Fecal Sludge Management: Diagnostics for Service Delivery in Urban Areas

Report of a FSM study in Hawassa, Ethiopia

Rebecca Scott, Ian Ross and Peter Hawkins

Supporting document

Final

April 2016

WORLD BANK GROUP
Water

wsp
water and
sanitation program


WORLD BANK GROUP
Water


wsp
water and
sanitation program

Preface / Acknowledgements

This report is a city case study of a World Bank Economic and Sector Work on *Fecal Sludge Management: Diagnostics for Service Delivery in Urban Areas* (P146128). The task team leaders were Isabel Blackett and Peter Hawkins and task team members were Zael Sanz Uriarte, Ravikumar Joseph, Chris Heymans and Guy Hutton.

This report is based on work conducted between January 2014 and February 2016 by Oxford Policy Management (OPM) in partnership with the Water, Engineering and Development Centre (WEDC) at Loughborough University. The core research team was Ian Ross (OPM), Rebecca Scott (WEDC), Ana Mujica (OPM) and Mike Smith (WEDC). The broader team who contributed to the study included Zach White, Rashid Zaman and Simon Brook from OPM, as well as Andy Cotton and Sam Kayaga from WEDC. Andy Peal (independent consultant) also contributed to certain aspects of the methodology.

The inputs of many other World Bank staff, consultants and data collection firms are acknowledged with thanks from the task team. They have contributed to the research, findings, analysis and reviews but are too numerous to mention.

Executive summary

Introduction

This report summarizes the main findings of a case study on fecal sludge management in Hawassa, Ethiopia. It is part of the project entitled 'Fecal Sludge Management: Diagnostics for Service Delivery in Poor Urban Areas', funded by the World Bank Water and Sanitation Program (WSP). There are five city case studies as part of this project (Balikpapan, Dhaka, Hawassa, Lima and Santa Cruz). The specific objectives of the Hawassa study were:

- To provide quantitative and qualitative data on the sanitation situation in Hawassa from a socio-economic perspective, specifically as it relates to FSM;
- To do the above in such a way that the data is representative of the city as a whole but also providing a separate picture of the situation in low-income areas, primarily through qualitative means in the Hawassa case;
- To provide initial recommendations to guide discussions around future interventions in the sanitation sector in Hawassa, by contributing credible data and analysis; and
- To inform the development of analytical tools and guidelines, by "road-testing" draft tools using primary data collection.

Methodology

The study followed an overall research framework developed as part of the inception period, which set out research questions and sub-questions. Data collection instruments were then developed so as to answer these questions. Four data collection instruments were used in Hawassa, two quantitative and two qualitative. The quantitative instruments were a household survey and transect walks. The qualitative instruments were key informant interviews and focus group discussions.

The study team led on methodology design and data analysis, while data collection was undertaken by separately-contracted consultants under the leadership of WSP. All data collection was undertaken by JaRco Consulting based in Addis Ababa, with the exception of key informant interviews which were undertaken by World Bank short-term consultants.

The household survey primarily aimed to collect data from households regarding their current use of fecal sludge management (FSM) services and preferences for future FSM services. The sampling allowed conclusions to be drawn about the city as a whole on a representative basis. The transect walks enabled a subjective and qualitative assessment of physical and environmental conditions within a community. The key informant interviews aimed to address key questions about how both the 'enabling environment' and the operating environment affects FSM services (past, current and future). Finally, the focus group discussions with residents of informal settlements aimed to gather qualitative data that would complement, validate, or challenge conclusions drawn from the household survey data.

Sampling for quantitative instruments was derived from the sampling for the household survey, for which there were two sub-samples. For sub-sample A, the Primary Sampling Units (PSUs) were *menders* ('villages'), with initial stratification by "sub-city" according to their population to ensure relatively broad geographical coverage. Sub-cities are the primary administrative division within the city, with *kebeles* below them and *menders* the smallest unit. There are population data for sub-

cities and kebeles based on the last census, but no population data for menders. A list of the 162 menders was collected from all the 20 kebeles. For sub-sample B, the PSUs were also menders, but they were purposively selected from using secondary data and expert opinion (of a WASH consultant based in Hawassa) of where the poorest areas are. The same list of 162 menders was used for selection, with no duplication. However, during data analysis it became clear that there were problems with the way the local survey firm had undertaken sampling, data collection and data entry for sub-sample B. This rendered the data from sub-sample B unreliable and therefore it has not been used in this report. The Secondary Sampling Units (SSUs) were households in both cases.

Analyzed results were presented to key stakeholders, representing the city administration, regional water bureau, federal ministries and the World Bank WSP in Ethiopia, during validation meetings in November 2015. These provided an opportunity for discussion around key findings and comments to inform completion of this report.

Results

The table below summarizes some key sanitation indicators from the household survey:

Indicator	%age of households
Use of improved sanitation	
Households using improved sanitation, excluding 'shared improved'	32%
Households using improved sanitation, including 'shared improved'	81%
Type of containment	
Households using a toilet discharging to a lined pit	41%
Households using a toilet discharging to an unlined pit	20%
Households using a toilet discharging to a fully lined septic tank with no outlet to on-site infiltration (i.e. a sealed tank)	16%
Households using a toilet discharging to a partially lined or unlined septic tank with no outlet to on-site infiltration (i.e. effectively a soakpit)	18%
Households using a toilet discharging to a septic tank with an outlet to on-site infiltration such as a soakpit	4%
Households using a toilet discharging directly or indirectly to a drain or ditch	0%
Households using a toilet discharging to a septic tank or pit which has never filled up / needed emptying	92%
Emptying	
Households who experienced a pit/tank filling up, who emptied that pit/tank and then reused it	31%
Households who experienced a pit/tank filling up, who covered the pit and used an alternative	64%
Households who emptied their pit/tank who used a formal provider (private company or municipal service)	57%

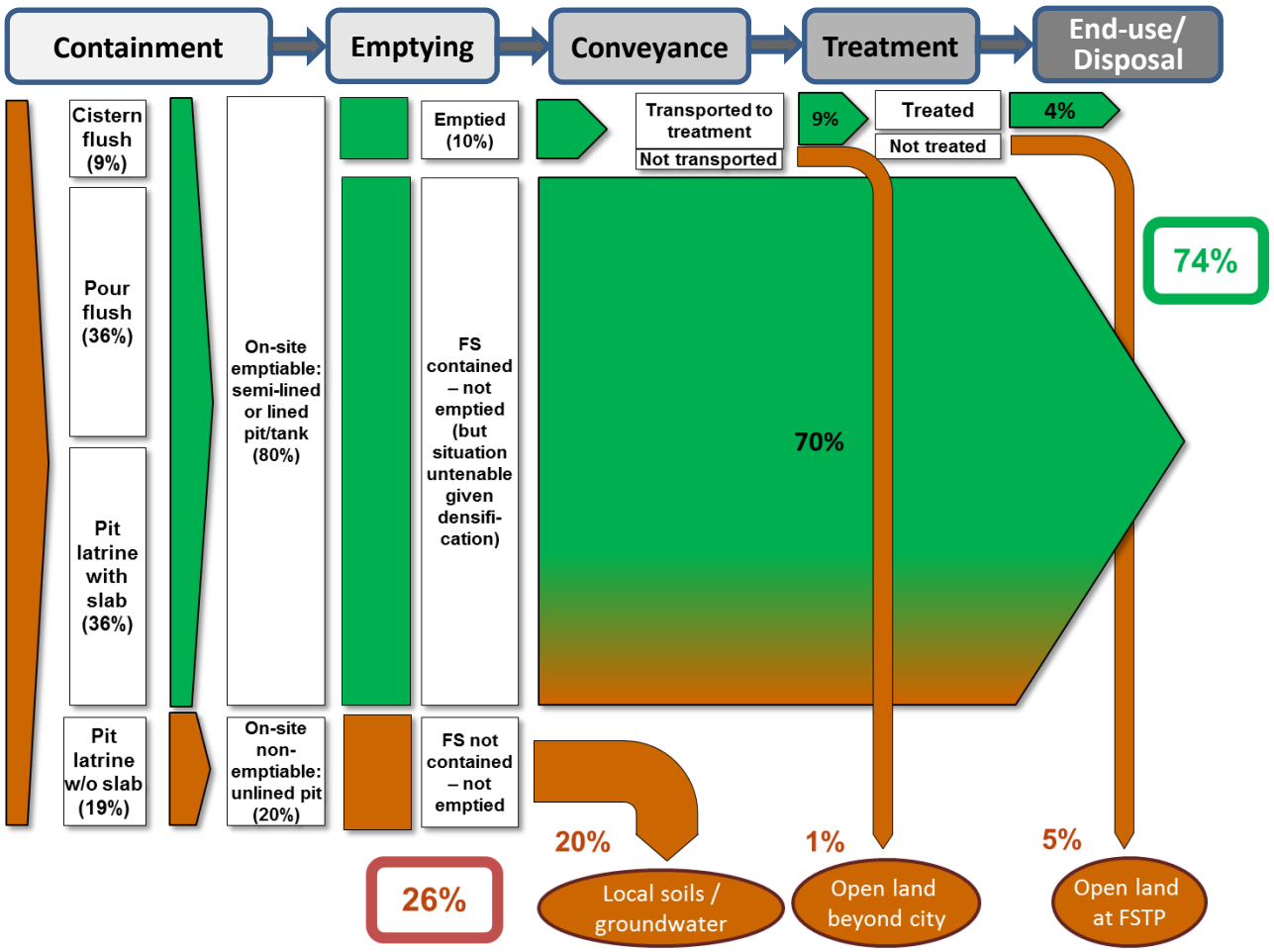
These key data are incorporated into the fecal waste flow diagram shown below. This shows that, while there is effective access to at least some form of on-site sanitation facility throughout the city (resulting in no reported open defecation through the household survey and limited evidence through other data collection tools), not all fecal waste is being effectively managed through the later stages of the FSM service chain.

The highly permeable volcanic soils underlying Hawassa facilitate the infiltration of leachate from pits and soakaways, resulting in the great majority of tanks and pits operating for many years

without the need to be emptied. Only about 10% of households in Hawassa reported having ever had their pit or tank emptied. However, it also means that there is an increasing pollution load reaching the lake which is one of the city's main attractions.

Of greater significance in terms of current FSM needs is where households in less formal areas are abandoning or covering pits once they are no longer in use (due to being full, or perhaps collapsed, or no longer accessible for another reason). In such cases, households resort to finding or constructing alternative facilities – but given reported concerns about the space to continue to do this becoming increasingly scarce as the city urbanizes, eventually this option will become non-viable and emptying will be required. A further challenge faces the city as it becomes more densely populated. The soil's absorption capacity will eventually be exceeded, putting the (little-used as highly contaminated with natural fluoride) local groundwater sources and Lake Hawassa at greater risk of contamination. These foreseen risks are indicated in the fecal waste flow diagram by the brown shading of the large green arrow representing pits that are abandoned and covered over. As Hawassa is growing and developing very fast, action will be required sooner rather than later to improve fecal sludge management. The diagram indicates the need for the city administration to identify priority areas for the introduction of sewerage options, while improving sanitation and FSM services more generally.

Fecal waste flow diagram for Hawassa city



The Service Delivery Assessment developed from the study shows that, in general, Hawassa's FSM service context is making progress in relation to the three major components of the assessment: enabling, developing and sustaining services. However, when looking into the details

for each component, this reveals that greater attention has been given to improving the provision and promotion of toilet infrastructure and to some extent the provision of emptying services to support this. Greater weaknesses are identified in relation to the existing treatment facility and the effective disposal of dried fecal sludge, or any actions to develop options for fecal sludge end-use applications. The greater component of 'treatment and disposal' of fecal sludge in-situ (the 70% shown on the diagram, where containment relies on local soils to continually absorb leachate from pits and tanks) may be satisfactory for now, but as areas of the city become more densely populated and soil infiltration capacity is surpassed, increased risks of localized surface ponding of effluent and pit collapse are anticipated. Residents of low-income areas also voiced concerns that the decreasing space to build new pits when current ones become full make this practice increasingly difficult to sustain. Without greater attention given to investing in the future needs of the city, risks to public health will increase. This will be particularly the case in the expanding low-income areas, where concerted efforts will be needed to address issues of inequity and lower service outcomes. To improve FSM services in Hawassa as a whole – and most notably for those vulnerable to poor services and resulting health risks – greater attention needs to be given to investment in a range of services that will meet the requirements of being appropriate, affordable, available and adapted to the needs of all users.

The Prognosis for Change surmises that overall, the market for FSM services is functioning. The few households whose pits fill up are able to get them emptied safely and the fecal sludge is, in general, disposed of at the fecal sludge treatment plant. While only about 10% of households in Hawassa reported having ever emptied a pit or tank, demand for services in Hawassa is likely to increase as the population grows and becomes more dense. Households who have relied on covering, abandoning and replacing full pits are unlikely to be able to do so in the future.

A key implication of the study findings is that the city administration should be planning ahead in much more detail. While the city service delivery assessment shows that basic elements of service delivery are there, important weaknesses in the enabling environment, relating to the planning, expenditure, operation and maintenance and expansion of services, remain. This is a significant challenge and in the medium-term the city administration must ensure households and the city council are involved in and committed to any plans, since they will have implications for standards and servicing of on-site sanitation facilities. In the shorter term, the administration must resolve the issues facing the market for FSM services, which is currently in flux due to price variations within and between public and private sector operators. The private sector can and should play an increasing role in service provision, under strengthened regulation by the city administration. Formalizing their role through licensing, alongside an increase in tariffs, is likely to support this.

The key recommended actions for Hawassa City Administration are therefore:

- Consult households and Hawassa City Council on the development of city-wide sanitation plans, especially where they affect changes to standards affecting containment infrastructure (septic tanks, pits and eventual connection to new sewerage systems);
- Resolve market-based issues for FSM services, through price review and negotiating an increased role for formalized private sector provision with licensing and regulation, alongside an increase in tariffs;
- Identify priority areas for development of sewerage networks – based on likely pollution risks to Lake Hawassa and saturation of soils;
- Address constraints at the existing fecal sludge treatment plant and negotiate land purchase to co-site the eventual construction of a new treatment plant, wastewater treatment plant and solid waste disposal facility.

Table of contents

List of tables and figures

List of abbreviations

CSDA	City Service delivery assessment
ETB	Ethiopian Birr (unit of currency). Exchange rate: 1 ETB = 0.048 USD
FS	Fecal sludge
FSM	Fecal sludge management
Kebele	a "neighborhood": the smallest administrative division, similar to a ward
KII	Key informant interviews
Mender	equivalent to a village: under the administration of a *kebele*
OSS	On-site (non-networked/non-sewered) sanitation facilities
OWNP	One WASH National Program (of Ethiopia)
PEA	Political Economy Analysis
PFC	Prognosis for change
PSU	Primary sampling unit
SSU	Secondary sampling unit
ST	Septic tank
WSE	Water and Sewerage Enterprise (of Hawassa City Administration)

1 Introduction and Research Framework

1.1 About this report

This report summarizes the main findings of a study on fecal sludge management in Hawassa, Ethiopia. It is part of the project entitled 'Fecal Sludge Management: Diagnostics for Service Delivery in Poor Urban Areas', hereinafter "the FSM research project". This work is funded by the Water and Sanitation Program (WSP) of the World Bank. There are five city case studies as part of this project (Balikpapan, Dhaka, Hawassa, Lima and Santa Cruz).

This project is led by Oxford Policy Management (OPM) in partnership with the Water, Engineering and Development Centre (WEDC) at Loughborough University. The full TOR for the project can be provided on request. The overall objective of this assignment is: "to work with the WSP urban sanitation team to develop the methodology, design, develop survey instruments and undertake analysis of data collected from four field case studies (linked to World Bank operations projects), refine the diagnostic tools and develop decision-making tools and guidelines for the development of improved FSM services." The scope includes the need for city-wide fecal sludge (or septage) management services with a focus on poor urban communities.

This document is one of several that make up the deliverables for the FSM research project, and is not a stand-alone report. It does not contain much background information and the assumed audiences are the World Bank team together with others familiar with or interested in the Hawassa city context, including the relevant municipal, regional and federal authorities. The inception report, available on request, contains more background information on the project and the methodology, including the Research Framework.

The report's structure is detailed below. It begins with background to the research and the city, moving into several sections analyzing the overall urban sanitation context, which are not specific to FSM. Thereafter, the report focuses on FSM services and the market in particular.

