55,197	16,128	71,325
Terengganu State	80,324	33,600	113,924

Source: IWK, National Statistics (April 2011)

As can be seen from the table, there are some 2 million ISTs and PF systems still operating within the service area of IWK. This number would be higher for the entire country if all the states are included. The information available shows that such systems are more common in the rural as well as small urban areas in the country and these will continue to require FSM services In the future.

Under current guidelines for desludging services to be carried out at least once every 2 years, the number of such sewerage systems that is needed to be serviced on an annual basis will be about 1 million for the entire nation. Even at the suggested revised rate of once every 3 years, the total number would be about 683,000 annually (**Table 3.9.2**).

Table 3.9.2: Annual FSM Service Estimates

Area / State	Total	Service Number/year (1 in 2 years)	Service Number/ year (1 in 3 years)
Total for IWK service areas	2,048,219	1,024,110	682,740
Kuala Lumpur	58,252	29,130	19,420
Melaka State	71,325	35,660	23,780
Terengganu State	113,924	56,960	37,980

Source: Faecal Sludge Management Study, 2011 (Malaysia)

Under proposed legislation to require house owners to desludge at a frequency of once every 3 years, it is estimated that some 365 or more tanker trucks will require to be deployed nationwide (this assumes a 6 day working week and an ideal per truck scheduled service average of 6 households per day). Hence, significant employment opportunities for truck drivers, operators, supervisors, maintenance staff, and other support services can be created to manage such services. Overall, the potential for

FSM service is significant and this is contingent on effective enforcement of the relevant legislations currently applicable in the country.

3.10 SERVICE DELIVERY MODELS REVIEW

The sludge extraction and transporting business in Malaysia is wholly of the mechanical type and operators fall within the medium and large size range (from 3-15 trucks). There are presently no active small operators which operate only 1 truck.

The survey of service providers yielded few returns with comprehensive income statements. Nevertheless, income statements from a medium-size operator, who is a private company in Melaka operating 3 trucks, and a large size operator, who is a branch operational unit of IWK operating in Kuala Lumpur, was received. The latter is one of the larger IWK branch units with 14 trucks. To conform to the guideline on operational size, the model analysis looked at medium-size and large-size operations on FSM.

Two scenarios are considered in the financial analysis. This was for year 2007 and year 2010. Year 2007 was a benchmark year as it was the last year before WSIA came into effect. The emptying business was stronger prior to 2008 as IWK schedule on desludging was in place and the service demand was stable. After 2007 and up to 2010, the practice of scheduling ceased and service demand dropped significantly. Although WSIA has provision to compel house owners to desludge, many are not aware of it, and desludging is on a responsive basis to such request.

During the pre-2007 situation, sludge extraction was mainly carried out by IWK, supported by private service providers, many of whom worked for IWK as sub-contractors. To encourage the regular emptying of individual septic tanks, an instalment payment scheme was introduced whereby consumers could make monthly payments for commercial and industrial premises and half yearly payments for domestic customers. In addition, non-customers could also request for responsive service from IWK or from other private service providers. The tariff payable for this responsive service was RM180 (US$60) for each job completed. Apart from the household segment, other market segments included Government institution buildings, commercial and industrial premises and each paid different rates for sludge extraction. Generally, Government institution buildings paid lower tariffs compared to commercial and industrial enterprises.

The post-2007 period took into account the impact of WSIA. Scheduled desludging was put in abeyance pending the drafting of a new desludging regulation by SPAN under WSIA. It affected adversely the private service providers, many of whom had to cease operations because they had been dependent on IWK scheduled service to provide them with regular business. For IWK, scheduled desludging still continues for Government buildings and premises and this has helped to keep the existing personnel and trucks occupied.

3.10.1 Tariff

Under current WSIA provisions, the present criteria for determining the rate of charge has been proposed to be based on a volumetric basis irrespective of the types of premises that will be serviced. The rates apply to both ISTs and PF systems. However, different rates (pending gazettement by the authorities) have been proposed that may be charged by the Service Licensee and for Permit Holders as shown in **Table 3.10.1**. The tariff represent maximum rates that may not be exceeded by the respective service provider.

Table 3.10.1: Proposed Service Fees for FSM

Capacity of IST/PF	Permit Holders	Service Licensee (IWK)	Remarks
Up to 2 cu.m	Not more than RM 230 (about US$76.70)	RM 300 (about US$100)	Rates for Permit Holders are negotiable but fixed for IWK
Additional 1 cu.m thereof	RM 115 (about US$38.30)	RM 115 (about US$38.30)	
Sludge Treatment and Disposal	RM 55/cu.m (about US$18.30/cu.m)	RM 55/cu.m (about US$18.30/cu.m)	IWK operated sludge treatment facilities

Source:IWK

As shown in the above table, a basic rate is charged for services provided for IST capacity up to 2 cu.m, this being the standard size for ISTs and possibly many PF systems used in residential property. However, where the volume of sludge exceeds this amount, as may be the case for commercial and industrial premises, an additional charge is imposed for each additional cubic meter of sludge that is abstracted.

Although the ceiling charge is specified, this does not preclude the Permit Holder from giving a discount to owners or occupiers of premises. However, the charge imposed by IWK (the Service Licensee) is a fixed rate and not to be discounted. Although it is unclear the rationale for this tariff arrangement, it nevertheless allows Permit Holders to offer more competitive rates to customers.

3.11 FINANCIAL AND BUSINESS MODEL ANALYSIS

3.11.1 Analysis for a Large Operator

The large operator model analysis is based on the operations of the IWK unit in the city of Kuala Lumpur. The unit operates some 14 trucks which provide services to the entire city area of about 243km^2. The city is served with a CSTF which is located within the city area. Areas served by this facility are generally within a 15km radius from the facility.

Revenue
All revenues of the large-size operator are derived from formal sources as it is established and registered as a company under the Companies Act of the country. Under this regulation, its accounts are audited and open to the public. It has four sources of income from its emptying business:

(i) revenue from emptying for domestic households,
(ii) revenue for emptying for commercial, industrial and government institutions,
(iii) responsive revenue, and
(iv) other revenue.

Responsive revenues are for emptying services for premises located outside the operational areas of a Local Authority i.e. in villages outside of the town area. Other revenue refers to income paid by the company's treatment plant section for the desludging of interworks tankering as well as desludging sewer lines.

Expenditures
Expenditures for IWK Kuala Lumpur are grouped into three major types as follows:

1. Capital Investment, which involves fixed assets items like trucks, office furniture and office equipment.
2. Operating Expenses, which include depreciation, salary and wages, travelling expenses, maintenance, repairs administration, etc.
3. Income Tax.

where:

1. Capital investment are mainly fixed assets of the company, comprising the emptying trucks, office equipment and office furniture, which are subject to depreciation annually.

2. Operating expenses of the large-size are made up of the following items:
   - Personnel costs – these include salaries/wages paid to permanent staff and daily wage workers, and would consist of the basic salaries, bonuses, overtime wages and allowances, and social contributions. Social contributions to permanent staff include the Employees Provident Fund,

Social Security, training, medical, retirement benefits and insurance and laundry services.

- Operating costs – include operating and disposal costs, maintenance and repair costs, transport costs and equipment capital costs. The operating and dumping costs are made up of the licensing fees for the trucks, consumption of fuel, and share of operation planning costs (for office building rental, electricity, water, and supplies), and the sludge dumping fees, while the transport costs include staff travelling expenses, parking and tolls. Equipment capital costs comprise interest on bank borrowings, truck hire purchase rental, insurance costs for trucks and vehicle, and trucks depreciation costs. Tires and suction pipes are not capitalized, and therefore not depreciated annually, but charged out in the year of purchase.