1.2 Study rationale and objectives

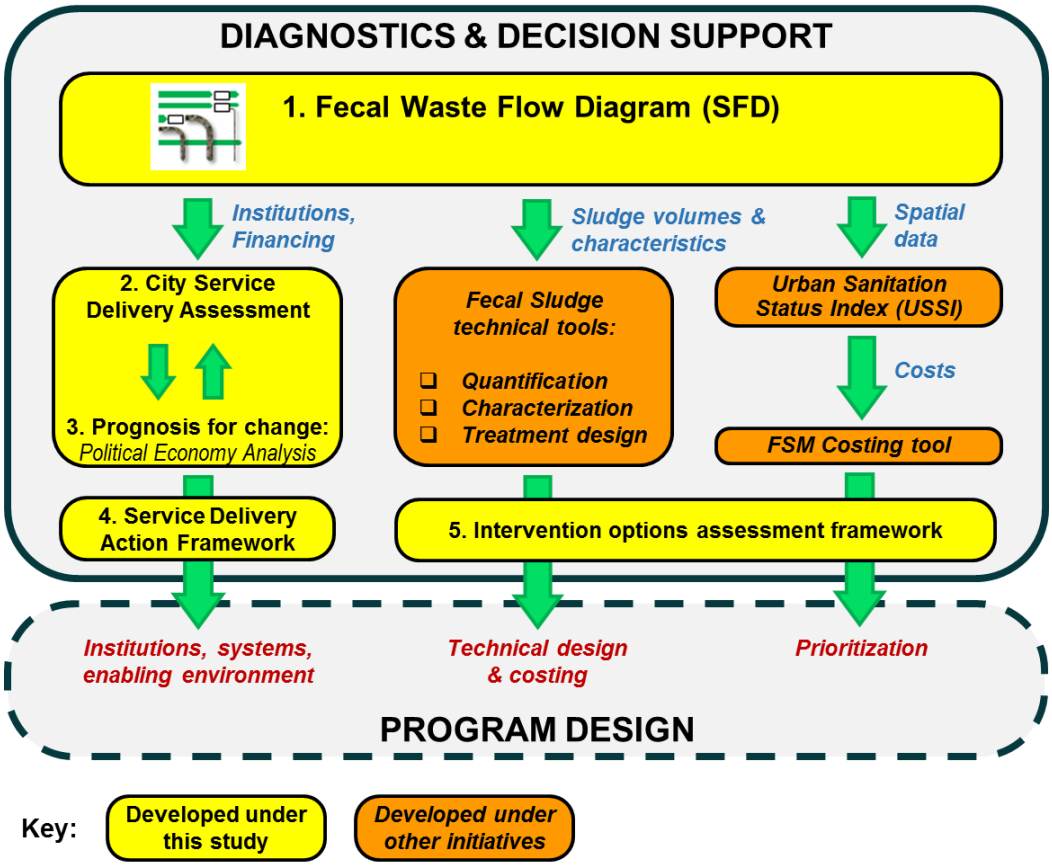
It is common for poor people living in the urban areas of most low-income countries to use on-site sanitation facilities, or to defecate in the open. Even when improved on-site options are used to contain excreta, in many cities there exist limited formal services for collection, transport and disposal or treatment of the resulting fecal sludge. Few instances of resource recovery through processing fecal sludge exist. The service delivery gaps within and between the stages of the sanitation service chain become more apparent as urban sanitation access increases. Failure to ensure strong links throughout the fecal sludge management (FSM) service chain results in untreated fecal sludge (FS) contaminating the environment, with serious implications for human health.

Despite this, there are few tools and guidelines to help city planners navigate complex FSM situations, despite increasing demand. This study builds on existing frameworks and diagnostic tools, in particular the City Service Delivery Assessment scorecard, Fecal Waste Flow Diagram, and the Economics of Sanitation Initiative toolkit – as indicated in Figure 1. The diagnostic and decision-support tools are themselves based on tried-and-tested strategic planning approaches and frameworks, with a focus on practicality, while the overall study aimed to update and develop a wider range of tools and guidelines based on the results of five case study cities. In most of the study cities, this has been supported by interaction with city stakeholders involved in ongoing

World Bank funding. Acknowledging the difficulty of reforming FSM services in cities, the political economy dimensions of FSM are explicitly included as part of the overall analysis.

How the full set of diagnostic and decision-support tools and program design guidelines fit together is represented in the following diagram, which is fully explained in accompanying study documents available on request.

Figure 1 **Diagram of how the tools fit together**



The specific objectives of the Hawassa city case study are:

- To provide quantitative and qualitative data on the sanitation situation in Hawassa, from a socio-economic perspective, specifically as they relate to FSM;
- To do the above in such a way that the data is representative of the city as a whole but also providing a separate picture of the situation in low-income areas, primarily through qualitative means in the Hawassa case;
- To provide initial recommendations to guide discussions around future interventions in the sanitation sector in Hawassa, by contributing credible data and analysis; and
- To inform the development of analytical tools and guidelines more broadly, by “road-testing” draft tools using primary data collection.

The Hawassa case study was primarily socio-economic rather than technical. It did not aim to carry out technical inspections of infrastructure or produce detailed maps with neighborhood-level analysis and recommendations. For those who have worked on sanitation in Hawassa for some time, there may be few surprises, but the report does offer representative data to back up what has previously been reported in smaller or more general studies.

1.3 Research framework

During the inception stage, the OPM/WEDC team developed a Research Framework (RF), based on the overarching research questions implicit in the TOR and draft research protocol. From these questions, a logical set of project components were developed, and data collection instruments devised that would help in the collection of data for the indicators making up each component. The approach taken in the research is to place all components – as well as ensuing results – of the study, within the context of the FSM service chain, to optimize its relevance and effectiveness. This is clear from the full version of the RF in the inception report, with all components and questions arranged along the service chain.

The initial structure of components from the inception report is reflected in Table 1 below. The study methodology used for the Hawassa city study is described in the next section.

Table 1 FSM project components

	Assessment	Objective		Component
1	Service delivery assessment	To understand the status of service delivery building blocks, and the political economy of FSM services overall	1a	CSDA scorecard
			1b	Stakeholder analysis
2	FS situation assessment	To understand current FS management patterns and future scenarios	2a	Fecal Waste Flow Diagram
			2b	FS characteristics and end-use potential
			2c	Public health risk analysis
3	Existing demand and supply assessment	To understand customer demand for FSM services and the current status of service providers	3a	Demand - mapping customer demand and preferences
			3b	Supply - mapping service provider supply and capacity
4	Intervention assessment	To identify a hierarchy of FSM intervention options and models for implementing and financing them	4a	Intervention options
			4b	Implementation and financing models
5	Appraisal	To appraise different interventions against the "business as usual" scenario	5a	Economic appraisal of intervention options

1.4 Report structure

This report is sub-divided into three groups of chapters. The initial chapters describe the city background and methodology. There are three chapters which address the urban sanitation context without a specific focus on FSM. The rest of the report considers FSM services and service delivery.

- Background
  - Section 2 summarizes the study methodology
  - Section 3 provides background to Hawassa
- Urban sanitation context
  - Section 4 shows a Fecal Waste Flow Diagram
  - Section 5 discussed aspects of Public Health Risk
- Analysis of FSM services
  - Section 6 contains the potential FSM service demand and supply assessment
  - Section 7 discusses the current treatment of fecal sludge and possible re-use options
  - Section 8 contains a City Service Delivery Assessment
  - Section 9 provides the Prognosis for Change of the current situation

- Section 10 proposes Intervention Options relating to service delivery options and an Action Framework in relation to the enabling environment for FSM development
- Section 11 concludes

2 Methodology

2.1 Overall design

A key component of the case study was primary data collection. The study was intended to have six different data collection instruments, four quantitative and two qualitative, each of which contribute to various project components shown in Table 1 above.

However, in reality two of the data collection instruments (observation of service provider practices, and testing fecal sludge characteristics) did not take place during the data collection period, as explained further below. In addition, while samples of drinking water were taken and analyzed during the Transect Walks, samples of drain water were not taken, because the drains were dry during the period of data collection (see limitations in Section 2.4). The full set of instruments is summarized in Table 2 below, showing *those that were not conducted in italics*.

Table 2 Summary table of data collection instruments

	Instrument	Data source	n per city
Quantitative	1. Household survey	Survey of households across the city[1]	360
	2. Observation of service provider practices	*Observation of containment, collection, transport/disposal and treatment/disposal*	*Not conducted (see below)*
	3. Testing fecal sludge characteristics	*Samples from (i) pits/tanks during emptying, (ii) truck/vessel outflow, (iii) final drying bed or outflow*	*Not conducted (see below)*
	4. Transect walk	Observation of environmental and public health risks through transect walk Drinking water supply samples, tested for fecal contamination and chlorine residual *Drain water samples, tested for fecal contamination*	40 (= 30+10) 57 (= 30+27) [2] *Not conducted (see below)*
Qualitative	5. Key informant interviews	(a) government (e.g. council / utility, ministries) (b) service providers along the sanitation chain (c) other key FSM agencies	As required
	6. Focus group discussions (FGDs)	FGDs with slum, low-income and informal communities	10

The OPM/WEDC team lead on methodology and analysis, while data collection was managed by two types of consultants contracted separately. A local firm JaRco was contracted by WSP to conduct primary data collection for most of the above instruments, with short-term consultants (Harold Esseku and Mesfin Getachew) contracted to conduct the Key Informant Interviews and produce the City Service Delivery Assessment (CSDA) and Political Economy Analysis (PEA) report.

[1] In other city case studies, surveying was also undertake in a separate purposive sub-sample only in low-income areas. In Hawassa, problems in sampling and data collection mean this data cannot be used with confidence. Further explanation is given below.
[2] A water supply in one PSU was not available during the study period, so no samples were taken.

Detailed research protocols for the instruments in the table above are available in a separate instruments report, available on request. This section briefly summarizes each instrument, and the following section describes the sampling approach.

Household survey: The household survey aimed to collect data from and about households using on-site sanitation regarding their use of FSM services and preferences for future FSM services. The household survey informs multiple components of this research. The sampling was carefully planned so as to allow conclusions to be drawn about the city as a whole on a representative basis. Questionnaire sections included household members and characteristics, use of water and sanitation infrastructure, usability and observation of latrines, satisfaction and planning on sanitation, filling up and emptying, and last time emptying.

Transect walk: The transect walk enabled participants to make a subjective and qualitative assessment of physical and environmental conditions within a community. During the walk, participants make systematic observations, discuss their observations and record their findings using a standard reporting format. The information collected complements information collected from household questionnaires, observations, and sample collection and analysis. For this study, a transect walk provides information about the broad environmental risks to public health, in particular with respect to the presence of fecal material and solid waste, and the likelihood that these enter drainage channels and water sources. When all observations are complete, participants ask community members a few short questions to gain information about typical behaviors in the community that could be a source of risk (people defecating in the open or throwing feces out with solid waste, uncontrolled latrine emptying or dumping of fecal sludge, etc.) and the frequency of those behaviors throughout the year (daily, weekly, seasonal, etc.). These walks were designed to give an overall picture of conditions in a neighborhood, with the aim of this being built into a city-wide picture. They did not aim to allow detailed maps to be drawn with FS flows to be physically tracked, nor did they aim to make operational recommendations at the neighborhood level. Further discussion of this issue is in Section 5.

Testing water supply quality: During transect walks, samples of drinking water supplies were taken from a selection of PSUs in the city and tested for levels of *E. coli.* The results can help to identify the extent to which there is an association between poor FSM services and resulting levels of fecal contamination in the local environment (i.e. in water supplies). This information, together with results from transect walk observations, reported behaviors and practices associated with sanitation in the community and other data sources, helps build up a picture of the public health risks from poor FSM services, also with contamination levels (hazard), exposure and vulnerability.

Key informant interviews (KIIs): Key informant interviews (KIIs) are the way in which primary information was sought to address key questions about how both the ‘enabling environment’ and the operating environment affects FSM services (past, current and future). KIIs were held with stakeholders having responsibility or interest in FSM services at city-level and beyond, allowing the enabling and operating environments to be better understood in relation to their influence in the city.

Focus group discussions (FGDs): The objective of Focus Group Discussions (FGDs) with residents of low-income areas was to gather qualitative data that would complement, validate, or perhaps challenge responses made during the household survey. Questions focused on obtaining information relating to household sanitation and FSM practices (particularly identifying the practices of “others” as individuals are reluctant to talk honestly about their own, or their family’s, practices), service levels, past interventions, risks and other issues associated with FSM services that affect their community.

Instruments not applied

Observation of service provider practices: This method aimed at making visual inspections about fecal sludge (FS) handling from pits or tanks to final disposal, in particular watching service providers go about their business. It required the identification of hazards, hazardous events and an assessment of possible risks at each stage (containment, emptying, conveyance, treatment and end-use or disposal) of the fecal sludge management chain.

The survey firm JaRco advised that, despite making several attempts to observe public or private service providers of emptying services, no household latrines or communal latrine blocks within the defined study boundary requested emptying services during the data collection period, although a number of institutions, hotels and public toilet blocks were using emptying services. With the study focusing on household-level FSM services, the practices associated with public and institutional facilities were not of direct interest to this aspect of the study.

Testing FS characteristics: Assessment of the characteristics was intended to take place at three stages of handling: (i) during removal, as this would influence the removal methods that could be used, (ii) after removal, as this would influence how the fecal sludge can be transported and treated, and possible resource recovery options, and (iii) after treatment, as this would determine the resource value of the end product derived from the fecal sludge. For the same reasons as given above in relation to observation of service provider practices, no samples were taken during the data collection period. In addition, JaRco were unable to find laboratories able to carry out the required tests for FS characteristics.

2.2 Sampling

2.2.1 Sampling for the household survey

In the sampling, the aim was to give a representative understanding of the city-wide situation.

The sampling frame for the household survey contains all urban areas within the boundaries Hawassa city. These boundaries were defined by the boundaries of the 7 sub-cities making up the main body of Hawassa.[3]

Originally, there were two sub-sample areas (denoted A and B). Sub-sample A is representative of the city as a whole, while sub-sample B focused on poor urban areas (identified as the 30 Primary Sampling Units, or PSUs, which are the lowest-income *menders*[4] in Hawassa) without any attempt to be statistically representative. However, during data analysis it became clear that there were problems with the way the local survey firm had undertaken sampling, data collection and data entry for sub-sample B. This rendered the data unreliable and therefore it has not been used in this report.[5] Explanation of sampling for sub-sample B is left in this section to give an idea of the objectives.

[3] One additional sub-city about 20km from Hawassa, separated by several rural *kebeles*, was excluded.
[4] A *mender* is equivalent to a village, which comes under the administration of a *kebele*. A *kebele* is the smallest administrative unit in Ethiopia, equivalent to a "ward" or neighbourhood
[5] The initial datasets received from the survey firm were not cleaned properly and had an uneven number of HHs per PSU and sub-sample. Furthermore the GPS coordinates for both sub-samples were not within the sample frame. The issue of the uneven number of HHs was due to manual error in recording the HH number and was subsequently corrected by the survey firm. The issue with the coordinates was due to multiple GPS coordinate formats being used and formats being recorded incorrectly; these were corrected by assumption but not to the extent whereby the coordinates could be used to validate sub-sample fidelity.

The aim of sub-sample A was to get city-representative estimates at minimum cost and minimum administrative burden. Therefore, it has a relatively small sample size, for example compared to what would be necessary for studies with different objectives (e.g. an evaluation aiming to attribute impact to an intervention).

Sub-samples and sampling units

- For sub-sample A, the Primary Sampling Units (PSUs) were *menders* ('villages'), with initial stratification by "sub-city" according to their population to ensure relatively broad geographical coverage. Sub-cities are the primary administrative division within the city, with kebeles below them and menders the smallest unit. There are population data for sub-cities and kebeles based on the last census, but no population data for menders. A list of the 162 menders was collected from all the 20 kebeles.

- For sub-sample B, the PSUs were also mender, but they were purposively selected from using secondary data and expert opinion (of a WASH consultant based in Hawassa) of where the poorest areas are. The same list of 162 menders was used for selection, with no duplication.

- The Secondary Sampling Units (SSUs) were households, in both cases.

Sample sizes

To estimate the sample size for sub-sample A, the statistical software EpiInfo was used. The sample size needed to generate city-representative estimates which, with a confidence level of 90%, was predicted to be 360 households, given other variables in the power calculation.[6] Surveys placing a premium on representativeness would aim for 95% confidence, but it was decided that 90% was enough to give us a good idea of FSM services used in the city. It was decided to use the same sample size for sub-sample B, for ease of comparison and understanding. The power calculation would be identical for sub-sample B, but since the sampling is purposive rather than random, there is no specific level of confidence. The total number of households surveyed across both sub-samples was therefore 720.

Sampling methodology

Sub-sample A – city-wide

Firstly any menders which are outside our sampling frame are excluded. For this survey, that was all the mender in Tulla 'sub-city' 20km from Hawassa and separated by rural kebeles, since these menders are effectively a separate conurbation.[7]

PSUs were allocated to each sub-city according to population. This stratification process was carried out by first rounding to one decimal place, and then again to an integer.[8] This creates PSUs of roughly equal size in terms of population. A random sample was taken from these PSUs using the statistical software package Stata; 'seeds' were used to avoid systematically selecting menders in sub-cities in the same order.

[6] This is based on an expected frequency of an average of 80% using non-networked sanitation (across all cities in the study), a design effect of 2, a PSU/cluster size of 12, a total number of 30 PSUs, and a margin of error of 5%. For the city-wide sample, our indicator of interest is the proportion of households using on-site sanitation (OSS), which for Hawassa was found to be 100%.

[7] In other cities (e.g. Dhaka) whole PSUs were excluded which were predominantly characterised by university areas, business districts, government administrative areas and diplomatic areas. However, in Hawassa there are no whole *mender* like this, so instead these areas were excluded at the household-level sampling.

[8] For example, if a city's population is 200,000 and a sub-city has a population of 25,000, then that sub-city should have 4 of the 30 PSUs ((25,000 / 200,000) * 30, rounded to nearest integer).

Households (SSUs) were sampled using systematic random sampling. 12 randomly selected HHs were interviewed from each PSU. Populations of the *menders* were estimated from the populations of the Kebele (e.g. if there are 5 menders in a Kebele of 1,800 households the population of the menders is estimated to be 360 HHs). Households were selected using a random walk method; the sampling interval is the population of that mender divided by 12. Enumerators started in any corner of the mender, visiting the n^{th} HH as per the sample interval. If the selected household were not present the enumerators would return a further 2 times. If the HH were not present on the third time, or they refuse to respond, then replace that household with the n^{th}+1 household. If there are still problems, then follow this procedure for the n^{th}-1, then n^{th}+2 and so on. Where the nearest household is a building of more than one floor containing more than one household, the enumerator is to randomly select a floor of the building.

Sub-sample B – low-income areas

After the selection of sub-sample A PSUs, a list of the remaining menders was collated. From this 50 PSUs were purposively selected as those which can be considered by local expert opinion to be the poorest in the city. From those 50 menders, 30 were purposively sampled again, on different criteria. The aim was to get a balance in geography and population density (e.g. even if all the very poorest mender are in one sub-city, try and get some marginally less poor ones in geographically diverse areas).

The sampling approach for sub-sample B within the full study was designed for cities like Dhaka and Lima, where low-income settlements are quite large and homogeneous. To that extent, it may not be as appropriate for secondary Ethiopian cities like Hawassa, where low-income areas are in small pockets interspersed with other types of land use, and therefore not large enough to be whole PSUs. In effect, Hawassa may not have 30 whole menders which can be distinguished as "low-income" and sufficiently distinct from the rest of the city.