3. Income Tax – technically IWK would have to pay income tax but presently it does not pay any revenue or income tax because the holding company has sufficient tax losses accumulated from previous years to off-set the profits made in Years 2007 and 2010.This happens as the individual operations of the IWK unit are consolidated into the holding company's accounts. If such tax credits are not available, the company would have to pay a corporate tax rate of 25% on all profits made. Technically, if each unit is to run as a separate entity (company), and if it is profitable, it would have to pay income tax at 20% on its net profit if the profit is below RM500,000 (about US$166,666), and 25% of net profit if the profit exceeds that value. The above tax rates are applicable for companies with paid-up capital smaller than RM2.5 million (about US$833,330), which most of the emptying operators would fall into.

Financial Assessment of Existing Operations

IWK unit in Kuala Lumpur operated 14 trucks in year 2007 and continued to maintain this fleet size in 2010. The Income Statements for 2007 and 2010 are respectively shown in **Appendix 3.11.1** and **3.11.2.**

Following are the results of the analysis of the Income Statements. The distribution of the operating costs per truck, and operating costs per trip are also highlighted in the said Appendices.

(a) Operating Costs per Truck

Its total operating costs per truck were as follows:

- Year 2007: RM170,587 (US$56,862)
- Year 2010: RM103,245 (US$34,415)

The higher cost for year 2007 on a per truck basis was incurred on a larger volume of business as compared to that in year 2010, thus increasing its overall operating costs and other expenses, and hence raised the operating costs per truck.

(b) Number of Trips per Truck
In terms of number of trips, the company's trucks made:

- Year 2007: Total 17,761 trips resulting in 1,268 trips per truck
- Year 2010: Total 3,075 trips resulting in 219 trips per truck

(c) Cost per Trip
The cost per trip therefore works out to be:

- Year 2007: RM134.50 (US$44.83)
- Year 2010: RM 470.10 (US$156.70)

The higher per trip cost in Year 2010 was attributed to lower number of trips while holding the fixed overhead charges constant even when the volume of business was reduced.

(d) Total Personnel Cost
Total personnel cost is a major cost item for the large-size operator. It made up 42.9% of total expenses in 2010 and 36.8% in 2007. Personnel cost tends to go up over time. Wages, in particular, made up the largest item under operating expenses. They contributed 29.4% in year 2007 and increased to 31.6% in year 2010.

(e) Operating and Dumping Cost
As for operating and dumping costs, they constituted 50.6% of total expenses in year 2007 but declined to 40.2% in year 2010, possibly due to reduced business.

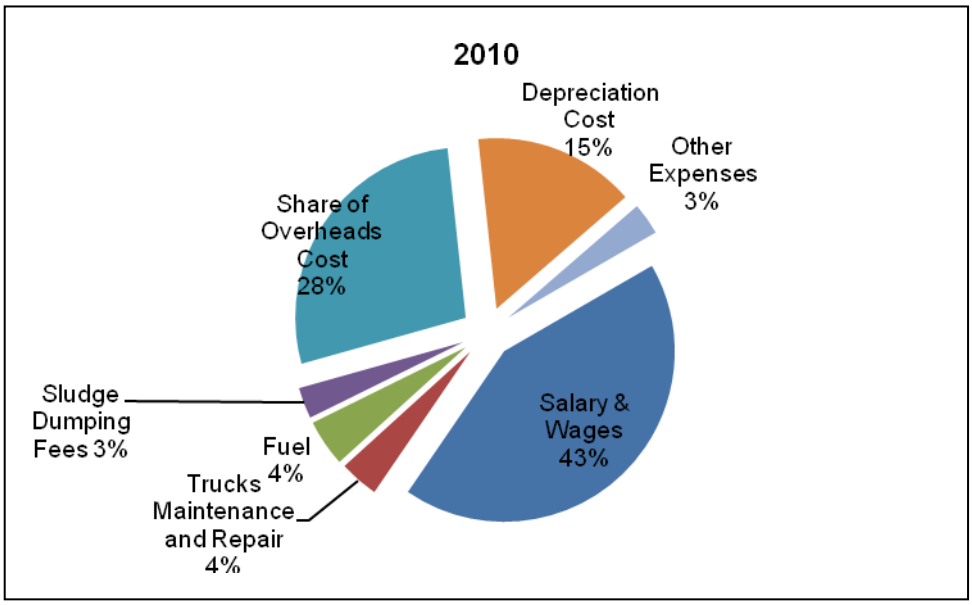
(f) Operation Overheads Cost
The share of Overheads Cost (office rental, telephone, electricity, water and office supplies and advertising) to total expenses was also quite substantial. In year 2007, it was 23.1% and increased to 27.6% in 2010, making it the second largest operating expenses after wages

(g) Truck Maintenance and Fuel Costs
Truck maintenance and fuel costs also took up a large portion of total operating expenses at 8.2% and 12.3% in Years 2010 and 2007 respectively.

(h) Cost of Sub-contractor Services
In year 2007, the use of sub-contractor services accounted for RM 268,369 (US$89,456) or 11.2% of total expenses in that year. This service was not required in 2010due the lower volume of business as a result of the cessation of scheduled services after 2007.

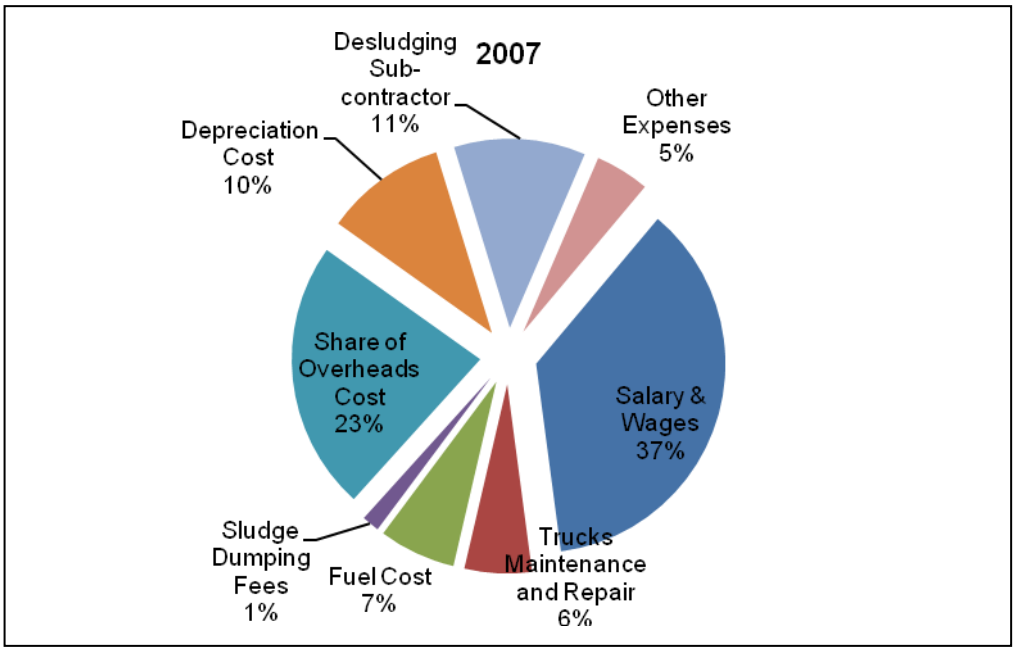
A breakdown of the operational expenses for the two years is depicted in **Figures 3.11.1 and 3.11.2** below.