For sampling households/SSUs, the same process was followed as in sub-sample A.

2.2.2 Sampling in the other instruments

Key informant interviews (KIIs): The total number of interviews required, as well as the range and extent of questioning, was influenced by the availability of current and reliable data from other sources, as well as constraints on time and resources. Selection of interviewees was purposive, based on advice received from stakeholders and existing knowledge of the World Bank consultant.

Focus group discussions (FGDs): 10 FGDs were held with households from 10 sub-sample B PSUs, which were randomly selected from the total of 30 sub-sample B PSUs in low-income areas.

2.3 Fieldwork implementation

Pretesting, training and piloting: Initial pre-testing was carried out by JarCo to refine the instruments before 4 days of enumerator training. During the training, all data collection instruments were piloted in urban communities in both higher-income and lower-income areas, as part of field practice for the enumerators. The team then joined a debriefing session before starting data collection.

Field team composition: Three field teams were deployed for data collection. Each team was composed by one Supervisor and five Household Enumerators. In addition to that there was one qualitative team composed of one supervisor and two qualitative researchers. An experienced

Field Manager was responsible for ensuring overall management, field implementation and quality assurance.

Data collection: The field teams collected the majority of the data from the 60 sampled PSUs over two weeks commencing 21st February 2015. On average, each team spent one day in a PSU. Each household interviewer conducted the survey in six households per day, and thus each team with two interviewers completed 12 households in a cluster in one day. For the transect walks (TWs), two teams of three participants conducted all 40 TWs over ten days. For the household survey, data collection was carried out using android mobile phones with and an Open Data Kit app, on which the enumerators received specific training and which was used during field practice. For other instruments, data collection was paper-based.

Data entry, cleaning and analysis: The household survey data were downloaded from the mobile phones at the end of each day of fieldwork, while data from other instruments were manually entered into Microsoft Excel. JaRco carried out data cleaning using various data quality checks, including range checks, skips and internal consistency checks. After data cleaning checks, data were then transferred into the statistical software Stata. Data were analyzed using Stata in OPM's offices in Oxford. Further extensive data cleaning checks were undertaken by OPM.

2.4 Limitations

This study has various limitations which are important to explain, so that readers understand the strengths and weaknesses of the data and what conclusions can and cannot be drawn from the analysis. These should be considered in the context of the objectives of the study (see section 1.2 above). These are:

- **Technical factors** – household surveys conducted by enumerators skilled in social research are designed to ask questions that can be responded to by the householders themselves. Such enumerators are not required to make technical inspections of sub-surface infrastructure, as this requires a different skillset. In a social survey, the household's response is taken at face value (e.g. about the destination of their blackwater) as the basis for establishing the conditions experienced by the household at the time of the study.

- **Sampling method** – sample surveys are designed to estimate indicators for a broader population. Therefore, they cannot produce detailed data for specific neighborhoods without dramatically increasing the sample size and appropriate stratification. The sample size is relatively small, compared to what would be necessary for an impact evaluation, for example. In a similar vein, transect walks aimed to build up a broad picture rather than specific maps or explanations for individual neighborhoods. In addition, the study only focuses on residential areas and households, not institutions.

- **Definition of Hawassa** – the definition of Hawassa used is the administrative boundaries of the sub-cities forming the main body of the city, rather than any other definition in use. The Tulla 'sub-city' 20km from Hawassa was therefore excluded, as were any rural *kebeles*.

- **Seasonality** – The data collection took place in February and March, which is at the end of the dry season (November to January) and at the start of the first rainy season (February to May). Peak average rainfall occurs in April and during the main rainy season (June to October). The survey timing influences results, which in this case most likely influenced: the groundwater table being lower than average, stormwater drains being dry and demand for emptying septic tanks and pits limited. Other influences may also have been operational, such as changes in water usage patterns and people's movement in and out of the city.

3 Background to Hawassa city

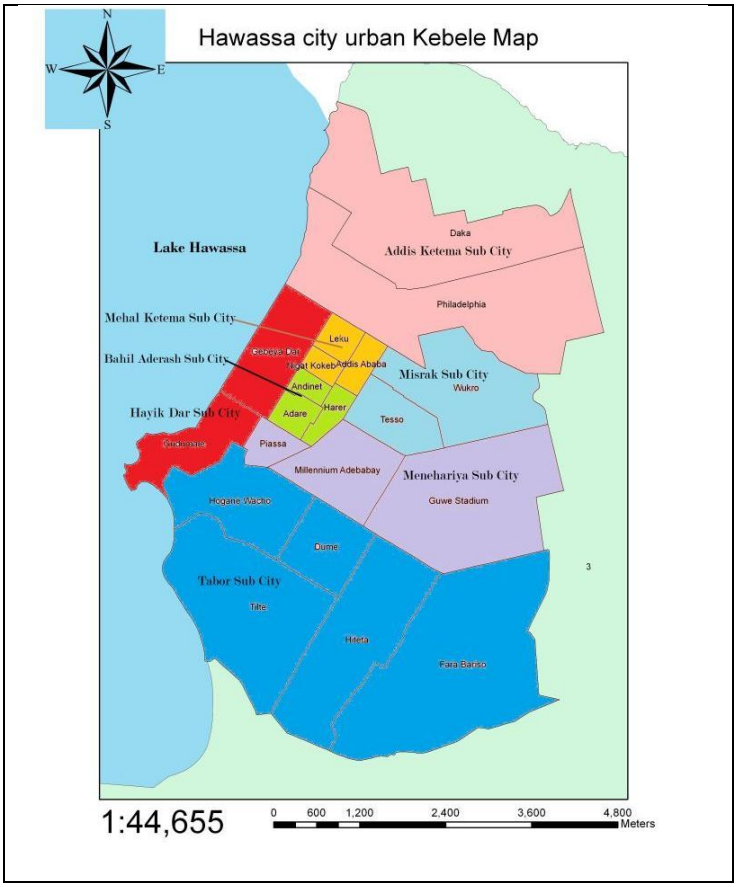
3.1 Hawassa overview

Hawassa, the capital of the Southern Nations Nationalities and Peoples Region (SNNPR), is one of the newly emerging cities in Ethiopia. Located on the shores of Lake Hawassa in the Great Rift Valley, Hawassa has a mean annual rainfall of about 950 mm and temperature of 20°C. The main rainy season generally extends from June to October.

The catchment of Lake Hawassa is fundamentally formed of Pliocene-age volcanic rock. Significant faults and ground cracks in the rock result in a highly permeable soil type which leads to there being highly productive, unconfined aquifers in the area. The depth to the static groundwater level varies from a few meters in the low-lying areas to up to 40m deep in elevated areas (Ayenew and Tilahun, 2008).

The city's water source comes mainly from deep boreholes outside of the city through a piped municipal network. The groundwater below the city has a high fluoride content. During times of disruption to the municipal supply, there is evidence that households in the peripheral areas of the city resort to using wells to supplement their supply, but this water is used for non-consumption purposes.[9]

The Ethiopian Central Statistical Agency (CSA, 2015), gives the estimated population of Hawassa for 2015 as 351,469, with an annual population growth rate of just over 4%. The population is relatively young, with 65% under 25 years of age and around 5.5% over 50 years of age.



The city administration is divided into 8 sub-cities and 32 *Kebeles*[10] (20 urban and 12 rural).

The administrative land area of Hawassa is 15,720ha, with the municipal boundary (i.e. urban *kebeles*) covering 6,465ha.

The city comprises three broad settlement types:

1) well-defined residential housing and industrial areas,
2) old *kebeles* within the city, and
3) newly developing informal peri-urban areas.

The central area is divided into industrial, residential and commercial zones.

[9] Based on personal communication with a member of World Bank staff in Addis Ababa – drawing from evidence found in a recent USAID-funded study of Hawassa
[10] A *kebele*, or "neighbourhood", is the smallest administrative division, similar to a ward

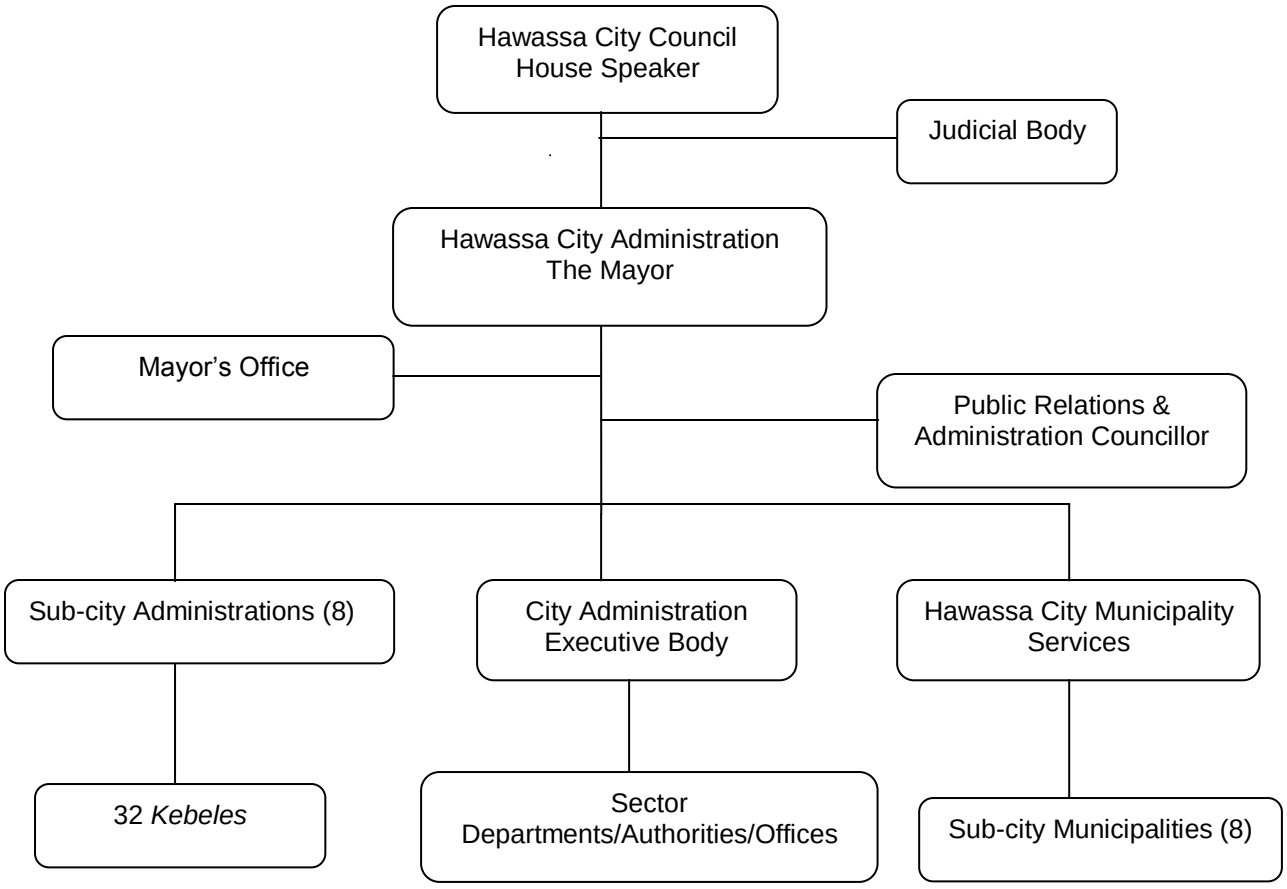
Within each of these three categories of settlement, the population density varies:

- well-defined residential housing and industrial areas: low density with well-planned good road access;
- old *kebeles* within the city: medium to high density; and
- newly developing informal peri-urban areas: high density within those on the city boundary, while those encroaching towards the city are currently more rural in nature.

Newly developing areas are inhabited by the very poor, with buildings in these areas largely semi-permanent as the areas are formally assigned for redevelopment. Where residents are challenged as to the legality of their status, they may end up paying to temporarily legitimize their stay.

Under the constitution of the Southern Nations, Nationalities and People's Regional State, Hawassa City Council is the highest government body, holding city-wide leadership responsibilities in relation to political, economic, judicial, administrative and security matters. Hawassa City Administration (HCA) is the highest executive body mandated to oversee the delivery of all municipal services. The Head of the HCA is the Mayor, under whom sit three main structures: the HCA Executive Body, Municipality Services and eight sub-city Administrations. The HCA Executive Body directly oversees activities of the different sectoral departments, authorities and offices established to deliver services. The Municipality Services Manager and Deputy Manager have executive roles to deliver services including Sanitation, Beautification & Park Development Services, and Plan Preparation & Monitoring Services, each led by a coordinator. The Water Supply and Sewerage Enterprise is the department responsible for fecal sludge management (FSM) services in Hawassa.

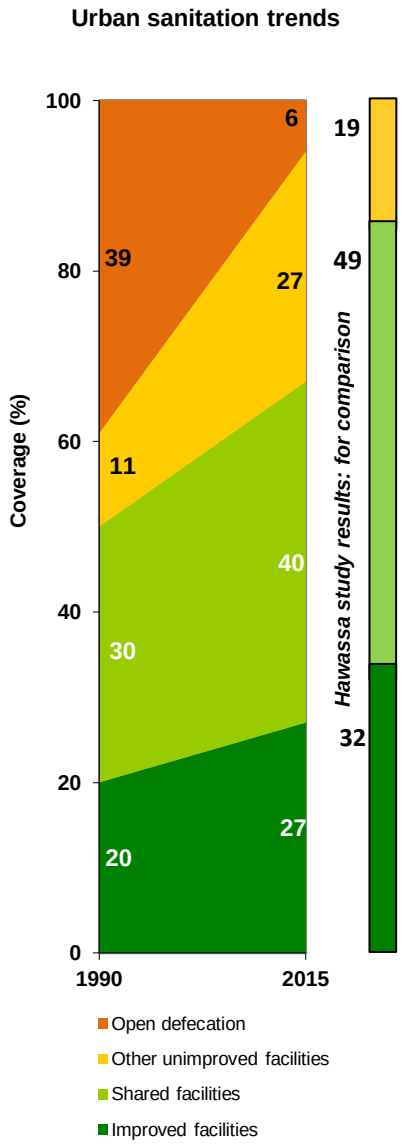
Figure 2 Hawassa City Administration Organizational Structure



3.2 Hawassa's sanitation context

Available data for Hawassa city indicates that improved water supply access in 2014 was 85%.[11] The household survey conducted for this study identified that 97% of households throughout the city have access to an improved water point.[12] The fast population growth of the city means that filling the gap between demand and supply of water in the city remains a major challenge, although additional surface water sources are under construction to supplement current supplies from groundwater sources outside the city.

Figure 3 Access to sanitation for urban Ethiopia, JMP 2015 report



The latest JMP data showing trends for Ethiopia as a whole from 1990 to 2015, indicate access to improved sanitation facilities in urban settings at 27%, while shared facilities account for a further 40% of urban access. Nationally, open defecation is still practiced by about 6% of the urban population.[13]

Sanitation access data specifically for Hawassa city has not been found to be available in published material. Results from this study (showing access to improved sanitation at 32%, to improved shared sanitation at 49% and to unimproved sanitation at 19% - see Table 5), are shown alongside the JMP national figures in Figure 3, for comparison.

Hawassa currently has no sewerage system. Fecal sludge management in Hawassa is the mandated responsibility of the Water Supply and Sewerage Enterprise. The Enterprise has responsibility for the collection and emptying of septic tanks and latrine pits. They operate two vacuum trucks and supervise about a dozen vacuum trucks owned by private operators. Vacuum trucks transport collected fecal sludge to a site operated by the Enterprise, located at Alamura on a hilltop close to the city. The route to the site is about 18km. The site has a treatment plant consisting of eight sludge drying beds.

Addressing the current status of urban sanitation needs to account for inter-related aspects, including land development and land tenure, the promotion, regulation and enforcement of environmental standards and solid waste management. The Health Department, through Urban Health Extension Workers is responsible for promotional aspects, while the regulation and enforcement of environmental standards comes under the Natural Resources and Environmental Protection Agency, reporting to the Land Administration, Utilization & Environmental Protection Authority established by the SNNP Regional State. The Urban Sanitation, Beautification,

[11] Socio-Economic and Geo-Spatial Data Analysis and Dissemination, 2014 (2006 Ethiopian Calendar).
[12] Categories of improved water supply in the survey include: piped into dwelling (10%), piped to yard/plot (77%), public tap (8%), semi-protected dug well (1%) and bought from a neighbour (1%).
[13] WHO/UNICEF JMP report: Ethiopia – Estimates on the use of water sources and sanitation facilities: Updated June 2015.

Development and Park Service is responsible for the coordination of solid waste management services in the city.

Definitions used in Ethiopia, or the Millennium Development Goal for sanitation, relate to the type of user-interface (i.e. the latrine itself), without reference to how or where the latrine discharges fecal waste beyond this containment stage, through to further stages of the sanitation service chain.

For the purposes of this study, the focus is primarily the management of fecal sludge from household latrines (i.e. the containment stage) through to end-use/disposal (see Figure 4 below).

Figure 4 The sanitation service chain

The case study does not focus on the structural condition of the latrine itself, rather the extent to which it contains / does not contain fecal sludge and what happens to the fecal sludge from this stage onwards. For this reason, later sections of this report refer to different categories for household sanitation facilities and assesses fecal sludge management in relation to the service chain above.

An assessment of access to sanitary latrines based on location within the city does not form part of this study, but within the three broad classes of housing area and density (given in Section 3.1), the sanitation services have been broadly identified to be as follows:

- In the well-defined housing and industrial areas, buildings are served by mostly septic tanks and soakaways. Septic tanks are emptied periodically using vacuum trucks.
- In the old kebeles, most of the houses are served by pit latrines. In some cases there are several households sharing one latrine. Some of these pits are emptied regularly, but in other cases pits are abandoned and new pits constructed.
- In the newly developing informal low-income communities in the peri-urban areas, there are a range of latrine types used, but with a number of households having no toilets at all. This has led to some level of open defecation.

Low-income areas are known to be mostly expanding in the southern area of the city, between the city center and Tabor Hill.