Figure 3.11.1: Large-size Operator's Operational Expenses, 2010



Source: Faecal Sludge Management Study, 2011 (Malaysia)

Figure 3.11.2: Large-size Operator's Operational Expenses, 2007



Source: Faecal Sludge Management Study, 2011 (Malaysia)

It may be observed from **Appendices 3.11.1** and **3.11.2** that the bulk of the revenue of the large-size operator's business came from services rendered to commercial, industrial and government institution premises. In year 2010, the revenue from these sectors was RM6,671,122 (US$2,223,707) or 95% of its total revenue for the year. However, in year 2007, the same sectors contributed RM9, 018,347 (US$ 3,006,116) contributed or only 74.6% of the total revenue for that year. It can be concluded that in the case of the large-size operator, the fact that it is IWK helps, as its business with the commercial, industrial and government institutions remained intact after 2007 to enable it to sustain its business reasonably well in year 2010. It is understood that the government sector itself contributed about 80% to the income from services to commercial, industrial and government institution portion of the business for both the years.

From a financial viewpoint, the company made a net profit of RM9,696,064 (US$3,232,021) in year 2007, and RM5,573,109 (US$1,857,703) in year 2010. The net profit margin for the large size operator was 79.4% for year 2010 and 80.2% for year 2007. Although its profit margin in absolute terms was down by RM4 million (US$1.33 million) between the two years, its percentage drop was insignificant as this is less than 1%.

Five-Year Projected Results for Large-size Operator

A financial analysis was undertaken for a new large-sized operation with the assumption that new trucks are purchased and applying assumptions that are benchmarked as closely as possible to the existing situation of the large-size operation discussed earlier. It is assumed that FSM services are expected to be on a scheduled basis ensuring a consistent number of desludging services to be undertaken daily. The assumptions for the analysis and the detailed working are appended in **Appendix 3.11.3.**

A summary of the projected Income Statement for the large-size operator is exhibited in **Table 3.11.1** below. The outcome of the analysis is discussed in the following.

Table 3.11.1: Projected Income Statement Summary for a Large-size Operator (RM'000)

	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue	4,057.2 *(US$1,352.4)*	4,347.0 *(US$1,449.0)*	4,636.8 *(US$1,*545.6)	4,974.9 *(US$1,658.3)*	5,313.0 *(US$1,771.0)*
Less Operating Expenses	3,146.2 *(US$1,048.7)*	3,348.6 (*US$1,116.2*)	3,555.9 *(US$1,185*.3)	3,787.3 (*US$1,262.4*)	4,024.1 *(US$1.341.4*)
EBITDA	911.0 *(US$303.7)*	998.4 *(US$332.8)*	1,080.9 *(US$360.3)*	1,187.6 *(US$395.9)*	1,288.9 *(US$429.6)*
Less Depreciation	812.0 *(US$270.7)*	812.0 *(US$270.7)*	812.0 *(US$270.7)*	812.0 *(US$270.7)*	812.0 *(US$270.7)*

	Year 1	Year 2	Year 3	Year 4	Year 5
EBIT	99.0 *(US$33.0)*	186.4 *(US$62.1)*	268.9 *(US$89.6)*	375.6 *(US$125.2)*	476.9 *(US$158.9)*
Less Interest	240.0 *(US$80.0)*	194.3 *(US$64.8)*	144.8 *(US$48.3)*	91.2 *(US$30.4)*	33.2 *(US$11.1)*
Earnings before Tax	(140.9) *(US$47.0)*	(7.9) *(US$2.7)*	124.1 *(US$41.3)*	284.3 *(US$94.8)*	443.6 *(US$147.8)*
Less Tax Payable	0	0	24.8 *(US$8.3)*	56.9 *(US$19.0)*	88.7 *(US$29.5)*
Profit/ (Loss) after Tax	**(140.9)** *(US$47.0)*	**(7.9)** *(US$2.7)*	**99.3** *(US$33.0)*	**227.4** *(US$75.8)*	**354.9** *(US$118.3)*

Source: Faecal Sludge Management Study, 2011 (Malaysia)

Main Observations

i. Revenue is approximately RM4.6 million (US$1.53 million) per year over the projected period
ii. Loss making for the first two years and profitable over the last 3 years of the projected period
iii. The trucks are depreciated over 5 years or 20%
iv. The operation is taxed at 20% of the gross taxable income. This is the tax rate applicable in Malaysia

A 5-year financial analysis of the results indicates the following important indicators

- After Tax Project Internal Rate of Return (IRR) 9%
- Pre-Tax Project IRR 10%
- Net Present Value (NPV) @ 8% discount rate RM110,354 (US$ 36,785)
- Average Annual Return on Equity 7%

A year to year analysis of the results gives the following important financial ratios as shown in **Table 3.11.2**

Table 3.11.2: Key Financial Ratios of the Large-size Operator

	Year 1	Year 2	Year 3	Year 4	Year 5
Debt Coverage Ratio (times)	1.15	1.26	1.34	1.43	1.52
Debt/Equity Ratio (times)	3.10	2.43	1.51	0.64	0.00
EPS (RM)	(0.14) *(US$0.05)*	(0.01) *(US$0.00)*	0.10 *(US$0.03)*	0.22 *(US$0.07)*	0.35 *(US$0.12)*
NTA backing/Share (RM)	0.86 *(US$0.29)*	0.85 *(US$0.28)*	0.95 *(US$0.32)*	1.18 *(US$0.39)*	1.53 *(US$0.51)*
Breakeven on Revenue (RM'000)	2,559 *(US$ 853)*	2,703 *(US$901)*	2,853 *(US$951)*	3,011 *(US$1,004)*	3,177 *(US$1,059)*
Breakeven on Emptying Fee (RM)	145 *(US$48)*	143 *(US$48)*	142 *(US$47)*	139 *(US$46)*	138 *(US$46)*
Breakeven on Trips/day (no.)	1.1	1.1	1.2	1.2	1.3
Proposed Trips/day (no.) (average 3 HH/trip)	1.68	1.80	1.92	2.06	2.20
Margin of Safety (%)	37	38	38	39	40

Source: Faecal Sludge Management Study, 2011 (Malaysia)

Key Observations

i. An IRR of 9% should be acceptable for the project as it is slightly higher than the cost of borrowing.
ii. A positive NPV at 8% discount rate of RM110,354 (US$36,785) testifies to the viability of the proposal
iii. A 5-year average annual Return on Equity of 7% may not be considered as attractive for the promoters of the project
iv. The proposed project should be able to take care of its debt obligations from year 1 onwards with the cash flow generated of more than 1 time its principal and interest repayments in Year 1, and increasing to 1.5 times its loan repayment ability in Year 5 due to the improving profits in that year.
v. The proposal should not have problem in sourcing its borrowing with debt/equity ratio within acceptable range.
vi. Earnings per share start at (RM0.14) (US$0.05) in Year 1 but improved to RM0.10 (US$0.03) in Year 3 and RM0.35 (US$ 0.12) in Year 5. It should still be attractive to investors participating in the project even though it is making losses in the first 2 years of operation with its average EPS over the 5-year period of RM0.10 (US$ 0.03).
vii. The breakeven on revenue of RM2,559,000 (US$853,000) in Year 1 allows for a margin of safety of about 37% for the project. The improving margin of safety over the projected period should be able to cushion any unexpected decline in revenue for the period
viii. Breakeven for the business on the emptying fee of RM230 (US$76.67) is RM145 (US$48.33) in the initial year and decreased to below RM140

(US$46.66) from Year 4 onwards. This Year 1 RM145 (US$48.33) breakeven is only 63% of the original emptying fee charged

ix. The breakeven on number of trips/day for each truck is 1.1 for Year 1, and increases to 1.3 in Year 5. These compare favourably against the original 1.68 trips and 2.2 trips, respectively.

Sensitivity Analysis for the Large-size Operator

Although cost estimates normally include allowances for contingencies, and revenue estimates are based on detailed market studies, uncertainties do exist in most projections to warrant an examination of the effects of changes in some estimates and assumptions on profitability and financial stability of the project. Such examinations are termed Sensitivity Analysis. The factors or variables chosen for examination are those which would likely have significant implications on the financial projections. As such, this analysis tests the sensitivity of the IRR to adverse changes in selected key variables in order to determine the impact on the financial outcomes of the proposed emptying and transportation project.

A Sensitivity Analysis was carried on the projected performance of the large-size operator to test the sensitivity of the IRR to changes in selected key variables in order to determine the impact on the financial outcomes of the large emptying company. The following variables were tested.

1) Decrease in total revenue by 5%
2) Increase in operating costs of the company by 5%
3) Increase in the price of fuel by 50%

The results of these variations on the company's financial profitability are summarized in **Table 3.11.3** below.

Table 3.11.3: Financial Sensitivity Analysis of Large-size Operator

Sensitivity Analysis	After Tax IRR
Base Case	9%
Decrease in Total Revenue by 5%	2%
Increase in Operating Costs by 5%	4%
Increase in Fuel by 50%	6%

Source: Faecal Sludge Management Study, 2011 (Malaysia)

In general, the financial sensitivity analysis indicated that the resultant IRR figures were sensitive under the tested assumptions. A decrease in revenue by 5%, or an increase in operating expenses also by 5% will result in unfavourable IRR in both circumstances. When fuel price is increased by 50%, the IRR was reduced to 6%, which makes it financially unfavourable too.

3.11.2 Analysis for a Medium-size Operator

The medium-size operator model analysis is based on the operations of the private operator in the city of Melaka. The company provides services to the entire Melaka city area of about 689km^2. The city is served with a CSTF which is located outside of the city area some 17km from the city centre. Areas served by this facility may be more than 25km away from the facility. Areas outside of the service areas are about 30km from this facility.

Revenue

The main revenue sources of the medium-size operator i.e. the private emptying operator were: (i) IWK, (ii) households, and (iii) commercial and industrial premises. Most jobs carried out by the private operator consisted of sub-contracting jobs from IWK, emptying of households on a need basis, and sludge extraction for commercial premises. It had no other informal sources of income.

Expenditure

In the case of the medium-size operator (private service provider), its expenditure groups are similar to the large operator. It also did not pay any revenue tax for year 2010 as its operation was not profitable.

Financial Assessment Existing Operations

The company, MBM Tiga Enterprise, is a sole proprietor company using 3 trucks with a total of 11 workers. The trucks were bought new at about RM300,000 (US$100,000) each, on hire-purchase from a commercial bank, paying a flat interest rate of 4.5% over a 5-year repayment period. Two of the trucks are 8 cubic meters in capacity, and the other has a capacity of 6 cubic meters. According to the private operator, on the average, the company's trucks travel approximately 30-50 km emptying about 20 cubic meters of sludge per day, serving mainly domestic households although the company also provides service to commercial enterprises.

Appendix 3.11.4 shows the Income Statement of the company in Melaka for Year 2010. The company was not in operation in year 2007 so income statement for that year is not available for comparison. The distribution of the operating costs per truck, and operating costs per trip are also shown in the said table.

Similar to IWK's operations in Kuala Lumpur, salary and wages paid to workers was the single biggest cost item for this private operator, amounting to 37.26% of the total expenditure incurred for the year 2010. Truck depreciation cost formed the second biggest expenditure item at 13.3% or RM43, 500 (US$14,500).

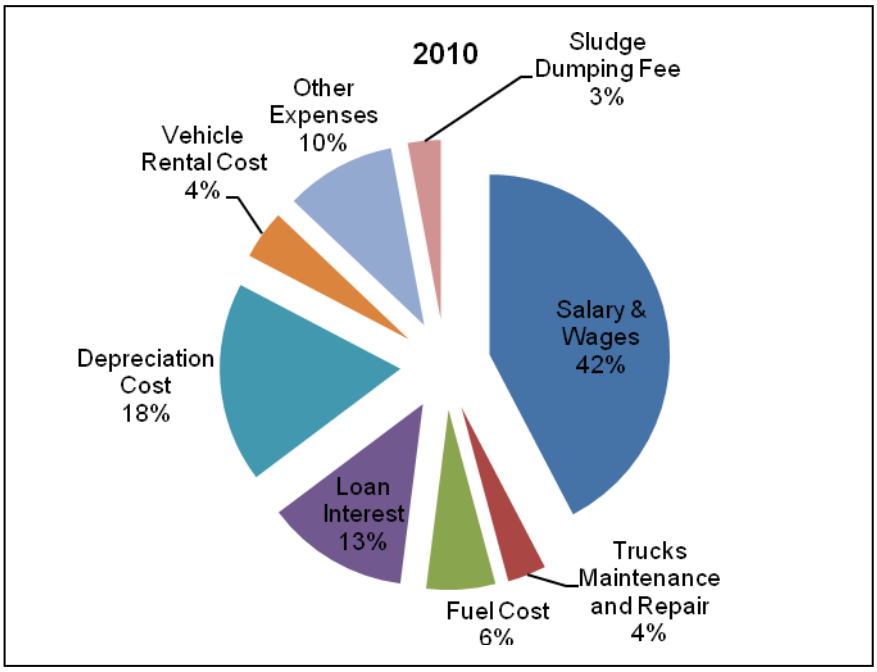
Hire purchase interest payment of RM41,668 (US$13,889) constituted 12.8% of total expenditure whilst truck maintenance and fuel costs, totalling RM31,595 (US$10,532),

also took up a substantial portion of the year's expenses, contributing about 9.7% of the total expenditure of RM326,782 (US$108,927)

The total operating costs per truck for Years 2010 was RM108,927.60 (US$36,309.20). A total of 1,600 trips were made by the company's trucks in year 2010, resulting in a cost per trip of RM204.20, (US$68.06) and 533 trips per truck for the year. From a financial viewpoint, the company made a net loss of RM270,090 in year 2010.

Figure 3.11.3 shows the operational expenses for the medium-size operator in 2010.

Figure 3.11.3: Private Operator's Operational Expenses, 2010



Source: Faecal Sludge Management Study, 2011 (Malaysia)

Five-Year Projected Results for a Medium-size Operator

Similar to the basis used for the large-size operator, the financial projections carried out for the medium-size operator is also based on the assumption that new trucks are purchased for the operation, and that whatever assumptions made will be benchmarked as closely as possible to the existing situation of the medium-size operation discussed in the earlier part of this report. The FSM services are also expected to be on a scheduled basis. The various assumptions and detailed workings are appended in **Appendix 3.11.5**

A summary of the projected Income Statement for the medium-size operator is depicted as shown in **Table 3.11.4** below.