3.3 Hawassa's FSM context

Later sections of this report identify the scale of FSM services, based on qualitative and quantitative data from the study. Here, we present the roles legally assigned to the key actors involved in sanitation and FSM from federal to local levels, based on the key informant interviews and field experience. How this plays out in reality is covered in Section 9.

The development of towns is supported both by the Federal and Regional governments. The Federal Government prepares policies, strategies and development plans in consultation with Regional counterparts. The range of Regional bureaus and offices, constituted under the Regional Government, then have a responsibility to guide the development of the regions' towns and rural areas, supporting towns in implementing policies and strategies in line with development plans and programs they are committed to deliver. The support is often in the form of capacity building,

procurement or technical assistance. Urban sanitation unfortunately does not have a clear institutional home.

Table 3 Roles assigned to key FSM stakeholders

Categories	Stakeholder	Assigned roles
Federal government	Ministries of Health; Education; Water, Irrigation & Electricity; and Finance & Economic Cooperation	**WASH Policy** - Joint WASH MoU (2006, revised 2012) with Implementation Framework signed in 2011. Cascaded down to Regions for implementation.
	Ethiopian Environmental Protection Agency	**Environmental regulation and monitoring** (independent institution) - Develops environmental strategic plans - Formulates environmental laws and standards - Provides support for environmental regulatory bodies and implementers - Undertakes monitoring and effectiveness evaluation of environmental systems
SNNPR Regional Government Bureaus Responsible for formulating and executing economic, social, development policy, strategies and plans of the State	Water, Irrigation and Electricity	**Deliver potable water supply and sewerage services** - Generally understood to be responsible for liquid waste management (blackwater and greywater). Sewerage is not explicitly mentioned on the establishment proclamation and town water utilities are charged to deliver sewerage services.
	Health	**Health promotion and regulation on food, health care and medicine control** - Oversees urban health extension packages, of which seven relate to hygiene promotion and waste management - Supports town administrations to plan and implement urban health extension programs through provision of at least two qualified (nursing education) health extension workers
	Urban development and housing	**Support improvement of solid waste management** - Strengthens capacity of the municipal agencies to implement solid waste management and beautification programs
	Environmental Protection and Climate Change	**Protection of the environment and nature** - Develops standards, regulations and guidelines on elements adversely affecting the environment and nature, in collaboration with other sectors
	Justice	**Ensuring implementation of all regulations** - Advises or takes legal action against defectors, including those releasing or dumping waste from their compound
Local government	Hawassa City Council	**Ensure sanitation provision** - Sets laws and regulations on socio-economic matters - Monitors appropriate enforcement
	Hawassa City Administration	**Water supply, sanitation and solid waste services** - Delivers municipal services to city inhabitants

Categories	Stakeholder	Assigned roles
	Hawassa City Water and Sewerage Enterprise	**Sanitation Services** - Oversees and coordinates activities undertaken in sub-city Municipalities
	Hawassa City Natural Resources and Environmental Protection Agency	**Ensuring well-managed natural resources and environment** - Uses Liquid and Solid Waste Proclamations as basis of ensuring proper disposal for industry, hotels and businesses
	Hawassa City Design and Construction Supervision Department	**Approves building plans** - Supervises construction of houses, including standards of sanitation
	Hawassa City Health Department	**Education and behavior change affecting sanitation and hygiene** - Motivates households and supports institutions to improve access to improved latrine - Urban Health Extension Workers – officially assigned staff in charge of organizing the Health Development Army (see below) - Health Development Army – voluntary teams of 6 workers covering up to 30 households in a neighborhood (5 households per worker)
	Hawassa City Finance and Economic Development Department	**Developing services** - Engages the private sector
	Enterprise Development Office (including Small and Micro Enterprises Development Office)	**Engaging private sector providers** - Enables business ventures by private sector providers, especially young graduates, with sanitation seen as a key area for development
Private sector & NGOs	Private vacuum truck operators	**Emptying services** - Runs private collection services to empty septic tanks and latrine pits – on invitation from households or institutions
	Jerusalem Children and Community Development Organization (JeCCDO)	**Support to communities** - Provision of communal toilets in low-income kebeles

4 Fecal Waste Flow Diagrams

4.1 Introduction

Fecal Waste Flow Diagrams (also known as SFDs) in their current form arise from some of WSP's previous work on urban sanitation (Peal et al., 2013). In short, an SFD is a visualization of how excreta flows along the sanitation service chain. At each stage of the chain, the proportion of each household's excreta which is or is not effectively managed to the next stage of the chain is indicated.[14] At the end of the chain, the proportion of excreta which is effectively managed is indicated as "safe", with the remaining proportion deemed "unsafe", and the primary destination of that fecal sludge indicated in general terms (e.g. receiving waters, general environment, drains etc.)[15]

Thus far, SFDs in different cities have been undertaken using different methodologies, as is often necessary in the context of poor data availability. Furthermore, most SFDs so far (including those in the 12-city study) were undertaken using secondary data and expert estimates. This study is one of the first to use primary household survey data and field-based observations to construct SFDs. A group of urban sanitation experts is currently developing the 'roll-out' of the use of SFDs, for which other methodologies will be developed.[16]

4.2 Methodology

For this analysis, several key indicators from the household survey were used. In particular, data from the following household survey questions was used:[17]

A. "What kind of toilet facility do members of your household usually use?"

B. "Where do the contents of this toilet empty to?"

C. "What did you do when the pit or septic tank filled up last time?"

D. "What was [the fecal sludge] emptied into?"

Of these, question 'B' is one of the most crucial for the construction of the SFD. It should be noted that the household's response is taken as given. It was not possible to confirm responses by observation since enumerators were selected for a background in social research and not sanitation. However they were trained to observe 'above-ground' components, so observation of slab, water seal, superstructure, etc. was carried out in all households where permission was given.

Given that 'B' is based on household response, possible sources of bias include the household not knowing the true answer, or knowing it but answering differently for fear of being identified as practicing illegal behavior (e.g. pits/tanks connected to drains). The former is certainly likely, the

[14] Previous iterations of SFDs distinguished between safe and unsafe management, but here we refer to effective/ineffective management. This progression has been made because it is difficult to know the safety of the process, but if the excreta is managed to the next stage of the sanitation service chain we can say it is effective.
[15] It is acknowledged that FS may pass from drains into other water bodies, e.g. rivers, but the diagram focuses on the *primary* destination.
[16] See website for the SFD promotion initiative - http://www.susana.org/en/sfd
[17] Full response categories for these questions are included in the survey questionnaire, to which there is a web link in Annex C. In particular, it should be noted that the response categories to question B above were: (i) Directly to piped sewer system, (ii) Septic tank connected to "piped sewer system", (iii) Septic tank with no outlet, (iv) lined pit with no outlet, (v) septic tank connected to drain, (vi) lined pit with overflow to drain/elsewhere, (vii) unlined pit, (viii) directly to sea, lake or river, (ix) directly to drain/ditch

latter does not seem to be an issue given the vast majority of households who willingly disclosed illegal behavior.

To analyze this data, an SFD matrix is created, as shown in Figure 5 below. It shows which data sources are used and how they are analyzed into levels of effective / ineffective management of fecal waste through the stages of the service chain – with results in the next section.

First, the household survey data on use of infrastructure (questions (A) and (B) above) is used to allocate households to five categories shown in the column marked (1) in the figure below:

(i) **"Sewered (off site centralized or decentralized)"** – toilets connected to sewers (not on-site sanitation)
(ii) **"On-site storage – emptiable"** – on-site toilets (either pits or tanks) which can be emptied and are emptied from time to time
(iii) **"On-site storage – single-use / pit sealed"** – on-site toilets where pits or tanks are sealed and/or abandoned once they have filled up
(iv) **"On-site non-storage – straight to drain/similar"** – on-site toilets which connect to drains or open water bodies (e.g. hanging latrine, or latrine with a pipe connecting the pan directly into a drain)
(v) **"Open defecation"** – self-explanatory

The question of emptiability is key. Category (ii) above is denoted as emptiable, meaning that this containment option involves a pit or tank which fills with excreta and is therefore emptied from time-to-time rather than abandoned or sealed when full. In Hawassa, pits/tanks are not legally allowed to be connected to drains. Between the two extremes of a closed system and a system which never fills up, there is a spectrum of scenarios. This is partly reflected in the data below.

The data from questions (A) and (B) at the beginning of this section are allocated in column (2) in Figure 5 below (a key shows the meaning of the color-coding of cells by data source). Next, the proportions for each of the stages of the chain are allocated. As can be seen from the emptying column, marked (3), a certain proportion of the population's excreta which makes it to that stage is emptied by a service provider, and the rest is not emptied. This is estimated by dividing the number of households which reported emptying their pit (question (C) above), by the number of households using emptiable technologies (questions (B) above).

The rest of the matrix follows similar logic. The full SFD matrix for the city-wide sample in Hawassa follows. This section has given a brief overview of where the data underlying the SFD comes from. The SFD itself is more intuitively appealing and presented in the next section.

It should be noted that since the data comes from a household survey, the proportions in the matrix are proportions of households, not proportions of people or of excreta volumes.[18] In Hawassa, the mean household size for sub-sample A was found to be 5.5.

[18] Excreta volumes depend on a series of factors, not only population, and are quite hard to estimate. The use of a population-related variable (number of households) is proportional to the amount of fecal microorganisms excreted and therefore to the potential public health hazard.

Figure 5 Fecal waste flow matrix for Hawassa

This shows the data which goes into producing the SFD.

		Containment		Emptying		Transport		Treatment		Overall
Hawassa - city-wide		*of which*		*of which*		*of which*		*of which*		**Managed :**
Type of system	*% pop. using*	*contained*	*not contained*	*emptied*	*not emptied*	*transported*	*not transported*	*treated*	*not treated*	**74%**
Sewered (off site centralised or decentralised)	0%	0%	100%	0%	100%	0%	100%	0%	100%	
		0%	0%	0%	0%	0%	0%	0%	0%	**0%**
On-site storage - lined pit/tank, emptiable	80%	100%	0%	12%	88%	90%	10%	50%	50%	
		80%	0%	10%	70%	9%	1%	4%	4%	**74%**
On-site storage - single-use / pit sealed (unlined pits)	20%	100%	0%	0%	100%					
		20%	0%	0%	20%					
On-site non-storage - straight to drain/similar	0%	0%	100%	0%	100%					
		0%	0%		0%					
Open defecation	0%	0%	100%							
		0%	0%							
		Containment	100%	Emptying	10%	Transport	10%	Treatment	0%	
Unmanaged:	**26%**		**0%**		**20%**		**1%**		**4%**	
Affected zones (you can adapt the terms to suit the context)		*Local area (leaching directly to ground)*		*Local area (leaching eventually to ground)*		*Neighbourhood (unmanaged emptying/transport)*		*City and beyond (poor quality of treatment)*		
		from household survey								
		estimate								
		de facto value								

FS not emptied is contained (fully or partially) in lined pits and range of STs. No risk to public health through groundwater, so considered as managed

4.3 Results

Firstly, the household survey results and secondary data used as inputs to the SFD are shown in the tables below for the city-wide analysis. After that, a separate SFD matrix and diagram for the city is presented.

4.3.1 Survey results as an input to SFD

As can be seen in the table below, the majority of households use a pour / manual flush toilet (36%) or a dry pit latrine with slab (36%). Use of a pit latrine without a slab is reported by 19% of households, while a cistern flush toilet is reported as used by less than 10% of households. No households reported practicing open defecation.

Table 4 Sanitation facility used, by technology type

	%	No. of households
Cistern flush	9.4	34
Pour/manual flush	36.1	130
Pit latrine with slab	35.8	129
Pit latrine without slab	18.6	67
VIP latrine	0.0	0
Open defecation	0.0	0
Total	**100.0**	**360**

The table above shows the basic categories, but it is also important to consider the proportion of these which are shared. This is relevant for standardized indicators of the WHO/UNICEF JMP, but

also because the FSM arrangements for shared latrines will be different to those of 'private' latrines. Accountability for dealing with full pits or blocked drains to septic tanks, as well as payment for FSM services, may be less clear-cut in a 'shared' situation, recognizing that the term 'shared' could refer to a number of scenarios. The technology and service would be the same as private household facilities, while noting that shared pits / tanks would be likely to fill up more quickly, depending on the number of users.

As can be seen from Table 5 below, 81% of households reported using an improved facility as their main latrine, where 32% of households used a private facility and 49% of households a shared toilet. Of the 19% of households reporting use of an unimproved facility in the table above (pit latrine without slab), 6% of these are reported as private facilities, while 13% are reported as shared facilities. Overall, 62% of households used a latrine (improved or unimproved) which was shared between 2 or more households – making this a significant element of sanitation provision in the city.

Table 5 Sanitation facility used, by JMP category

Type of facility	No. of Households			% of Households		
	Private	Shared	**Total**	Private	Shared	**Total**
Improved	116	177	**293**	32%	49%	**81%**
Unimproved	21	46	**67**	6%	13%	**19%**
Total	**137**	**223**	**360**	**38%**	**62%**	**100%**

As noted above, the most important question is where the fecal matter goes after flushing or similar. The standard question in the Demographic and Health Surveys (DHS) incorporates this into the overall sanitation question (see WHO/UNICEF core questions available at www.wssinfo.org). For this case study, an additional question was asked in order to get better quality data.[19] Household-reported data is relied upon for this indicator, while noting that households may not always know the full detail, especially if they are renting. Furthermore, with a socio-economic survey rather than a technical survey, it was not possible to physically verify what lay below the latrine or toilet. Nonetheless, the enumerator training included ensuring that the enumerators fully understood distinctions between the response categories.[20]

Further discussion about the potential public health risks associated with the management of blackwater, within the broader context of FSM services in Hawassa and the city as a whole, is presented in Section 5.

The results are shown in Table 6 below. The first point to note is that no households reported discharging blackwater in a way that might be considered to be a high risk – i.e. blackwater discharging directly into the environment (such as through discharging to open drains) that would put people at risk of contact with fresh excreta. The majority of households (57%), reported arrangements that could be considered to be of low risk to public health, through the use of lined septic tanks or pits, with slow leaching of fecally contaminated effluent into the ground in a situation where the groundwater is not used for domestic purposes. 43% of households reported arrangements considered to *potentially* pose some risk – where tanks and pits are either partially lined or unlined and have no formal outlet (i.e. to a soakpit), or where they have an outlet – such as to an onsite soakpit. In these cases, fecal sludge may end up finding a way into the environment, such as through overflowing pits and tanks. Where the fecal sludge leaches into the ground, the

[19] As stated above, the question asked was "Where do the contents of this toilet empty to?" The question is answered by all households, regardless of whether they owned a private toilet, managed a shared toilet or used a shared toilet.
[20] In Table 6, the data are reported as per the response categories used in the questionnaire, with footnotes in the table below qualifying aspects of the data. The response categories used were developed on the basis of discussion with experts on sanitation in Hawassa regarding prevalent containment options.

extent to which this poses a health risk is subject to further discussion – considered in Section 4.3.2.

61% of households use pit latrines and 39% some form of septic tank. Thus, with 100% of households using on-site facilities, it could be reasonably expected that this would result in a strong market for FSM services.

Table 6 Management of blackwater – where toilets discharge to

	%	No. of households
Lined pit	40.9	147
Septic tank: fully lined with no outlet to on-site infiltration (i.e. a sealed tank)	16.4	59
Septic tank: partially lined with no outlet to on-site infiltration (i.e. effectively a soakpit)	14.5	52
Septic tank: unlined with no outlet to on-site infiltration (i.e. effectively a soakpit)	3.6	13
Septic tank: with an outlet to on-site infiltration such as a soakpit	4.2	15
Unlined pit	20.3	73
Total	**100.0**	**359**

In order to assess the potential demand, households were asked whether their pit or tank had ever filled up. The vast majority of households answering the question (92%, n=265) stated that their pit or tank had *never* filled up, with only 8% reporting that their pit or tank had ever filled. Of the households reporting that their pit or tank had filled up, 35% reported that the average time to fill was less than 1 year and 65% that the time was less than 2 years. The average age of sanitation facilities was reported as 10 years (n=302), with a median age of 8 years.

Given the prevalence of partially or unlined septic tanks and pits, together with the low reporting of tanks and pits filling up, it is likely that significant volumes of contaminated effluent are infiltrating into the ground below and immediately around these facilities, given the soil conditions in Hawassa. The implications of this for public health are explored further in Section 5.

Finally, it is worth considering the reported household behavior in the context of pits filling up. This was assessed by asking about the action taken by the household when their pit last filled up. As can be seen in Table 7 below, the majority of households who answered this question reported taking action that results in an existing facility being abandoned – leaving the household reliant on another facility.

Table 7 Past action after pit/tank filled-up

	%	No. of households
Emptied & reused pit/tank	31.3	35
Abandoned (pit/tank left unsealed)	1.8	2
Sealed and abandoned	2.7	3
Covered and used alternative pit	64.3	72
Total	**100.0**	**112**

It is difficult to interpret the implications of these responses, as the number of respondents to this question is much higher than those reporting that their pit or tank had ever actually filled. This may be for various reasons, including households answering the question about the pit/tank filling rate in relation to their *current* facility but the question on past action taken in relation to a *previous* facility.

Of significance is that 31% of those responding stated that they had emptied and reused the pit or tank. This accounts for only 10% of the total city-wide sample of 360 households, for which the emptying methods and types of service provider used are considered in more detail in Section 6, as part of the assessment of demand and supply for FSM services. Given that such a high proportion of households answering this question (64%) covered and abandoned their pit, it is likely that many households were answering on the basis of the previous question in the survey (whether their pit/tank had ever filled-up) with respect to that particular pit currently in use. It would therefore be wise to value the data in Table 7 more highly. Given 112 out of 360 households answered this question, it could be concluded that 31% of the total sample had experienced *any* pit/tank filling up (as opposed to 8% reporting that they had experienced the current specific pit/tank filling up).

4.3.2 Presentation of SFD

Using all these results, together with secondary data gained during key informant interviews and observation of the fecal sludge treatment facility at Alamura (see Section 7 for more details), the SFD matrix and diagram were constructed for the city-wide sample. They are presented in Figure 5 above and Figure 6 below.