Table 3.11.4: Projected Income Statement Summary for a Medium-size Operator (RM'000)

Item	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue	869.4 *(US$289.8)*	931.5 *(US$310.5)*	933.6 *(US$331.2)*	1,066.0 *(US$355.3)*	1,138.5 *(US$379.5)*
Less Operating Expenses	681.2 *(US$227.1)*	725.3 *(US$241.8)*	770.5 *(US$256.8)*	820.9 *(US$273.6)*	872.6 *(US$290.9)*
EBITDA	188.2 *(US$62.7)*	206.2 *(US$68.7)*	233.1 *(US$74.4)*	245.1 *(US$81.7)*	265.9 *(US$88.6)*
Less Depreciation	177.0 *(US$59.0)*	177.0 *(US$59.0)*	177.0 *(US$59.0)*	177.0 *(US$59.0)*	177.0 *(US$59.0)*
EBIT	11.2 *(US$3.7)*	29.2 *(US$9.7)*	46.1 *(US$15.4)*	68.1 *(US$22.7)*	88.9 *(US$29.6)*
Less Interest	52.3 *(US$17.4)*	42.3 *(US$14.1)*	31.6 *(US$10.5)*	19.9 *(US$6.6)*	7.2 *(US$2.4)*
Gross Taxable Income	(41.1) *(US$13.7)*	(13.2) *(US$4.4)*	14.5 *(US$4.9)*	48.2 *(US$16.1)*	81.6 *(US$27.2)*
Less Tax Payable	-	-	2.9 *(US$1.0)*	9.6 *(US$3.2)*	16.3 *(US$5.4)*
Profit/ (Loss) after Tax	(41.1) *(US$13.7)*	(13.2) *(US$4.4)*	11.6 *(US$3.9)*	38.6 *(US$12.9)*	65.3 *(US$21.8)*

Source: Faecal Sludge Management Study, 2011 (Malaysia)

Main Observations

i. Revenue is in the region of approximately RM 990,000 (US$ 330,000) per year over the projected period
ii. Loss making for the first two years and profitable over the last 3 years of the projected period
iii. The trucks are depreciated over 5 years or 20%
iv. The operation is taxed at 20% of the gross taxable income. This is the tax rate applicable in Malaysia

A 5-year financial analysis of the results indicates the following important indicators

- After Tax Project Internal Rate of Return (IRR) 7%
- Pre-Tax Project IRR 8%
- Net Present Value (NPV) @ 8% discount rate (RM 18,353) (US$6,118))
- Average Annual Return on Equity 3%

A year to year analysis of the results gives the following important financial ratios as shown in **Table 3.11.5.**

Table 3.11.5: Key Financial Ratios of the Medium-size Operator

Item	Year 1	Year 2	Year 3	Year 4	Year 5
Debt Coverage Ratio (times)	1.09	1.20	1.28	1.37	1.45
Debt/Equity Ratio (times)	3.16	2.65	1.72	0.74	0.00
EPS (RM)	(0.18) *(US$0.06)*	(0.06) *(US$0.02)*	0.05 *(US$0.02)*	0.17 *(US$0.06)*	0.29 *(US$0.10)*
NTA backing/Share (RM)	0.82 *(US$0.27)*	0.76 *(US$0.25)*	0.81 *(US$0.27)*	0.98 *(US$0.33)*	1.27 *(US$0.42)*
Breakeven on Revenue (RM'000)	557 *(US$186)*	589 *(US$196)*	622 *(US$207)*	656 *(US$219)*	693 *(US$231)*
Breakeven on Emptying Fee (RM)	147 *(US$49)*	145 *(US$48)*	144 *(US$48)*	142 *(US$47)*	140 *(US$47)*
Breakeven on No. of Trips/Day	1.1	1.1	1.2	1.3	1.3
Proposed Trips/day (no.) (average 3 HH/trip)	1.68	1.80	1.92	2.06	2.20
Margin of Safety (%)	36	37	37	38	39

Source: Faecal Sludge Management Study, 2011 (Malaysia)

Key Observations

i. An after tax IRR of 7% should be considered unfavourable for the project against a cost of borrowing at 8% p.a.
ii. A negative NPV at 8% discount rate of (RM 18,353) (US$6,118) testifies to the non-viability of the proposal
iii. A 5-year average annual Return on Equity of 3% adds to the unattractiveness of the project
iv. The proposed project is generating sufficient cash flow to satisfy its debt obligations with the debt coverage ratios exceeding 1 throughout the projected period.
v. The debt/equity ratio deteriorated in Year 1 from its initial ratio of 3:1 due to the loss in the first year, but recovered in subsequent years to below 1 in Year 4.
vi. Earnings per share for Years 1 and 2 are in the negatives but improve from Year 3 onwards due to profits made in that year. EPS for Year 5 stood at RM0.29 (US$0.10)
vii. The breakeven on revenue of RM 557,000 (US$186,000) in Year 1 allows for a margin of safety of around 36% for the project. This margin of safety should be able to cushion any unexpected decline in revenue for the projected period
viii. Breakeven on the emptying fee is RM147 (US$49) in Year 1, and improved to RM140 in the fifth year of the projected period.
ix. Breakeven on the number of trips/day per truck is 1.1 trips for the first year of operation and reaches to 1.3 trips in Year5.

Sensitivity Analysis of the Medium-size Operator

A Sensitivity Analysis was carried on the projected performance of the medium-size operator to test the sensitivity of the IRR to changes in selected key variables in order to determine the impact on the financial outcomes of the medium emptying company. The following variables were tested.

a. Decrease in total revenue by 5%
b. Increase in operating costs of the company by 5%
c. Increase in the price of fuel by 50%

The results of these variations on the company's financial profitability are summarized in **Table 3.11.6** below.

Table 3.11.6: Financial Sensitivity Analysis of Medium-size Operator

Sensitivity Analysis	After Tax IRR
Base Case	7%
Decrease in Total Revenue by 5%	0%
Increase in Operating Costs by 5%	2%
Increase in Fuel Price by 50%	4%

Source: Faecal Sludge Management Study, 2011 (Malaysia)

In general, the financial sensitivity analysis indicated that the resultant IRR figures were significantly affected under the tested assumptions. When the total revenue is decreased by 5%, the resultant IRR drops to 0%, and when the operating expenses were increased by 5%, the IRR is also reduced to only 2%. The project becomes significantly affected and it may not be viable to proceed under these two circumstances. The project is therefore sensitive to a drop in total revenue by 5% as well as an increase in operating expenses by the same margin. Similarly, an increase in the price of fuel by 50% also decreases the IRR to 4%.

3.11.3 Comparison of Existing Operations between Large and Medium-size Operators

Comparison was made between the large and the medium-sized operators and **Table 3.11.7** is a summary of the Income Statements for both.

The financial analysis for Year 2010 showed that the large-size operator (IWK Kuala Lumpur unit) for extraction and transportation services yielded good annual income. Its operations were profitable in 2010, generating net profit margin ratio of 79.4%. This arose largely from income for services extended to the government, commercial and industrial premises and not so much from income from households. The positive financial results were attributed largely to government premises being more dominant than the commercial and industrial enterprises as the latter would tend to save on such

services if they could and thus, would call upon IWK or any private service provider only when the need arises. This was not the case for government premises which were serviced through a scheduled programme.

Table 3.11.7: Income Statements Summary for Year Ended 2010 (US$)

Items	Large Operator	Large Operator/Truck	Medium Operator	Medium Operator/Truck
Expenses				
Personal Costs	206,653	14,761	46,112	15,371
Operating and Dumping Costs	193,744	13,839	21,767	7,256
Equipment Capital Costs	81,416	5,815	41,049	13,683
TOTAL EXPENSES	481,813	34,415	108,928	36,310
Revenue Sources				
Households	62,832	4,488	18,897	6,300
Commercial/Industrial/Govt	2,223,707	158,836	-	-
Responsive Emptying	10,069	719	-	-
Others	42,906	3,065	-	-
TOTAL REVENUE	2,339,514	167,108	18,897	6,300
Profit and Loss				
Net Revenue before Tax	1,857,701	132,693	(90,030)	(30,010)
Revenue Tax	-	-	-	-
Profit/(Loss) after Tax	1,857,701	132,693	(90,030)	(30,010)

Note: 1US$ = RM3 *Source: Faecal Sludge Management Study, 2011 (Malaysia)*

The medium-sized private operator's financial result showed a loss for year 2010. This loss can be attributed to the lesser revenue received by the company due to the non-schedule nature of the business after 2007. This is also shown by the operation of the large-size operator when comparing its financial results for 2007 and 2010, in which the financial results in 2007 out performed those in year 2010.