SFDs work on the principle of the matrix shown above (Figure 5). Household toilet technologies and associated containment methods are shown on the left, with intermediate steps and primary destination of the fecal sludge along the sanitation service chains shown to the right.

It is clear from the SFD that, for households with a containment facility that could be emptied, only a small proportion of these facilities are reported as actually being emptied. The majority of fecal sludge removed from pits and tanks is considered to reach the treatment facility (including when emptying is reported as done by an informal provider), with only a small percentage reported as being removed informally by households themselves or neighbors (refer to Section 5 and 6 for more detail) and limited evidence of trucks dumping fecal sludge to land before reaching the treatment plant. The efficiency of treatment at the fecal sludge drying beds is unknown and goes undocumented, so a figure of 50% is used to account for seasonal variation in treatment capacity, as discussed further in Section 7.

The majority of emptiable pits and tanks are reported as not being emptied. Where people are using pits that are abandoned and replaced once full, it is highly likely that these are all in fact simple, unlined pits, otherwise this would represent a significant abandoned investment. If this is the case, then the fecal sludge in these pits (accounting for 20% of total facilities) will eventually leach into the ground.

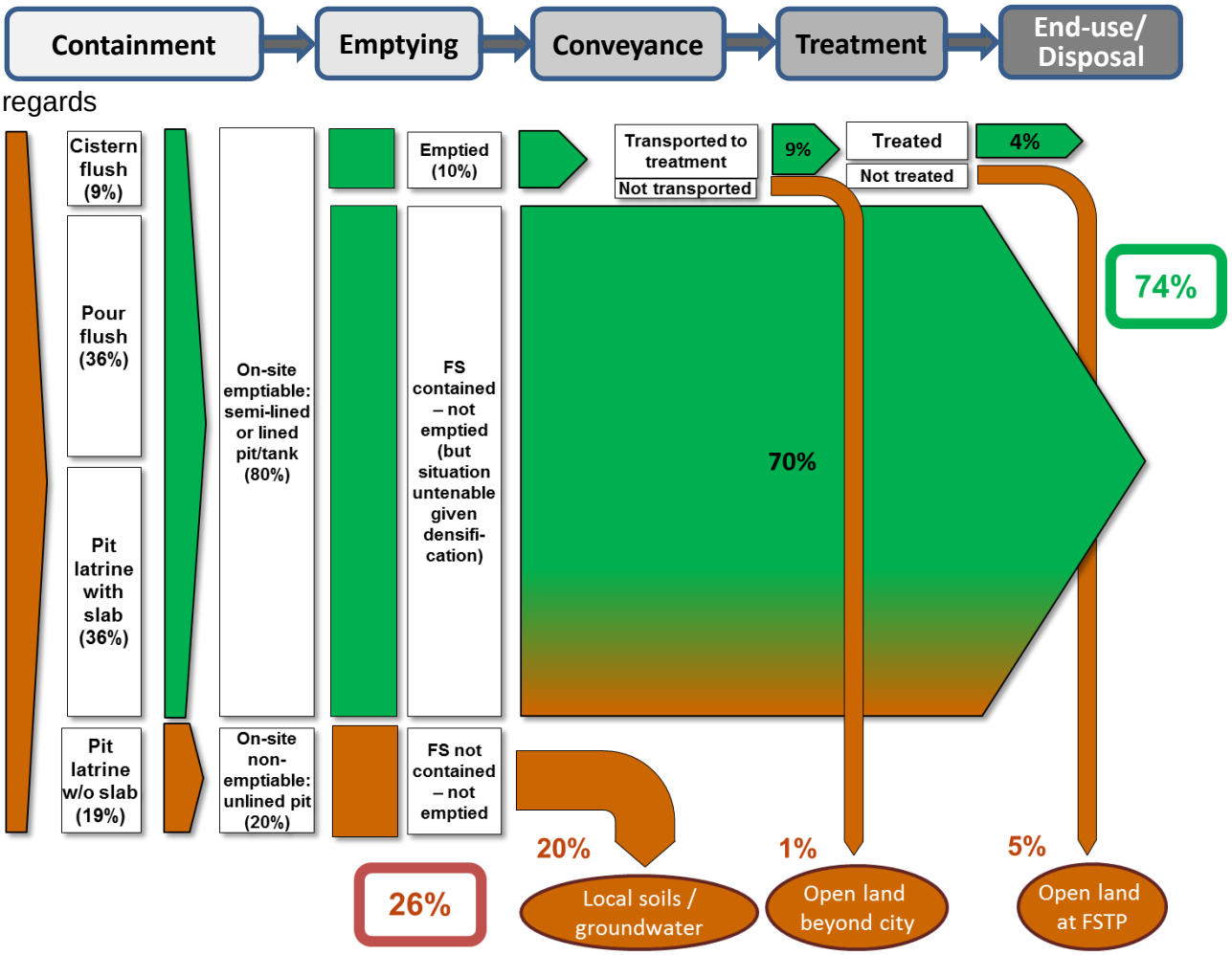
Where people are using septic tanks (lined or partially-lined) and lined pits, Figure 6 below is based on an assumption that the fecal sludge that remains unemptied also remains in these pits and tanks and even if it is interacting with the groundwater, there is no risk to public health or environmental contamination, at present. The proportion of fecal sludge in this component (70%) is therefore considered to be effectively ‘managed’.

Given the rapid growth of the city, the SFD also highlights that, for this 70% of contained fecal sludge, which can be considered as effectively managed at present, the situation is going to change over time. Shifting settlement patterns in Hawassa will result in the saturation of soils, increasing levels of groundwater contamination and increasing reliance on poorly constructed unlined pits in low-income areas. All this will contribute to a greater proportion of the fecal sludge becoming unmanaged, with likely increasing risk to public health and environmental contamination

risk to the lake and other water bodies in and around the city. This is discussed further in Section 5.

The actual change in risk as a result of the change to the fate of fecal waste flows from a future mix of facilities would require a much more detailed study. This has been indicated schematically in the SFD that follows, by mixed green and brown shading for those on-site sanitation facilities which are not reported as being emptied but are abandoned when full.

Figure 6 Fecal waste flow diagram (SFD) for Hawassa



As noted above, the mixed green and brown shading for the facilities reported as not being emptied indicates an anticipated change in the overall risk from the fate of these fecal waste flows over time. The situation will reach 'crisis point' when there is insufficient sub-soil absorption capacity for the total liquid effluent load being generated. As buildings are built in more central and planned areas of the city at above say 3 storeys high, there will be a need for sewerage systems to service those buildings. Other more informal and out-lying areas of the city are likely to maintain the existing pattern of low-quality sanitation systems, while septic tanks will become more common in the intermediate areas.

4.4 Implications of the SFD for FSM in Hawassa

The SFD shows that, while there is effective access to at least some form of on-site sanitation facilities throughout the city (resulting in no reported open defecation through the household survey

and limited evidence through other data collection tools), not all fecal waste is being effectively managed through the later stages of the FSM service chain.

For many, the actual 'management' of fecal waste within their containment facility is strongly influenced by the poor construction quality (resulting in partially lined or unlined tanks and pits) and the soil conditions, resulting in those tanks and pits operating for many years without the need to be emptied. Effluent from septic tanks is being managed through the use of on-site soakpits, or steady leaching from the tank into the soil where tanks are not fully lined. As the city becomes more densely populated, this practice will become increasingly untenable as the soil's absorption capacity is exceeded – with the resulting need to identify priority areas for the introduction of a range of sewerage options. In some specific cases, or as an interim solution, there may be the need to consider the use of well-constructed septic tanks, anaerobic baffle reactors (ABRs), or other improved on-site containment systems supported by more responsive FSM services.

Of greater significance in terms of current fecal sludge management needs is where households in less dense areas are abandoning or covering pits once they are no longer in use (due to being full, or perhaps collapsed, or no longer accessible for another reason). In such cases, households resort to finding or constructing alternative facilities – but given the reported concerns about limited space to continue to do this, eventually this option will become non-viable and emptying will be required. This is discussed further in later sections. It is likely that in most of these instances the pits will be of low quality and poorly lined, putting them at risk of collapse if they are emptied mechanically. It is also unlikely to be considered cost-effective to put them back into service by having them emptied – unless this is done informally.

Creating the conditions for better containment and resulting safe emptying for all of these situations will require a combination of interventions, which are considered further in the Intervention Options assessment, under Section 10).

5 Public Health Risk Assessment

5.1 Introduction

A key component of the wider FSM study is to identify the extent of public health risks resulting from poor FSM services within each city. The Hawassa study did not conduct all instruments intended to support an assessment of the public health risks (i.e. observation of household latrine emptying, testing fecal sludge samples taken during emptying and testing samples of drain water were not undertaken, as explained in Section 2.1). Therefore, the limited data available from Transect Walks and water quality tests can only provide an indication of the level and location along the sanitation service chain of possible adverse public health impacts.

Methods adopted within the data collection instruments to do this include:

- Identifying types of household facility and emptying services used (supported by direct observation of the cleanliness and functionality of the facility), during the household survey;

- Scoring hazards and vulnerability factors observed during transect walks (see explanation below), along with information about local practices that could result in fecal contamination in the environment (see Annex C for information on the scoring system used and the summary of results);

- Measuring fecal contamination levels in local water supplies, to identify potential levels of exposure to risks; and

- Asking for perceptions of risk related to emptying services, during focus group discussions.

Collating and analyzing results from the data collection instruments provides information about sources of risk through the service chain. This includes how clean and operational toilets are kept within the household, and the extent to which infrastructure provides effective handling of fecal sludge and wastewater through the city.

Given the very limited extent of data collected for this part of the study, it can only provide a general indication of risks at positions along the service chain. The study is not intended to report on specific locations or flow paths of fecal sludge movement within the sampled PSUs.[21]

For more information about the sanitation-related diseases and the significance of safe management of fecal sludge to protect environmental and public health, see Cairncross and Feachem (1993, pp.11-25), and Strande et al (2014, pp.1-4).

5.2 Results: risks through stages of the FSM service chain

5.2.1 Containment: household facilities, levels of sharing and practices

The standard of household containment facilities has been identified from the household survey, as indicated in Section 4.3.1.

From the survey, **reported levels of sharing** show that 62% of households overall were using a shared facility, of which 49% of households used an improved shared latrine and 13% an unimproved shared latrine. Interestingly, ownership of private household latrines was high, with

[21] Original datasets contain GPS locations of observed risks in the PSUs that could be examined further

80% reporting ownership of a private latrine (on plot) and 14% a shared latrine (on plot). Use of communal toilet blocks was reported by 6% of respondents and use of public toilet blocks by less than 1% of respondents.

Standards of **cleanliness** for facilities, observed during the household survey, show that 78% of observed latrines had a cleanable slab and 66% no visible fecal or urine contamination on the floor or slab (9% had feces only and 26% urine only visible). 82% were considered to offer reasonable privacy to the user and all were reported to be operational at the time of observation.

Practices around the **disposal of child feces** can also introduce risks to both households and potentially the wider public. 92% of households who reported their practices (n=122) identified safe methods when managing the feces of children under 5 years old. 2% reported that their children use the latrine and 90% that their children's feces are put/rinsed into the latrine. Of the 8% who reported unsafe practices, 6% throw the feces out with solid waste, while the remaining 2% of households either buried the feces, or put them into a ditch or drain. As 17% of households reported storing their solid waste in a public place before collection, this practice could have implications for contamination of the local neighborhood in low-income areas, given the highly informal nature of solid waste collection practiced in these parts of the city.

Self-reported **prevalence of diarrhea** stated by the respondent during the household survey are shown in Table 8 below. As can be seen, prevalence is low.

Table 8 Prevalence of diarrhea among respondents in the last 2 weeks

	%	No. of households
None	97.8	352
One	2.2	8
Two	0.0	0
Total	**100.0**	**360**

A question asking about the prevalence of diarrhea in children under 5 (for up to 4 children per household) resulted in the highest prevalence rate reported for the youngest child, at 9% of responses (n=158).[22] The DHS survey data of 2011 shows that 13% of children under 5 were reported to have had diarrhea in the 2 weeks preceding the survey, with diarrhea most common among children age 6–23 months (DHS, 2011). While results from self-reported prevalence cannot be taken as robust, this does indicate that children within the city may be more at risk from fecally contaminated environments than adults, as would be expected.

Diarrhea prevalence is only one indicator of a contaminated environment. It is increasingly understood that nutrition outcomes, especially stunting (reduced height-for-age) are strongly linked to sanitation through multiple transmission pathways. While stunting has numerous determinants, living in contaminated environments does appear to be a major causal factor.

5.2.2 Emptying: household practices around emptying services

As seen in the results from the household survey and discussed in the earlier section, all households make use of on-site sanitation facilities discharging to lined, partially-lined or unlined tanks and pits. The majority of these pits and tanks are in use but very infrequently emptied, or are being abandoned and replaced when full. No households reported discharging blackwater into the environment (drains, ditches or open ground).

[22] Responses given for additional children were at too small a number to be of any significance.

Satisfaction expressed about the **safety** of emptying services was reported to be high, with 79% of households reporting the use of emptying services stating they were either very satisfied or satisfied with their safety. Risk as perceived by householders will not be the same as actual risk resulting from the process – but focus group discussions reported that the emptying process is not considered to introduce risks, either in the emptying or transportation stages. Trucks have not been seen to spill fecal sludge, or contaminate the local area – and no one reported identifying risks from the trucks transporting fecal sludge within the city.

The most likely source of risk will be as a result of the delay from needing a pit or tank emptied and the services becoming available. This is discussed further in Section 6.4 considering the supply capacity, but here it is worth noting that although it is at a small scale, households do sometimes experience pits/ tanks overflowing. Of the households who have called on emptying services (n=35), the main reason has been identified as the pit or tank being nearly full (95%) with 5% reporting a pit or tank overflowing.

In response to a question in the household survey, 10% of respondents stated that greywater is discharged into septic tanks along with blackwater, while 41% of households discharged greywater directly into a soakpit. 26% discharged greywater to an open drain, ditch or to open ground. This is backed up by observations during the transect walks, that noted the presence of limited drainage infrastructure close to homes in over half of the PSUs, but any evidence of the presence of greywater in only two of them. The transect walks also confirmed that no blackwater is discharged into the environment, at least beyond the boundary of the household.

Unfortunately the study has not been able to make direct observation of emptying services for households (while services are clearly used by businesses such as hotels). Given the limited access to emptying services throughout the city, it has not been possible to gather evidence on which to make informed judgements about the standards of service provision and consequences for public health risk from those practices, over and above what is reported here from the limited data in the household survey and focus group discussions.

5.3 Results: risks from wider environmental risks and practices

Solid waste

The 40 transect walks (30 conducted city-wide and 10 in low-income areas) confirmed that solid waste dumping is the most frequent visible problem relating to environmental sanitation across the city. Solid waste was reported as being discarded in drains and by the roadside, typically on a daily basis, in over half of the city-wide locations and in seven out of 10 of the low-income areas. Given that some households dispose of child feces with solid waste (see Section 5.2.1 above), this could introduce a certain level of risk, particularly in areas with informal solid waste collection services, or where children play in drains and in or around solid waste piles.

Public latrines / open defecation

The transect walks identified three city-wide locations in which a public latrine had some form of fecal contamination. This was either from feces accumulating around the facility, or the facility itself overflowing. Residents of those PSUs noted that open defecation occurred around two of the public latrines on a daily basis. In a further six PSUs, residents reported that people defecate in the drains “most weeks” and around the market in one further PSU.

During transect walks held in low-income areas, in one PSU residents reported that people defecate near to the public toilet “most weeks”, around a tobacco farm in another PSU, and

"around the road" on a daily basis in one other PSU. The extent to which open defecation is currently occurring in Hawassa has not been possible to determine. For the purposes of this study, it is considered to be at less than 1% of the total population, so is not included in the SFD for the current status of the city. However, it is clear that the situation is likely to worsen, with resulting levels of open defecation increasing, over time.

In only one of the PSUs was a diarrheal outbreak reported as having occurred in the last 1 year. In this PSU, the public latrine was observed as overflowing, while residents reported both uncontrolled dumping of fecal sludge by the public latrine and that people defecate around the public latrines on a daily basis.

The presence of **animal feces** was also noted during the transect walks. In only one of the PSUs in low-income areas was this reported as being widespread, while in seven of the 30 city-wide PSUs and in two of the 10 low-income area PSUs animal feces was reported as being seen but "limited to a few locations". Donkeys are commonly used in Hawassa as a means of transportation, so this is not a surprising finding. The implications of environmental contamination by animal feces are not directly a part of this study – the results are simply noted here for information.

Water supply

Samples of drinking water supplies were taken in 19 PSUs, 10 from the city-wide sample and 9 from the low-income areas. The following table shows the number of PSUs in which total coliforms and *E.coli* were detected at different levels.

Unless otherwise indicated, all supplies were from the town water supply to a dwelling – but these may have been a private house or public building such as a school, cafe, clinic or hotel. As shown in Table 9 below, contamination in the form of total coliforms was detected in seven of the city-wide locations and in eight of the low-income areas. More significantly *E.coli* was detected in drinking water sources from three of the city-wide locations (none of which were identified as being "High income") and in six of the low-income areas.

Table 9 The number of contaminated main water supplies in 19 PSUs

	Total coliforms 0<n<10 CFU /100ml	**Total coliforms** n>10 CFU /100ml	***E.coli*** 0<n<10 CFU /100ml	***E.coli*** n>10 CFU /100ml
City-wide (n=10)	3 (1 standpipe)	4	2 (1 standpipe)	1
Low-income areas (n=9)	2	6	5	1

This suggests that fecal contamination of water supplies is occurring in a number of locations and is more likely to occur in low-income areas. The extent of risk to consumers of the water will depend on household practices and behaviors around treatment of water before drinking and using it for other domestic purposes. 77% of households in Hawassa report having a piped water supply into their yard or plot, with a further 10% having water piped into their home. 8% of households rely on public taps and 5% get water from other sources (neighbor, vendor or well).