The other differences between the large-size operator and the medium-size operator are highlighted in the following:

(i) Operating Costs per Truck
The total operating costs per truck for the 2 categories of operator size is summarized as follows:

- Large-size Operator: RM103,245 (US$34,415)
- Medium-size Operator: RM108,927 (US$36,309)

The medium-size operator's total operational costs per truck were 5.5% higher than those of the large-size operator. The 5.5% difference may be considered small as this medium-size operator took a hire purchase facility to finance the purchase of the three trucks, of which the interest payment amounts to 12.75% of the total operating costs. The large-size operator financed its purchase of the 14 trucks through its own equity

(ii) Number of Trips per Truck

In terms of average number of trips made per truck, the different category of operator will indicate the following:

- Large-size Operator: 219 trips per truck/year
- Medium-size Operator: 533 trips per truck/year

The conclusions that can be drawn from the above numbers are

(1) trips made by large-size operators are more than doubled the distance travelled by trucks owned by the medium-size operator, and
(2) large-size operator has an excess number of trucks for that year.

(iii) Cost per Trip

The cost per trip therefore works out to be:

- Large-size Operator: RM470 (US$156.70)
- Medium-size Operator: RM204 (US$68)

The higher costs per trip for the large-size operator as compared to that of the medium size operator partly confirms that the trips it made are of longer distances.

(iv) Revenue per truck

The revenue per truck for the two categories is as follows:

- Large-size Operator: RM501,325 (US$167,108)
- Medium-size Operator: RM18,897 (US$6,300)

The large-size operator's revenue per truck showed that it is significantly higher than that of the medium size operator. This high revenue is likely attributed to the income from the government premises which the private operator does not service.

The large-size operator has minimal bank borrowings, as the bulk of the fixed assets were financed by internally generated funds and the company's equity capital. Overdraft facilities for the working capital of the business operations are obtained from commercial banks with interest rates of base (presently at 6.60%) plus 0.5-1.0%. The medium-size private operator's borrowing for the trucks is

through Hire Purchase, obtained from a commercial bank, financing them at 80% of total cost, with a flat interest rate of 4.5%.

In terms of financial resources, the large-sized operations would require a higher capital commitment since each new truck would cost around US$100,000. On top of this, working capital requirement for a bigger business turnover would far exceed the requirement for the medium operation. IWK's ability to obtain banking facilities from commercial banks is never a problem as its main shareholder is the Ministry of Finance Incorporated. For the private operator, it is also not too difficult to obtain hire purchase financing from commercial banks if the financing is for 80% of the cost of the trucks. However, for working capital financing, the private operator may have difficulty sourcing it because of its business track records.

3.11.4 Comparative Projected Performances between Large and Medium-size Operators

Results of the projected financial analysis for the large and medium-size operations outlined earlier were analysed and the performances of the two compared. **Table 3.11.8** shows the comparison between the two.

Table 3.11.8: Comparison between Medium and Large-size Operators

Items	Medium-size Operator	Large-size Operator
Location	Melaka	Kuala Lumpur
No. of Trucks	3	14
Equity Capital	RM227,000 *(US$75,667)*	RM1,012,000 *(US$337,333)*
Term Borrowings	RM708,000 *(US$236,000)*	RM3,248,000 *(US$1,082,667)*
After-tax Project IRR	7%	9%
Pre-tax Project IRR	8%	10%
NPV @ 8% discount rate	(RM 18,353) *(US$6,118)*	RM 110,354 *(US$36,785)*
Average annual ROE	3%	7%
Breakeven on Revenue (Year 1)	RM557,218 *(US$185,739)*	RM2,559,461 *(US$853,154)*
Breakeven on Emptying Fee (Year 1)	RM147 *(US$49)*	RM145 *(US$48)*
Breakeven on No. of Trips/Day (Year 1)	1.1 trip	1.1 trip
Margin of Safety (Year 1)	36%	37%

Source: Faecal Sludge Management Study, 2011 (Malaysia)

Key Observations

i. Medium-size operator needs a smaller starting capital compared to the large-size operator.
ii. Borrowing of medium-size operator is small in comparison to that of the large-size operator. Stringent rules and stricter evaluation may be performed by bankers as the amount to be borrowed by large-size operator exceeds the RM1 million (US$0.33 million) bracket.
iii. After-tax Project IRR for both operators is close, and that for the medium-size operation indicates the project is not viable, whilst the one for the large-size operator indicates that the project is viable.
iv. NPV for the medium-size project is negative, indicating that the project is not feasible, while the large-size project has a positive NPV indicating that the project is acceptable
v. The ROE for both projects are low, at below 10%
vi. Breakeven on revenue for the medium-size operator is smaller than that of the large-size operator because the large-size operator has to carry a bigger fixed overhead cost compared to the medium-size operator.
vii. Both operators have a breakeven on number of trip at almost the same level of 1.1 trips per day.
viii. The margin of safety for both projects is almost similar, the large size operator at 37% whilst the medium size operator is at 36%.

3.12 FINANCIAL AND BUSINESS MODEL ANALYSIS USING GEO-TUBE

Pilot studies undertaken earlier by IWK showed the benefits of the Geo-tube system to improve FSM performance. It was decided to extend the Geo-tube system for the case of the medium-sized operation in Melaka, to determine if the model had a positive effect on its operations.

3.12.1 Model Set-up for Geo-tube System

The model set-up for the Geo-tube system has been described in section 2.7 of this report. The basic premise of the model is to reduce the maximum distance of travel by locating Geo-tube systems at strategic locations. In this case, a maximum distance of travel of not more than 15km from a Geo-tube or a sludge treatment centre was applied. The locations suggested for the Geo-tubes are shown in **Figure 2.7.1.**

3.12.2 Project Cost

The proposed 3-truck medium-size operation will require an estimated investment of RM935,000 (US$ 311,667). This total cost covers the costs of the 3 new trucks, office equipment, pre-operating expenses and the working capital requirement for the proposed project. Breakdown of these costs is summarized in **Table 3.12.1** below

Table 3.12.1: Project Cost Estimates

Items	RM
New Trucks	870,000 *(US$290,000)*
Office Equipment	12,000 *(US$4,000)*
Pre-operating Expenses	3,000 *(US$1,000)*
Working Capital Requirement	50,000 *(US$16,667)*
TOTAL	**935,000** *(US$311,667)*

Source: Faecal Sludge Management Study, 2011 (Malaysia)

All development cost and other operating cost expenditures are based on the following assumptions:

a. The capital cost estimates are extracted internally from team discussions and suppliers' quotations;
b. Office equipment includes office furniture and other equipment;
c. Pre-operating expenses are for the setting up and incorporation of a private limited company to run the operation, and other related expenses;
d. Average tariff per trip is assumed to be RM690 per truck(3 desludging services @ RM230/service) US$230 ;

e. Diesel cost is RM1.90 (US$0.63)per liter;
f. Depreciation of fixed assets is in accordance to the industry's accepted practices, where a straight line method over its economic live is adopted, and summarized below in **Table 3.12.2**

Table 3.12.2: Assumptions on Depreciation

Item	Rate (%)	Fixed Assets (RM)	Annual Depreciation (RM)
New Trucks	20	870,000 *(US$290,000)*	174,000 *(US$58,000)*
Office Equipment	20	12,000 *(US$4,000)*	2,400 *(US$800)*
Pre-operating Expenses	20	3,000 *(US$1,000)*	600 *(US$200)*
TOTAL		***885,000*** *(US$295,000)*	**177,000** *(US$59,000)*

Source: Faecal Sludge Management Study, 2011 (Malaysia)

g. Bank financing for the fixed assets of the operation is at 80%, at an interest rate of 8% per annum;
h. Corporate tax rate is imposed on all profits made by the operation. If the profits is below RM500,000, the tax rate is 20%, and if the profits exceed RM500,000 (US$ 166,667), the rate will be 25%
i. FSM is based on the scheduled services to households and commercial and industrial premises. It is assumed that 3 such services can be performed per trip due to planned schedules.
j. There is a need to provide an initial working capital of RM50,000 (US$16,667). For the first one or 2 months, business may be slow and revenue may not be able to fully cover staff salaries and other expenses.

3.12.3 Financial Projections

The projected detailed financial statements are shown in **Appendix 3.12.1.** These financial projections assume a financial plan as shown in **Table 3.12.3.**

Table 3.12.3: Sources of Funds

Funding	RM
Equity Capital	227,000 *(US$75,667)*
Bank Borrowings	708,000 *(US$236,000)*
TOTAL	**935,000** *(US$311,667)*

Source: Faecal Sludge Management Study, 2011 (Malaysia)

In order to complete the financial plan, the project requires an amount of RM 227,000 (US$75,667) in capital from one or more investors and a bank loan of RM708,000 (US$236,000). The resulting initial debt-to-equity ratio is expected to be at 3:1. The following is an analysis of the Financial Statement from the model study.

Income Statement

The income statement shows the record of the profitability of the project. A brief of the projected income statement and some important profitability ratios for the project are given in **Table 3.12.4.**

Table 3.12.4: Projected Income Statement Summary

Year	1	2	3	4	5
Revenue (RM'000)	1,043.3 *(US$347.8)*	1,117.8 *(US$372.6)*	1,192.3 *(US$397.4)*	1,279.3 *(US$426.4)*	1,366.2 *(US$455.4)*
Operating Expenses (RM'000)	781.2 *(US$ 260.4)*	835.2 *(US$278.4)*	890.8 *(US$296.9)*	952.6 *(US$317.5)*	1,015.9 *(US$338.6)*
Depreciation (RM'000)	177.0 *(US$59.0)*	177.0 *(US$59.0)*	177.0 *(US$59.0)*	177.0 *(US$59.0*)	177.0 *(US$59.0)*
Interest Payment (RM'000)	52.3 *(US$17.4)*	42.3 *(US$14.1)*	31.6 *(US$10.5)*	19.9 *(US$6.6)*	7.2 *(US$2.4)*
Profit after Tax (RM'000)	**26.3** *(US$8.8)*	**50.6** *(US$ 16.9)*	**74.4** *(US$ 24.8)*	**103.8** *(US$ 43.6)*	**132.8** *(US$ 44.3)*
Earnings per Share (RM)	0.12 *(US$ 0.04)*	0.22 *(US$ 0.07)*	0.33 *(US$ 0.11)*	0.46 *(US$ 0.15)*	0.58 *(US$ 0.19)*
Breakeven on Income (RM)	616,218 *(US$205,406)*	656,725 *(US$218,908)*	699,414 (*US$233,138)*	744,395 *(US$248,13)*	791,787 *(US$263,929)*
Breakeven on Emptying Fee (RM)	136 *(US$ 45)*	135 *(US$ 45)*	135 *(US$ 45)*	134 *(US$ 45)*	133 *(US$ 45)*
Breakeven on Trips/Day	1.0	1.1	1.1	1.2	1.3
Proposed Trips/day (no.)	2.016	2.160	2.304	2.472	2.640
Margin of Safety (%)	41	41	41	42	42

Source: Faecal Sludge Management Study, 2011 (Malaysia)

The projected results show the proposed project would make a profit from the first year of operation. It is expected the project will achieve RM1,043,300 (US$347,767) in revenue and a profit after tax of RM26,300 (US$8,767) in the first full year of operation. The revenue is expected to reach RM1.366 million (US$0.46 million) on the fifth year with an after tax profit of RM132,800 (US$44,267). Under current tax regulations the project is expected to pay the tax rate of 20% on all taxable income

Breakeven Analysis

The project is forecasted to have healthy results over the projected period of five years and is expected to make accounting breakeven averaging 58.6% of revenue. The margin of safety is high, at an average of over 41%, within the projected period. Breakeven on emptying fees range from RM136 to RM133 (US$44 to US$45) over the projected period, while the breakeven on trip averaged about 1.16 trips per day.

Cash Flow Statement

Cash flow is essentially a movement of money into and out of the project, and it is used often to determine the solvency of the project. A summary of the projected cash flow statement and some important ratios for the proposed project are given in **Table 3.12.5.**

Table 3.12.5: Projected Cash Flow Summary

Year	1	2	3	4	5
Accumulated Cash Balance (RM'000)	139.8 *(US$46.6)*	243. *(US$81.2)*	360.2 *(US$120.7)*	496.0 *(US$165.3)*	648.0 *(US$216.0)*
Debt Coverage Ratio (times)	1.48	1.57	1.64	1.75	1.84
After Tax IRR over 5 years	18%				
NPV @ 8% discount rate	RM 247,770 *(US$ 82,590)*				

Source: Faecal Sludge Management Study, 2011 (Malaysia)

Liquidity Status

The project's liquidity appears to be satisfactory throughout the projection period. This liquidity will allow for the continued operation of the proposed project without much hindrance. The IRR over a 5-year period at 18% is good, and indicates the proposed project is financially viable. The NPV at 8% discount rate of RM247,770 further testifies to the viability of the proposed project.

Cash Accumulation

The positive cash flow position throughout the projected period also indicates that the project is financially sustainable. The project also has a cash accumulation of RM648,000 (US$216,000) at the end of Year 5.

Debt Coverage

The debt coverage is adequate from year 1 onwards with a ratio averaging 1.6 times. This indicates that the project is generating sufficient cash flow to repay all its debts, both principal and interest, within the stipulated period.

Balance Sheet Statement

The balance sheet tells the worth of the project. A summary of the projected balance sheet for the project and some relevant financial ratios are shown in **Table 3.12.6.**

Table 3.12.6: Projected Balance Sheet Summary

Year	1	2	3	4	5
Net Term Loan (RM'000)	588.0 *(US$196.0)*	458.1 *(US$(152.7)*	317.4 *(US$105.8)*	165.0 *(US$55.0)*	-
Net Worth (RM'000)	253.3 *(US$84.4)*	303.8 *(US$101.3)*	378.2 *(US$126.1)*	482.0 *(US$160.7)*	614.8 *(US$204.9)*
NTA per Share (RM)	1.12 *(US$0.37)*	1.34 *(US$0.45)*	1.67 *(US$0.56)*	1.75 *(US$0.58)*	1.84 *(US$0.61)*
Debt/Equity Ratio (times)	2.32	1.51	0.84	0.34	-
Return on Equity (%)	10	17	20	22	22

Source: Faecal Sludge Management Study, 2011 (Malaysia)

Borrowings and Debts

The project's net term debt stood at RM588,000 (US$196,000) in Year 1, but reduced to RM165,000 (US$55,000) at the end of Year 4. The annual debt service is RM172,268 (US$57,423) per year with no grace period proposed on principal loan repayment. The debt to equity ratios remain within acceptable limits and improve over the projected period, also due to the annual repayment of the principal loan amount.