5.4 Implications: assessing the public health risk from poor FSM

Risk to public health, as a result of poor FSM services, comes when there is human exposure (i.e. some form of contact) to the hazard (i.e. fecal sludge that contains pathogens), through an event (such as walking barefoot over fecal sludge, working or playing in drains that carry fecal sludge discharged from latrines, drinking water contaminated with pathogens from fecal sludge).

The study has identified that the most widespread source of environmental contamination is solid waste – and where this includes fecal matter it could present a risk to public health. While fecal contamination of water supplies was most commonly found in low-income areas, assessment of the findings has so far not identified a strong association between the contamination and other external factors including poor solid waste management, lower access of household latrines or the presence of public latrines. Further investigation would be necessary to identify the sources of contamination.

While current practices for managing containment and emptying of pits and tanks cannot be directly linked with any risks to public health at present, what is of concern is how these practices are coming under increasing pressure from the rapid expansion of the city. Where low-income areas are growing in size and housing density, pressure on available space is becoming an increasing concern. The current practice of abandoning or covering pits when they are full and using alternatives will become increasingly non-viable as space runs out. The potential outcomes are unknown, but may include more overflowing pits, or increased dependency on communal or public facilities

Decreasing space to dig new pits

This issue was raised a number of times during focus group discussion (FGDs) held in low-income areas – where people have up to now been abandoning pits – usually temporary ones – and digging new pits, or reverting to other forms of sanitation. However, respondents acknowledge that this practice will not be possible for much longer, as they are running out of space to dig new pits. The implications for this on increased risk of direct fecal contamination from overflowing pits or reversion to latrines shared with more households or even open defecation, as well as a growing need for desludging services, cannot be quantified at this stage – but must be raised as a major concern for any plans to address the informality of settlements and tenure security.

Contamination of groundwater

The household survey identified that 97% of households throughout the city have access to an improved water point. Given this, and a significant number of people reporting using septic tanks, the rate of emptying pits and tanks could be expected to be higher than reported. A number of factors are likely to affect this situation – most notably the interaction between the groundwater table and the contents of the tanks.

As indicated in the overview, the soil type in the area is volcanic rock that has a high permeability, while the groundwater table is also within a few meters of the surface in much of the low-lying areas around the lake. This would result in significant leaching from soakpits, unlined or partially lined pits and tanks into the surrounding soils. Implications for health risks from the movement of pathogens and eventual interaction with the groundwater (influenced by the depth of groundwater below the surface throughout the year) is considered negligible – given people's reliance on treated water brought in from outside of the city and minimal, if any, use of groundwater taken from shallow wells within the city for domestic purposes (especially drinking). However, the real possibility of resulting pollution of Lake Hawassa in the near future must not be under-estimated, as discussed further in Section 10.

Pit / tank filling rates and emptying

As noted later in Section 6.3.1 in relation to pit filling rates, participants of focus group discussions held in some of the low-income areas indicated that pits can fill with groundwater during the rainy season, then the level drops during the dry season. The filling of pits from groundwater rising above the base of the pit could result in the pit contents effectively 'fluidizing' on a regular basis, with the content being 'washed-out' into the sub-soils.

This situation may be considered as "under control" at present, given that the demand for FSM services is extremely low, as unlined pits and tanks take a very long time to fill. However, the chance of localized fecal contamination from rapidly-filling pits and tanks will only increase as more and more are poorly constructed, especially as low-income areas expand rapidly and become more densely populated. Without the development of a viable service sector for pit and tank emptying, this increases the risk of pits and tanks not being emptied before they overflow.

6 FSM service potential demand and supply assessment

6.1 Introduction

In economic theory, markets for goods and services operate on the basis of demand and supply. This chapter provides a brief assessment of demand and supply for FSM services in Hawassa. At this stage, it is important to note the difference between potential (or notional) demand and effective demand. The *potential* demand for FSM services is considered to be the type and quantity of services which would be demanded in the absence of any market failures or distortions. This is different from *effective* demand, which is the type and quantity of services actually purchased in the context of current supply and current prices.

Reasons for a gap between potential demand and effective demand in Hawassa include: (i) many pits and septic tanks are unlined or partially lined with contents leaching directly from the chambers into the soil, rather than fecal sludge being stored within a sealed tank and only settled effluent discharging through a soakpit, (ii) poor operation of septic tanks, which are allowed to back-up before being evacuated instead of regular desludging to maintain correct function of the tank and soakaway, (iii) service providers may not be able to physically access households, (iv) market prices for services may be higher than consumers are willing or able to pay.

On the supply side, the types of FSM services the market is currently providing to households are considered.[23] Dimensions of supply include the number of service providers of different types (manual, mechanical etc.), the geographical areas they serve, the prices they charge, and so on.

6.2 Methodology

This sub-section sets out key dimensions of demand and supply, and the data collected related to those, from the various instruments. The study did not set out to collect data on all of these aspects, given the broad scope of the research and the limitations of some of the instruments used.

6.2.1 Demand

In the research framework (see section 1.3), there is the following question: “What is the existing customer demand and preferences for FSM services?” i.e. the current effective demand. This is discussed below in three parts: (a) physical and economic determinants of household demand, (b) household satisfaction with current services, and (c) the barriers which households face in obtaining FSM services. This list is not meant to be exhaustive, but rather covers those points which were important for answering the questions in the research framework.

Physical and economic determinants of household demand

It is useful to separate the physical and economic determinants of household demand, because the differences between them have implications for any interventions to either stimulate or respond to that demand. Physical determinants are related to demographics, geography and infrastructure, whereas economic determinants are more to do with markets and finance.

Some of the main determinants are set out in Table 10 and Table 11 below, which list various key determinants and the way they have been measured in the research instruments, as well as if a decision was taken not to collect data in this area.

[23] FSM services are also demanded by the government, businesses etc. but households are the focus of this study.

Table 10 Physical determinants of demand for FSM services

Dimension	Instrument used to collect quantitative data
1. Accessibility of location	
Equipment access – likelihood of equipment of different sizes (manual emptier, VacuTug, tanker truck, etc.) being able to access the facility to empty it	Household survey questions about equipment access and emptying point. Also transect walk questions around conditions of roads/paths in the area
Type of building – whether single-storey or multi-storey, and privately owned or in shared ownership	Household survey question
2. Fill rate	
Volume of containment – the nature of the containment method (e.g. whether a pit, tank, or no real containment) and its volume	Household survey question on type of containment, from which we constructed a latrine durability index, but not volume (as household estimates thought to be unreliable)
Solid waste accumulation in pits– the amount and nature of solid waste thrown into pits, rather than being collected	Household survey question on the main means of solid waste collection
Number of users – the number of household members (i.e. the owner household plus any sharing households) determines volumes entering the pit	Household survey questions around household members and numbers of households sharing
Climate, soil type and groundwater – the fill rate is not a simple function of the previous two determinants. Ambient temperature, soil type and groundwater table can all strongly influence the rate of filling and digestion of fecal sludge.	Qualitative only, through key informant interviews, plus secondary data.

Table 11 Economic determinants of demand for FSM services

Dimension	Instrument used to collect quantitative data
3. Financial	
Ability to pay **(ATP)** – poor people do not always have the available finance to pay for FSM services.	No formal assessment of ability and willingness to pay, as this was to be added at the request of the World Bank in each city. However, we did collect data on capital expenditure on latrine construction and the price paid last time the pit or tank was emptied (if relevant).
Willingness to pay **(WTP)** – people may have access to the finance required but not be willing to pay for the service at the market price, for any number of reasons.	
4. Incentives	
Tenancy status – households who rent property from a landlord may not have authority to deal with sanitation matters. Landlords may not want to pay for tenants' ongoing services, connecting latrines instead to a direct discharge. Tenancy status therefore influences the incentives and decision-making role of the likely service purchaser.	Household survey question
Alternative sanitation options – if there is space, then households can dig a new pit and cover the old one. If there is not, the household may still abandon the latrine and use an alternative option (shared/public latrine or open defecation) rather than use an FSM service	No data, since it is hard to gauge what options are open to households. We did however ask in the household survey what they planned to do next time their pit or tank filled up.

Household satisfaction with existing services

Household satisfaction with the performance of service providers will be a determinant of demand. This was addressed in two ways through household survey questions based on a four-point Likert scale.[24] Firstly, households were asked to rate their satisfaction level with various aspects of the sanitation facilities used, including quality of construction, ease of access, privacy and cleanliness. Secondly, households which had used an emptying service the last time their pit or tank filled up, were asked to rate the service provider on price, overall service quality, safety and ease of obtaining service.[25]

Other barriers which households face in obtaining FSM services

Some reasons for a gap between potential and effective demand for FSM services that may be operating in Hawassa are already listed above (e.g. physical access to households and willingness to pay). However, there are other potential barriers which households may face in securing FSM services. Some of these barriers to accessing services have not been possible to predict *ex ante*. These were therefore explored in the qualitative research, particularly through FGDs with community members in low-income areas. Several of the discussion questions focused around perceptions and opinions of existing services, and what participants would like to see in terms of improved services in the future. Discussions were semi-structured, with participants able to discuss questions more openly, so allowing for the identification of further determinants of demand not otherwise addressed in the household survey. The full list of topics and questions addressed can be found via a link in Annex D.

6.2.2 Supply

On the supply side, the research questions were around the current status and quality of FSM service delivery, with a focus on assessing current technical and institutional capacity (i.e. the scope and quality of services). This was assessed mainly through the report submitted by the WSP consultants, using interviews with Hawassa City Administration, service providers and operators of the treatment plant.

The following areas were considered:

- **Physical capacity**
  - Scale – number of service providers, their staffing capacity and areas they serve
  - Clients – number of clients in past month

- **Technical/institutional capacity**
  - Formality – whether formal (i.e. licensed/registered) or informal
  - Compliance – local regulations, or fines/persecution imposed

Answers on all these dimensions were not always available or forthcoming. Naturally, households' satisfaction with service providers (see previous section) was also relevant.

6.3 Findings – household demand for FSM services

The results in each key area are presented below, with an overall assessment provided in the concluding section, alongside implications for FSM in Hawassa.

[24] Categories included "very satisfied", "satisfied", "dissatisfied" and "very dissatisfied".
[25] A low proportion of households responded to this question (35 out of 360), so there are few observations for these indicators.

6.3.1 Determinants of household demand

6.3.1.1 Accessibility of location

Whether a service provider can actually get to the facility requiring emptying (as well as the household's perception of this) will be a key determinant of demand for services. Data to assess accessibility were collected from several angles and analyzed starting from road / path systems in the PSU, before focusing down to the household level and, ultimately, the facility itself.

Some of the transect walk data sheds light on the kinds of housing density, paths and roads observed in the studied areas. Table 12 provides scoring data for city-wide and low-income areas.[26] The main issue is that housing density is a significant issue in low-income areas only, with paths and roads not likely to pose significant limitations on access for services either at a city-wide level, or in low-income areas specifically. In terms of implications for FSM services, what can be concluded from this table is that while mechanized emptying equipment may find it relatively easy to access all areas of the city, reaching individual households may prove to be difficult in some low-income communities.

Table 12 Scoring for housing density, paths and roads from transect walks

	City-wide (n=30)			Low-income (n=10)		
Score	**Housing density**	**Paths**	**Roads**	**Housing density**	**Paths**	**Roads**
1 = lowest impact	50%	53%	67%	0%	40%	50%
2	13%	7%	30%	10%	0%	50%
3	20%	27%	0%	30%	30%	0%
4	17%	13%	3%	60%	30%	0%
5 = highest impact	0%	0%	0%	0%	0%	0%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Notes: Definitions used to score Housing density, Paths and Roads are given in Annex C. Scores indicate relative impact on effective FSM (see footnote below and the table in Annex C), while values per parameter show the percentage of transect walks for which this score was given. There were 30 and 10 TWs held in city-wide and low-income PSUs respectively.

The type of building also influences the extent and nature of the emptying likely to be required, though a large number of variables will affect this. Table 13 below shows that the majority of households in Hawassa live in private residences (95%), mainly single-storey construction (92%) and a few multi-storey (3%). The remaining 5% occupying shared residences. On this basis, the majority of emptying arrangements will be within the control of the home owner/occupier.

Table 13 Type of building occupied

	%	No. of households
Private residence (villa)	92.5	333
Private residence (multi-storey)	2.8	10
Shared residence (in single-storey building)	3.3	12
Shared residence (in multi-storey building)	1.4	5
Total	**100.0**	**360**

[26] Scores of 1-5 have been developed to address a range of physical factors in the built environment for each city study. The scores provide a quantitative value to represent the qualitative assessment of each factor, relative to the impact from that physical aspect of the PSU on achieving effective and safe FSM services. A score of 1 represents the lowest impact and 5 the highest impact. Annex C includes further explanation of the scoring mechanism.

Focusing on the toilet itself, Table 14 below shows the accessibility of the main pit/tank structure, followed by the presence of a purpose-built access point to enable emptying (as would be expected with a correctly-constructed septic tank for example).

Table 14 Accessibility of toilet for emptying equipment

Access for emptying equipment	%	No. of households
Poor access	28.1	101
Reasonable access	24.2	87
Good access	47.8	172
Access point for emptying	**%**	**No. of households**
Yes, purpose-built	68.6	247
Yes, squatting plate must be removed	16.4	59
No, slab must be broken	15.0	54

Overall, from the perspective of accessibility it is clear that 'geographical access' to the toilet itself is a concern for almost a third of households (28%), while there may be reasonable access reported to gain access into pits and tanks for emptying.

Filling rate

Data on the type of containment is already shown in Table 6 in section 4.3.1 above. As noted earlier, data were not collected on the volume of pits and tanks, since household estimates of this were thought to be unreliable. However, households were asked how long it usually took for their pit to fill up, which was considered more relevant, and a more reliable indicator for households to estimate. The results are in Table 15 below. It should be noted that out of 265 households responding to the question on whether their pit/tank had ever filled up, only 23 households (<9%) answered "yes". The data shows that among households in Hawassa who have reported their pit/tank as having ever filled up, 35% are taking less than 1 year to fill and 87% less than 4 years.

Table 15 Average time taken for pit or tank to fill-up

	%	No. of households
Less than 1 year	35	8
1-4 years	52	12
5-10 years	9	2
>10 years	4	1
Total	**100**	**23**

Considering data on sharing of latrines, the mean number of households reported to be using a latrine which was shared was 5.3 (n=223). Where toilets are shared, it is worth considering the numbers of *people* sharing in more detail, as is shown in Table 16 below. This comes directly from data reported by all households, as opposed to estimations based on secondary data. It should be noted that the average household size was 5.5.

Just under a quarter of latrines were shared with fewer than 5 people (i.e. one household), with over 50% of people using latrines shared by between 5 and 15 people and over 20% using latrines shared by more than 15 people. This supports perceptions expressed during FGDs about high reliance on shared facilities, but perhaps suggests fewer households sharing each latrine than indicated when respondents stated the number of households they shared a latrine with.

Table 16 Number of people using the same sanitation facility

No. of people using the same facility	%	No. of households
1 to 5	23.7	85
6 to 10	34.1	122
11 to 15	20.1	72
16 to 20	9.8	35
21 to 30	9.8	35
More than 30	2.5	9
Total	**100.0**	**360**

Where facilities are shared between households, they can expect to fill more rapidly than those used by single families. However, filling rate is also affected by the size of pit, construction (extent of lining) and soil characteristics. While the household survey did not include an assessment of the physical characteristics of the facilities, participants in FGDs did refer to certain characteristics of pits in low-income areas. In eight locations participants identified that emptying services had never been used. Of the factors identified as possibly influencing this, they included:

- soil conditions: sandy soil and stony soil was noted as occurring at depth in three locations. While pits in these locations might fill up during the rainy season, the level in the pit drops again in the dry season;
- depth of pits: in two locations pits were reported to be anything from 5m to 10m deep.

The implications of this, coupled with the soil characteristics, water table and other factors are considered in more detail in Section 5.

Financial aspects

Collecting data on willingness to pay (WTP) and ability to pay (ATP) was beyond the scope of this study. However, data were collected on the price paid the last time an FSM service was used, and whether households thought that price was fair.

First though, it is worth briefly considering finance for containment. Households were asked how much they spent (in cash, including materials and labor) to build their toilet at the time when it was built, if they spent cash at all. City-wide the average financial cost of constructing an improved facility was US$156 (n = 178), while the cost for an unimproved facility was US$84 (n = 39).

Table 17 below presents the average cash contribution reported by households for all toilet types (improved and unimproved) – for city-wide and according to wealth quintiles. Although the figures are somewhat variable between the quintiles, it does indicate that all households are making a significant contribution to latrine construction – most notably those in the lowest quintile, when compared to their income level.

Table 17 Average cash contribution to toilet construction by wealth quintile: all types

	Average cash contribution (USD)	No. of households
City-wide	**$143**	**217**
Lowest	$108	41
Second	$84	47
Middle	$168	45
Fourth	$147	40
Highest	$210	44

Regarding repairs or maintenance to toilets in the past 12 months (including repairs to the toilet mechanism, superstructure, or drainage arrangement), the average expenditure was US$114 (n = 51).[27]

Overall, households are investing significant resources in both the construction and maintenance of their sanitation facilities. While 51% of households have spent money in maintaining their sanitation facilities, these costs amount to 80% of the original investment for the construction of the facilities.

With regard to payment for FSM services the last time emptying took place (Table 18), the mean amount paid was US$61 (n = 34). 32 households (94%) paid a flat rate for the emptying service and paid the full amount on delivery. These costs are considered further, in relation to the official tariffs and reported charges made by private and municipal service providers, in Section 6.4.1 and Table 21. For about half of household respondents, these costs were perceived to be high, while the other half considered them to be fair.