Net Worth, Equity and Return on Equity

The net worth of the project increased from Year1 onwards due to the accumulation of the projected profits. It peaked in Year 5 with its worth at RM614,800 (US$204,933), more than 2.7 times the original contribution of RM227,000 (US$75,667) from equity shareholders. The projected average return on equity is 18% for the five-year period.

3.12.4 Sensitivity Analysis

A Financial Sensitivity Analysis was carried on the projected performance of the proposed project. The following variables were tested.

a. Decrease in total revenue by 5%
b. Increase in operating costs of the company by 5%
c. Increase in the price of fuel by 50%

The results of these variations on the company's financial profitability are summarized in **Table 3.12.7** below.

Table 3.12.7: Financial Sensitivity Analysis of Medium-size Operator

Sensitivity Analysis	After Tax IRR
Base Case	18%
Decrease in Total Revenue by 5%	10%
Increase in Operating Costs by 5%	12%
Increase in Fuel Price by 50%	15%

Source: Faecal Sludge Management Study, 2011 (Malaysia)

The financial sensitivity analysis indicates that the parameters tested are sensitive, especially in a decrease of total revenue by a 5% margin, with a reduction in the rate of return to 10% from the base case of 18%.The IRR estimate for the proposed project is, however, still sound, and remains acceptable under the three tested scenarios.

3.12.5 Risk Analysis

Itemised below are the risk profile of the proposed Geo-Tube project for the emptying and transportation of faecal sludge in the Melaka area.

Issues	Risk Statement
Fuel price increase	Very likely with oil analysts predicting crude oil price reaching US$100 and above, an oil price increase could affect operational costs. In addition, in Malaysia, fuel is currently heavily subsidized by the Malaysian Government who has been gradually phasing out this subsidy. Reductions in subsidy would expose the business to rising fuel costs. This risk factor, however, is found to be not significant as shown by the Sensitivity Analysis performed.
Scheduled services	The business model is premised on scheduled services to ensure positive revenue inflows. The possibility of reverting to non-scheduled services is a risk as the present legislation has advocated non-scheduled services as a norm. If this happens, the risk is quite considerable because then it would not be possible for the business to achieve a minimum of 3 emptying services per trip and be profitable.
Centrally connected system	The market is anticipated to be relatively static in the long term especially now that all the new housing schemes in the country are moving towards the centrally connected system. Added demand for desludging

	services is likely to be derived mostly from existing IST and pour flush systems. However, this risk does not appear to be critical because at this point in time, it is estimated that demand for services exceed supply. The existing providers are only able to empty 40% of the projected sludge generated in the country which means there is room to expand till demand meets supply.
Change in legislation detrimental to the industry	Changes in legislation and regulations governing the industry often create uncertainties. The industry is being regulated and unclear guidelines cause operators to be wary in the conduct of business. Uncertainties discourage investment and expansion. New laws could change the nature of the services; it could create undue competition, emptying fees, and payment schedule. This risk is more difficult to factor into the business and often, business operators have to wait to see how it works out and how they could be impacted upon.
IWK to continue to dominate the business	IWK presently dominates the business in the presence of its concession agreement with the government. The new legislation appears to change this, allowing for more competition, but it has yet to be fully implemented. Full control continues to be vested in IWK which, as a government-linked company (GLC), mitigates its dominant position by sub-contracting to small and medium-sized operators in the desludging business. However, as a GLC, IWK company structure could change if the government decides to divest or new investors took control of IWK. Added with the unpredicted changes in legislation and regulations, such uncertainties could impact negatively on its sub-contractors who may find the business environment too risky to operate. .

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4. CONCLUSION

For the Malaysian case study, the financial analysis was carried out for both an existing medium-size and large-size emptying private operations in Peninsular Malaysia. There was no small scale emptying operation in the 3 cities reviewed. The financial statements of the two operators formed the basis for the initial analysis.

The model analysis was further extended to include a five-year financial projection for each of the operators. The objective of these analyses was to evaluate and determine a possible scale of operation that is both manageable and realistic for the private sector sludge emptying to continue operating in the urban areas, given possible and available financial and other resources.

Results of the model analysis for the medium-size operation, which operates 3 trucks, showed that its projected financial results were not viable to support its continual operations over the next five years. The large-size operation, on the other hand, was found to be financially viable when its operation was extended over the next five years as it has 14 trucks to service a wider area. The results show that in the Malaysian context, the large-scale operator has the distinct advantage of being able to empty a higher volume of sludge and thereby, caters to a larger market. This is aided in part by the latter having a revenue source from servicing government premises which is currently not available to the medium-sized operator.

Whilst it is observed that large-scale operations were financially viable, they also entail higher resource commitments, both in terms of investments, and human resources, all of which are not always and easily available in developing countries. It was thought that a medium-size operation would have been a better model but such an operation faces financial and technical constraints to do more business.

A major difference between the medium-size and large-size operations is the number of trucks they operate. In the Malaysian situation, the high cost of the emptying trucks is a major capital investment for all operators but affects more the medium-size sludge emptying operators. It is understood that in order to protect the local trucks assembly industry, an imported emptying truck would have to bear the following taxes: (a) 125% excise duty, (b) 30% import duty, and (c) 10% sales tax. In addition, an Approved Permit (the cost of which is said to be substantial), is required for the import of such trucks. All these add to the costs of the locally assembled trucks, and when these are factored into the financials of the business operators, they constitute a hefty amount that makes the sludge emptying business less lucrative than it could be. Preliminary financial analysis showed that a reduction in the cost of such vehicles would have positive impact on the viability of desludging business.

A model that incorporated the Geo-Tube extension was proposed to reduce a major technical constraint caused by large travel distances. The adaptation of the Geo-tube system in the business model is intended to cut down on the distance each truck has

to travel for their emptying services, enabling them to cater to more customers and thereby, increasing the volume of sludge to be emptied, and in turn, would help to reduce operating costs. This model was applied to the medium-size emptying service and a financial analysis was carried out to determine its feasibility as a possible business model. Results from the model analyses were most encouraging and demonstrated that incorporating the Geo-tube extension into the “standard” model is a key determinant in improving the financial viability of the desludging business.

The above business model is premised on some assumptions of which a key one is that services are to be scheduled. This is aimed at ensuring regular and positive revenue inflows. Without it, it would not be possible for a business to achieve at least minimum number of emptying services (determined to be 3 HH/trip) for it to conduct a viable business. Analysis of past performances of existing service providers, pre- and post-WSIA, clearly indicated that a responsive approach to the provision of desludging services is not desirable. Strict enforcement of the requirement for desludging on house owners, as provided under existing law, may be an alternative, but past experiences show that this is not likely to be achieved as enforcement is often difficult due to a lack of personnel and the tedious legal procedures that have to be followed. The household survey also showed that public awareness on the need for desludging at prescribed intervals is low, as the issue of maintenance of the IST or PF is of little concern unless it causes a problem, such as blockage of the toilet system in the premise.

In addition to the above study findings, it has been shown that another critical factor influencing the financial viability of the business model is the tariff of RM230 (US$76.70) per standard emptying. As demonstrated by the sensitivity analysis performed earlier, a drop of 5% in tariff would unfavourably affect the financial viability of the FSM business, as observed from the drop in After Tax IRR. In this regards, the tariff that is to be set has to be realistic and based on sound assumptions of costs that determine its value. The present tariff for sludge extraction, transportation and disposal may be marginally above breakeven cost for the services and may require to be reviewed if no other adjustments are to be made to other cost elements. This and other matters require appropriate attention by the authorities to ensure that the FSM services business remains attractive to private entrepreneurs, especially small and medium-size operators.

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