Table 18 Average amount paid for emptying services

	US dollars	No. of households
Amount paid	$61.07	34

* Exchange rate: 1 ETB (Ethiopian Birr) = 0.048 USD

6.3.1.2 Incentives

The incentives that drive demand for improved FSM services are influenced by who is responsible for the ongoing maintenance to keep toilets functioning. The household survey shows that 85% of respondents own their property, so they will have greater influence over how their latrine is managed. 80% of households used a private household toilet (on plot), with landlords reported to be responsible for managing toilets in 30% of cases. This value does not tally completely with the 15% of people reporting to be in rented property. This may illustrate some confusion over the definition of 'landlord' when responding to the specific survey questions, or be influenced by the occupancy of government-owned "*kebele houses*". These are large houses in the older parts of Hawassa, often originally owned by a single family, but now with several families living in them and paying nominal rents to the local government.

However, it can be ascertained that, with high numbers of households using an on-plot private toilet, they are more likely to be responsible for servicing that toilet and/or what it is connected to (i.e. a septic tank or pit). Most households are therefore key stakeholders in decision-making around investments and plans to improve infrastructure and FSM services to support ongoing functionality of the sanitation service chain.

Where households invest in a toilet facility, they are likely to have stronger incentives for seeing it continue to function. 33% of facilities were reported as being strongly improved (with an overall durable superstructure, cleanable slab, a roof and providing privacy, possibly with a water seal) and a further 10% being basically improved (with a durable superstructure and cleanable slab).

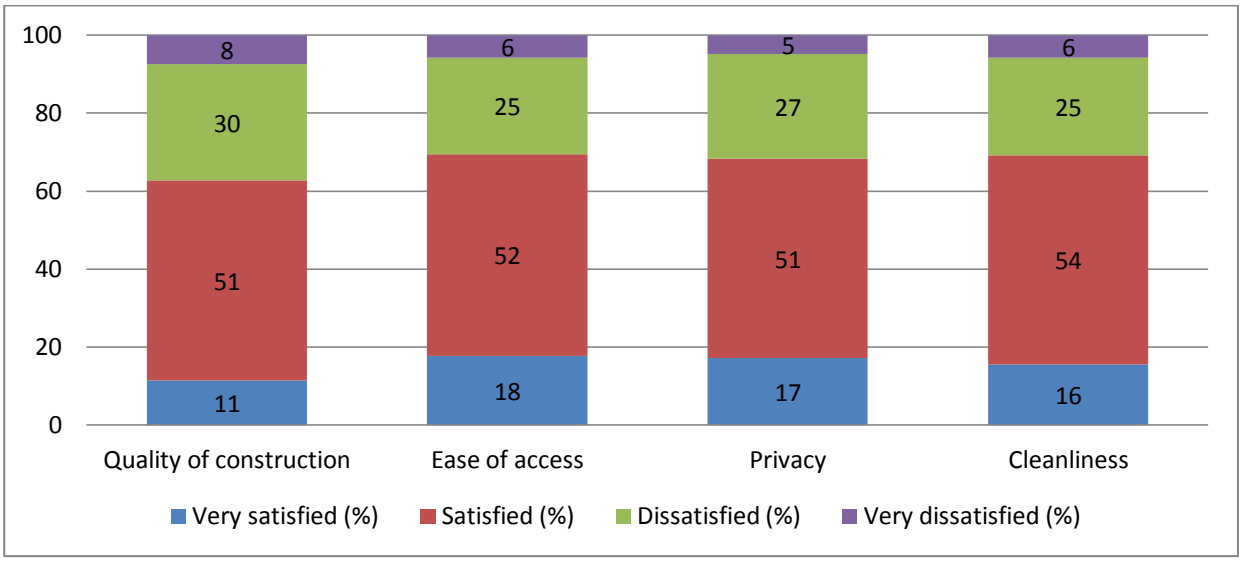
[27] Most households reported that this expenditure was mainly for repairs to the toilet bowl/slab or to the superstructure (82%), while only 8 households (16%) incurred costs for emptying their pits/septic tanks in the last 12 months.

6.3.2 Household satisfaction with current services

Households were asked to express their satisfaction with current services – both the sanitation facility itself and the emptying services used – across a range of factors, as shown in the following Figure 7 and Figure 8.

The majority of households (60-78% in all cases) reported being satisfied or very satisfied with the sanitation facility, across all four characteristics in the question. Dissatisfaction with all four characteristics was at a similar level (25-30%), with levels of being very dissatisfied limited to less than 10% in each category. In this case all 360 households responded.

Figure 7 Satisfaction with characteristics of the sanitation facility



For the households who reported using a service provider (35 households, or 9% of respondents), satisfaction levels (either satisfied or very satisfied) were between 65-80% for all four categories of service provision. Levels of dissatisfaction were less than 35% in all four categories, with price receiving the highest level for dissatisfaction (dissatisfied and very dissatisfied combined at 35%) and the ease of obtaining services gaining the highest response for very dissatisfied at 20%.

The issues of price and gaining services are verified by comments made during the FGDs in PSUs where participants had used emptying services. Respondents noted that households can be waiting up to 3 months for a government truck to be available to provide emptying services, as the public operations have restricted capacity. The private truck operators have much greater capacity to response and often charge a much higher fixed rate per emptying. As a result, the flat rate per emptying is typically 600 ETB (approximately USD 30) for the government service, compared to 1,600 ETB (approximately USD 77) for the private provider service. The private providers are reported as being able to respond more quickly to requests, which will be influenced by their level of capacity compared to the level of demand. Other aspects of service quality and safety were not raised during FGDs as issues of particular concern.

Figure 8 Satisfaction with emptying service provider

Households were also asked their *intended* action once their pit or tank fills-up (whether it had filled previously or not). The results are shown in Table 19 below. Less emphasis is given to this data than what action was taken after the pit last filled up, as these intentions may not be carried out. Nonetheless, it does indicate a strong degree of intention to use the mechanical emptying market – with 78% of respondents inferring use of a mechanical emptier. Making use of mechanical emptying services is by far the preferred intention – but in reality this is not the action that most households have taken in the past.

Table 19 Intended action after pit/tank fills-up

	%	No. of households
Empty by household member	1.1	4
Empty by a manual emptier	0.3	1
Empty by a mechanical emptier	78.1	281
Cover and seal pit	16.4	59
Abandon without covering	0.8	3
Don't know	3.3	12
Total	**100.0**	**360**

The household survey data do not give insight into the reasons why people's preferred option is different to current practice, but responses given during FGDs in low-income areas do provide some idea of the barriers households currently face in obtaining FSM services, as discussed in the next section.

6.3.3 Barriers faced by households, in obtaining FSM services

Focus group discussions (FGDs) held in low-income areas identified that the key barriers faced by households in obtaining FSM services relate to (1) cost / affordability, (2) access to services and (3) legality of residence affecting latrine design and operation.

In relation to **cost and affordability**, householders living in low-income areas do not have the financial resources to build a good latrine that could be easily and safely emptied. They also find the emptying services expensive. The service providers charge fixed fees per trip and these are

recognized as very expensive by people who have used them – although in the vast majority of cases, people are not making use of these services. Households are clearly aware of the services on offer from the government and private operators, as well as the costs being charged for these services. There was a reported lack of government subsidy, or direct financial support, to make emptying services more affordable, but an expression of demand for these services if they were "affordable".

In relation to **geographical access**, the transect walks identified the main limitation for service providers in low-income areas was housing density. This is indicated in Table 12. Respondents in a number of FGDs also identified poor physical access to their area and to the households themselves (dense housing and narrow pathways between them) as a constraint to using current emptying arrangements (i.e. the mechanized vacuum tankers). In more formal areas of Hawassa however, access for service providers to households does not appear to be a significant barrier.

The issue of **tenure security** is more complex and a significant barrier affecting households in low-income areas within the city, particularly as these areas continue to expand and become more densely populated. Households often arrange for an initial temporary shelter to be constructed on an unregistered plot of land, sometime paying builders to construct them at night so it is 'built' before the authorities can prevent them from doing so. While they also do not have permission from the Municipality to construct toilets, the household will generally construct a temporary, unimproved and shallow (1-2m deep) pit latrine. When the pit fills up or collapses, it is abandoned and a new pit dug. This practice is widespread and occurs while families have space to dig replacement pits, but increasingly a lack of space is putting pressure on these households. Those living in low-income areas identified that they have no incentive to build toilets that would require emptying, as they are not prepared to make the investment in an improved toilet when it is in danger of being destroyed by the authorities. They are effectively barred from receiving formal containment or emptying services.

Households **living in poorer areas** of the city in general may end up using shared latrines, or one of the few communal or public toilet facilities provided by the government or an NGO. 6% of households in the city-wide survey were identified as using a communal (off-plot) latrine facility (as distinct from the 14% using an on-plot shared facility) and less than 1% using a public (off-plot) facility.

A further barrier for households identified during the FGDs was a lack of **technical knowledge and broader awareness** about how to construct good latrines, effectively manage and maintain them. Respondents said that with government support in the way of materials and training, households would be prepared to provide labor and skills to improve their existing latrines or build new improved ones. However, they see far less of a role for households in emptying these latrines, unless and until: a) people have no other option (i.e. they run out of space to dig a new latrine pit), b) they have permission to more permanent build latrines that are designed to be emptied, and c) the cost and waiting times for services are reduced.

6.4 Findings – supply of FSM services

As set out in section 6.2.2, questions on the supply side of FSM services related to the current status and quality of FSM service delivery. This was divided into assessments of physical capacity of service providers (number of providers and the scale of service reach) and technical / institutional capacity (the scope and quality of services).

6.4.1 Services effectively supplied

The first stage of the supply analysis is to consider what services are supplied in the market, where effective supply intersects with effective demand. Some relevant context was already provided in Section 4.3.1, especially in Table 6 and Table 7. These tables show that when pits have previously filled up, some people do empty them, but the majority of households abandon the pit and make use of an alternative. The data show that city-wide, only 10% of households in Hawassa have emptied a pit or tank.

The households which reported having their pit or tank emptied last time it filled up were also asked the emptying method and type of equipment used. The results are shown in Table 20 below. This highlights that in all instances, some form of mechanical emptying was reported to be used. In most cases, this was carried out by a formal private provider, followed by an informal provider, then by the utility. Together these account for 77% of reported emptying methods.

Table 20 Emptying method cross-tabulated with service provider type

	By hand	Manual pump	Mechanical machine (%)	Total no. of households
Member of household	0	0	9	3
Neighbor	0	0	3	1
Informal provider	0	0	20	7
Formal provider (company)	0	0	40	14
Formal provider (utility)	0	0	17	6
Other	0	0	11	4
Total	**0**	**0**	**100**	**35**

These households were also asked about where the fecal sludge was discharged during emptying. Households were only asked about the initial discharge point, as they would not always be in a position to know where service providers eventually discharged to. All 35 households responded that the contents were (initially) discharged into a machine/tanker.

Emptying by a member of the household, neighbor or “other” means was reported to account for 23% of emptying methods used. It would be surprising if a mechanical machine was employed in all of these cases, but with the responses about the initial discharge point backing this up, it would appear that use of a mechanized arrangement predominates, when people do actually empty their pits or tanks. This is also supported by the high reported levels of satisfaction with the quality and safety of emptying practices, as shown previously in Figure 8.

With regard to the type of payment made for services, almost all responding households (n=34) reported paying a flat rate (94%), with only 6% of households (n=2) reporting being charged a volumetric rate. As reported in Table 18, the average amount paid for emptying is approximately USD 86 for formal private services and USD 70 for formal municipal services. However, costs reported in the household survey vary by a factor of 16, from USD 14 to USD 230 for a formal private provider, even with 94% of responses from the city-wide sample reporting a flat rate rather than a volumetric charge.

The approved charge rates (applicable only to the WSE services) given by the General Manager of Hawassa City Water and Sewerage Enterprise (WSE) are shown in Table 21 below. This highlights the variation in official and unofficial charges for services provided by private operators and those provided by the municipality. It is interesting to note that the prices reported directly from households in the survey are almost twice the currently approved rates, and close to the commercial rate. Even if this is a result of additional ‘informal’ fees being paid to the drivers, it

indicates that the current rates paid are commercially viable. The General Manager also pointed out that actual charges made by private operators are often more like ETB 1,500 (or USD 72 – which compares with values reported during the FGDs), as operators are unable to achieve cost-recovery based on the official rates and find that households are willing to pay more anyway. This is placing greater strain on the Municipality for services, which they feel unable to respond to at present.

In addition, the Municipality is proposing an increase to the official tariff, to achieve greater parity between charges made by the public and private operators. An increase in fees will also support the costs associated with trucks travelling to the existing drying beds – which places significant wear on the vehicles travelling on the unmade and rough road as they travel up the hill to the site, especially with a full load and during the rainy season. These costs are also shown in the table below. At these rates, they are more like the charges reported during a focus group discussion in one of the low-income areas of the city – which suggests that some households are already being charged at the higher proposed rates for private operators. The full set of results in the table highlights that household survey data are broadly consistent with other data sources.

Variations in charges will be affected by the capacity of the trucks used. The specific capacities have not been determined, but are known to vary between those used by the private and municipal operators. It is likely that the capacity in the range of private trucks is larger (between 7-10m³), while those of the municipality are in the order of 4-6m³.

Table 21 Ranges of identified emptying charges: formal private and municipal services

Source of data	Charge (USD) Private provider	Charge (USD) Municipality
Household survey (average cost) [28]	$86 (n=14)	$70 (n=6)
FGD: residents in central Hawassa, using emptying services (mostly in the rainy season)	$77	$30
WSE: approved tariff for private institutions	n/a	$36
WSE: proposed new tariff (to be approved)	n/a	$77
Private provider: more typical charge	$72	n/a

Note: Charges are per trip, where a trip is based on emptying one household septic tank or latrine.

6.4.2 Service provider capacity

Mechanical emptying services

FSM services in Hawassa City are provided either by the municipality (Water and Sewerage Enterprise, WSE) or private service providers.

- The municipality owns two vacuum trucks that carry out up to six trips per day. However, at the time of the study one of the municipal vacuum trucks had broken down and was out of action – and had been for some time. WSE expressed an intention in late 2015 to purchase a further two trucks, which may affect the decision to re-adjust the charge rate.
- There are five privately owned vacuum trucks registered with the Water and Sewerage Enterprise. In addition, a further four or five vacuum trucks provide emptying services exclusively for hotels, resorts and restaurants in the city. In total, up to twelve vacuum trucks

[28] These costs compare with an average of USD 57 for emptying by informal operators, as reported in the household survey (n=6).

can be operating in the city at any one time – although only up to seven are available to serve domestic properties. The private providers do not operate only in Hawassa, but sometimes move to other towns to gain additional business.

The private providers are considered by households to provide a faster response service, but they are also reported to be unofficially charging much higher rates than the approved tariff. This places greater pressure on the municipality, which charges lower rates, and feels that the level of demand they face is putting pressure on their operators and the trucks themselves. As a result, the General Manager of the Enterprise identifies that current capacity for FSM service delivery in terms of materials, financial and human resources is insufficient, especially in light of the increasing demands of a rapidly expanding city.

During interviews with city stakeholders, it was mentioned that private vacuum truck operators complain they do not secure enough emptying jobs to make their work financially viable. The seasonality of this work is in any case a commercial challenge. Together with the felt inadequacy of the official tariff rate, these operators go on to identify themselves as operating from 'outside of the city' and are therefore able to charge unofficial tariffs when serving customers within the city. Implications of this practice on future licensing of the operators is addressed in Section 9, the Prognosis for Change.

Manual emptying services

The household survey did not identify any manual emptying service operating in Hawassa – although in a few instances emptying of pits/ tanks was reported as being carried out either by the household themselves, a neighbor, or a means "other" than a recognized emptying provider (see Table 20). This accounts for only 8 households, or 2%, of those surveyed. Only one household identified using a manual emptier in any intended future emptying. Interviews conducted by the WSP consultants confirmed that manual emptying is virtually non-existent in the city.

Factors affecting household decisions about which service provider to use

The main decision households make is between using the vacuum trucks operated by the municipality, or those operated by private providers, or to abandon their full pit/tank. Both providers appear to offer a safe and efficient service, with no concerns reported during FGDs about the emptying or transport practices introducing risk to people's health, or contaminating their compound, neighborhood or the city from poor operating standards and procedures.

The key factors affecting the choice between private and public emptying are cost and speed of response. As identified in Table 21, the average fees reported as charged by private and public providers (from the household survey) are not that different. However, actual fees more typically charged by private providers, including in central areas of Hawassa, can be more than double those more typically charged by the municipality. Set against cost is the bureaucracy that affect the response times of the municipal services – particularly given the lack of capacity they currently have. In spite of the private operators being registered with the Water and Sewerage Enterprise, they are in a position to act more independently and informally when it comes to charging households, as they provide a more responsive service. Waiting times for the municipal tanker in some areas were reported as being up to 2-3 months – especially during the rainy season when demand for emptying is at its greatest. Respondents stated in the FGDs that they would like the municipality to address the waiting times when using the Enterprise truck, so that services can be available as and when needed.

7 Fecal sludge treatment and possible end-use options

7.1 Fecal sludge characteristics

During the study, including the period in which survey data was piloted and conducted in Hawassa, the survey firm was unable to arrange to take samples of fecal sludge being removed from household latrines, or communal latrines used by households as their main latrine. This was reported as being due to a lack of demand for emptying services from households during that time, notably as it was during the dry season in Hawassa when demand for emptying services by households is known to be extremely limited. However, it may also be that the sample areas were not sufficiently extensive to pick up the emptying of septic tanks in more formalized areas of the city, or from communal toilet blocks shared by households in the more informal settlements. As a result, field-based samples for testing fecal sludge characteristics were not made available. Despite this, fecal sludge emptied from commercial properties and institutions (hotels, offices, public toilet blocks, etc.) continued to be emptied and transported to the fecal sludge treatment plant, with discussion about the quality of services and treatment provided informed by those operations.

Interviews held with vacuum truck drivers identified that trucks make on average four trips per day in the dry season. This is reported to double during the rainy season, as a result of pits and tanks being unlined and filling more quickly either by filling from below as the groundwater table rises, or the inflow of surface run-off. With the city being a tourist destination, there are many large hotels and resorts with dedicated vacuum trucks that can be emptying and disposing of fecal sludge at least once a day. In addition, industrial effluents are likely to already be a significant contribution to what is taken to the treatment plant. This will increase over time as the new industrial zone expands – having an impact both on the treatment capacity of the site and the potential end-use of treated fecal sludge.

Vacuum tankers were observed discharging fecal sludge at the treatment plant during the survey firm training and while the WSP consultants were conducting interviews. The discharge from these tankers was noted as being extremely liquid – with only a small proportion of the discharged fecal sludge having any significant solids content as the tanker reached the final stages of discharge. These tankers were identified as having emptied fecal sludge from hotels and other non-household sources in Hawassa. It is to be expected that in such cases, significant volumes of wastewater will be entering into the pits and tanks – from water used in cistern-flush or manual flushing toilets, together with water used for anal cleansing and possibly greywater from showers, sinks and other outlets in hotels and restaurants. This, combined with the limited access to fecal sludge emptying services for households in Hawassa, will result in weak fecal sludge arriving to the drying beds.

The discussions that follow are based on limited data made available during this study. Any further developments to the current treatment facility and detailed designs for any new treatment facilities will require much more detailed investigation into the full range of domestic, commercial and industrial effluents being collected and transported to treatment – both at present and anticipated in the future.

Tanker discharging fecal sludge (very weak in this instance) at the drying beds…

7.2 Current treatment and possible future options

The Water and Sewerage Enterprise has a treatment plant located at the top of a hill near the city and about an 18km journey from the city center. The location is known as Alamura. The treatment system is made up of eight drying beds, with a total area of approximately 2,500 square meters, and each bed thus has a surface area of approximately 300m².

The treatment process consists of dewatering of the fecal sludge by percolation of liquid through the sand beds, and evaporation. The drying beds are open to the atmosphere and will be significantly affected by the variation in rainfall and weather patterns between the dry and wet season.

A maximum of 12 tankers (10 private and 2 municipal) operate throughout the year. An estimation can be made about the volumes of fecal sludge *potentially* reaching the plant in the dry and wet seasons, using data available from interviews and observations.

Table 22 Maximum volume of fecal sludge reaching the treatment plant[29]

Season	Trips/truck/day (reported average)	No. of trucks	Max no. of trips	More likely no. of trips (50%)	Volume per truck (average)	Total volume received
Dry	4	12	44	22	8 m³	176 m³
Wet	8	12	96	48	8 m³	384 m³

An estimation of the capacity of the plant size needed to take the loading of total solids (TS load) per day can be made, using the following values:

Sludge loading rate: 100 kg/TS/m² *(based on "poor conditions" that include high humidity, long periods of rainfall and a large proportion of fresh FS – and in the case of Hawassa, a significant*

[29] Assuming all trucks operating and based on reported number of trips during discussions with truck operators

proportion coming from hotels and other commercial outlets which will have a lower percentage of TS as compared with FS from on-site systems)

Sludge loading height: 0.2m *(the typical depth of FS on a drying bed)*

The volume of fecal sludge arriving to the site each day (see Table 22 above for values):

Dry season = 176 m^3/day

Wet season = 384 m^3/day

Daily volumetric capacity required is therefore:

Dry season = 176 / 0.2 = 880m^2/day

Wet season = 384 / 0.2 = 1,920m^2/day

With each bed having an area of 300m^2, the number of beds required is:

Dry season: 3 drying beds

Wet season: 6.5, or 7 drying beds

On this basis, the eight drying beds would appear to be adequate. However, this is only true where the treatment plant is operating as it is designed to, with effective monitoring, management and planned maintenance. Observations made during both the dry season (March 2015) and soon after the end of the wet season (November 2015) indicated very different conditions.

In March, no overflow from the beds was seen, as well as a number of beds containing dried sludge, which could be emptied if required to take additional discharges of fecal sludge.

Fecal sludge treatment plant drying beds, in the dry season

Drying bed in use

Drying bed at rest

Dried FS being removed

Photos courtesy of Harold Esseku and Mesfin Getachew (March 2015)

During a visit to the plant shortly following the rainy season (November 2015), fecal sludge was observed to be bypassing, or overtopping, a number of the beds and accumulating in an informal “pool” of fecal sludge further down the hillside (see images below). The condition of the beds was also found to be poor, with damage to retaining walls around the drying beds and excessive plant growth on the sludge.

Condition of the FSTP drying beds, following the rainy season

Damaged retaining walls and FS by-passing

Sludge "pond" at lower edge of the site

Photos courtesy of Peter Hawkins (November 2015)

Google maps image showing FSTP and informal "pool" of FS below

What this indicates is that, despite the installed capacity of the drying beds being *potentially* adequate, the treatment plant is not being effectively managed and its condition is deteriorating. Exacerbating the issue of available capacity is that the wet season is the time when demand for emptying increases – although at the same time the number of sludge trucks actually reaching the treatment plant may be affected by the condition of the road, which is reported to become impassable to heavily-loaded tankers when very wet.

Systematic monitoring of tanker effluent discharge and plant effluent (volume or quality) is not taking place. The plant operators and manager do not appear to have the necessary skills, competency or incentives to ensure good practice operation, maintenance and oversight of the facility, in an effort to achieve optimal functioning of the plant. As a result, the strain on current treatment capacity will only be exacerbated and eventually fail, given the almost total lack of attention to monitoring and regulating the tankers, or operation and maintenance of the plant.

The situation at present does not appear to be creating a public or environmental health risk, partly due to the remote location of the site where there is little human activity. However, there may well be greater flows of untreated fecal sludge downhill during the peak of the wet season. If the treatment plant continues to deteriorate, as well as access to it, there is more chance that informal and/or illegal dumping of fecal sludge could occur, or that overflow from the plant will increase to such an extent as to have a wider and greater effect on residents or farmers around the site.

Future treatment / re-use options

Once dried, fecal sludge is manually removed from the beds and the sand layer levelled to take further discharges of fecal sludge. The means of disposal of the dried fecal sludge is not clear and not documented. Fecal sludge is currently thought to be disposed of in open spaces around the plant. It may be further utilized by local farmers on an informal basis, but there was no evidence of this established. The municipality has indicated that Hawassa City Natural Resources and Environmental Protection Agency (NREPA) plans to conduct tests on the fecal sludge to ascertain the possibility of using it in the future as a soil conditioner. Given the weak nature of the fecal sludge, it is extremely unlikely that other uses of dried fecal sludge (such as for biogas generation or as a solid fuel) would be viable under current conditions.

Interviews identified that operation of the treatment plant may be contracted to a private sector institution in the future. The decision for this would need to be taken by the Water and Sanitation Enterprise. A clearly defined management structure, monitoring system and financial arrangement would need to be developed. Such an arrangement is thought likely to help improve the operation of the facility and could also promote use of processed sludge as a way to generate further revenue to manage the plant. However, given the weak nature of the sludge currently received, the capacity limitation of the existing beds to accept additional loading, operational challenges relating to the site, including its location and access, a thorough assessment of private investment potential and implications would be needed.

As such negotiations are occurring, there is a more strategic and pressing need to secure additional land for the site of a new, extended fecal sludge treatment facility, co-sited with a sewage treatment plant as and when this becomes a reality. This site would benefit from also co-siting a new solid waste disposal site – as the location of the current site is known to be problematic.

8 City Service Delivery Assessment

8.1 Introduction

The FSM City Service Delivery Assessment (CSDA) is a crucial part of the analysis of FSM services. It answers an overarching question around the quality of the FSM enabling environment, the level of FSM service development and the level of commitment to FSM service sustainability. The aim of the CSDA is to allow an objective assessment of FSM service performance through all stages of the service chain, so as to identify priorities for reform. The prognosis for change assessment (in the next section) then attempts to explain *why* some the CSDA looks like it does.

Like the Fecal Waste Flow Diagram (see section 4), the CSDA format builds on an approach developed under the 12-city study (Peal et al. 2013). In turn, the 12-city method was based on similar exercises in water and sanitation (e.g. Country Status Overviews produced by WSP).

The CSDA is arranged around three broad areas: enabling services, developing services, and sustaining services. This is illustrated in Table 23Table 23 below, alongside the key question associated with each area, and the indicators used.

Table 23 The CSDA framework for FSM

Area	Question in research framework	Indicator
Enabling	What are current policies, planning issues and budgetary arrangements?	Policy
		Planning
		Budget
Developing	What is the level of expenditure, degree of equity and level of output?	Expenditure
		Equity
		Output
Sustaining	What is the status of operation and maintenance, what provisions are made for service expansion and what are current service outcomes?	Maintenance
		Expansion
		Service Outcomes

8.2 Methodology

The CSDA aims to be objective and transparent, so the analysis is clear and stakeholders can engage with it and update it over time as the situation improves. It is primarily a qualitative analysis, based on a review of key documents and interviews with stakeholders at the city level. As set out in section 2.1, WSP's overall study design was that the OPM/WEDC team designed the methodology, but did not do primary data collection. For analyses such as the CSDA and PEA, it is very hard to separate data collection from analysis. Therefore, the collection and preliminary analysis was conducted by a short-term consultant contracted by WSP.[30]

There are several questions beneath each of the nine overall indicators in Table 23 above, with 21 questions in total. For each question, there are objective criteria to enable a score to be given for the city, with 0 (poor), 0.5 (developing) or 1 (good) on that question. Each question is scored along the whole service chain from containment to disposal. An example is given in Table 24 below, for the first question under the "policy" indicator.

[30] The analysis for the CSDA and PEA chapters of this report are therefore strongly based on the internal report produced.

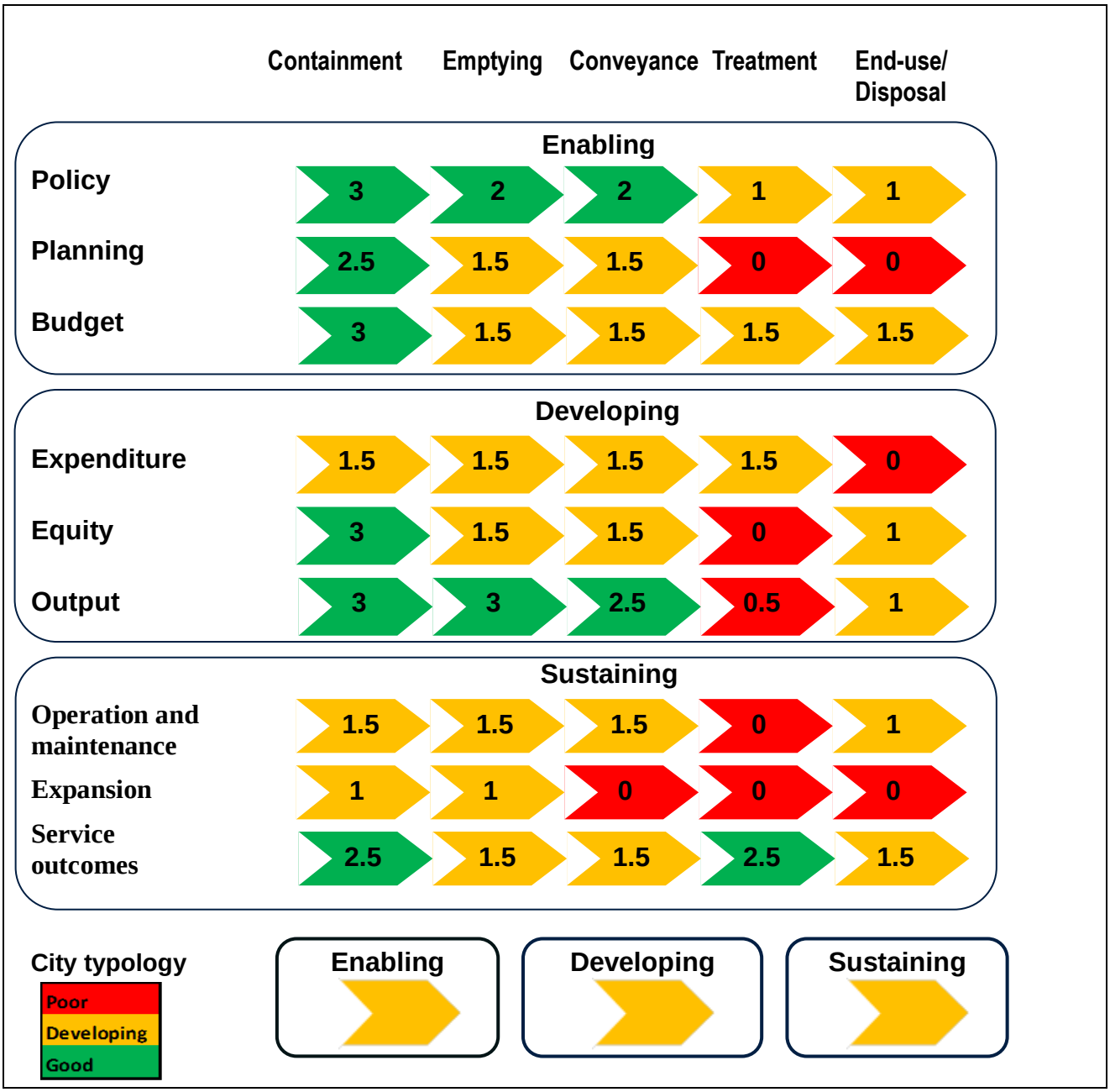
Table 24 Example CSDA question, criteria and scoring

Question	Containment	Emptying	Conveyance	Treatment	End-use / disposal	Indicator/ Score
Policy: Is FSM included in an appropriate, acknowledged and available policy document (national / local or both)?	**0.5**	**0**	**0**	**0**	**0**	• 1: policy is appropriate, approved (or in draft form), acknowledged and available • 0.5: policy is appropriate, approved (or in draft form), but not clearly acknowledged / available • 0: policy not available, or inappropriate to the context

Once all of the questions are scored, the next step is to aggregate those scores into a city scorecard, by summing together the scores for each indicator (policy, planning etc.). Because there are different numbers of questions for each indicator, a final step is required, which is to normalize the scores to a total out of 3 for each indicator. This is achieved by dividing the city score for that indicator by the maximum possible city score, multiplying by 3, and finally rounding to the nearest 0.5. This process delivers the overall CSDA scorecard.

The output for Hawassa is shown in Figure 9 below.

Figure 9 CSDA scorecard for Hawassa



8.3 Findings

The overall CSDA scorecard for Hawassa is shown above. An explanation for each score allocated to the full set of questions is shown in Annex B, while the following summarizes the implications of those results.

8.3.1 Enabling

The extent to which components of the enabling environment are making progress (in relation to policy plus to some extent planning and budgeting, at least for the construction of household facilities) is the result of recent advances at national level for enhancing urban sanitation services throughout Ethiopia. While FSM services are not explicit in existing documents, they are being incorporated into the upcoming National Integrated Urban Sanitation and Hygiene Strategy – which

will account for aspects of fecal sludge emptying, through to treatment and end-use. The overall national objective has, up to now, focused on the safe containment of excreta. Upcoming frameworks will account for the sanitation service chain beyond household containment and the importance of both improving hygiene standards and addressing aspects of environmental protection. The WASH Implementation Framework (WIF) and MoU between ministries of Health; Education; Water, Irrigation and Energy; and Finance and Economic Development are seen as providing a strong basis from which to deliver services. While the national enabling environment is strengthening, implementation within Hawassa faces a number of challenges and opportunities.

- *Institutional roles* for sanitation are clearly defined in Hawassa, though they are stronger in relation to upstream services (containment, emptying and transportation), while aspects of treatment and end-use arrangements are less developed. This is all due to be addressed in the Integrated Urban Sanitation and Hygiene Strategy. The Municipal Enterprise Development Office is tasked to support the development of small and micro enterprises – but this has not been strongly developed for FSM services up to now. Private emptying service providers are somewhat uncoordinated and not strongly regulated at present. NGOs and other non-state providers generally limit their role to providing (communal) latrines in low-income areas, but do not offer follow-up support for the operation, maintenance and servicing of these facilities. A proclamation addressing private sector roles for liquid waste management is under preparation at national level and will eventually be adapted by Regional government and Hawassa City Administration, accounting for the local context.
- *National targets, investment plans and budgets* have been developed as part of the One WASH National Program (OWNP). A lot of significance is placed onto the OWNP, which is seen as a key mechanism through which WASH services will be enhanced throughout Ethiopia. This in turn places substantial responsibility on Hawassa Municipality to identify city-level targets, investment plans and associated budgets for the full range of sanitation and FSM services. Currently, budgets are focused on the provision of (public) toilet facilities and their operation and maintenance (cleaning, emptying, repairs, etc.) but not on aspects of treatment and disposal of fecal sludge. A new Hawassa City master plan is in preparation. This gives greater attention to sanitation than in previous plans, including both developing a sewerage network for the new industrial zone and possibly central areas of the city, and developing the capacity for FSM service delivery within Hawassa.

8.3.2 Developing

Recent capital investment in sanitation in Hawassa has been very low throughout all stages of the service chain and is considered as be insufficient to meet current service requirements, or account for the needs of the expanding city population. The range of service options currently available to all users is considered as adequate in relation to containment facilities, in that the Municipality and NGOs provide public and communal latrines in low-income areas and the Municipality is also considering alternative facilities (including mobile latrines) to serve the poorest. This is reflected in the reported 81% use of an improved latrine (private or shared). However, FSM emptying and transport service options remain very limited and in low-income areas are constrained by cost, access and durability of pits, with market growth for emptying services constrained by the lack of demand for their services at present. There is clearly a problem in that demand for the cheaper utility-operated trucks can result in a 2-3 month waiting time during the rainy season, while the private sector operators often fill this gap.

The availability of capacity and resulting quality of services is considered as adequate – to the extent that the status quo is not posing a risk to public health, either through direct contact with fecal sludge in the open, or through use of the groundwater. There are however no defined standards at present with which to measure the quality of service delivery – either in relation to the

extent of sharing facilities, or monitoring performance of service providers and treatment facilities. The Municipality is continually looking to improve on this and currently takes a forward-looking approach to FSM services and sanitation provision for the city more broadly.

8.3.3 Sustaining

Support of sustained services, operation and maintenance of existing services, achievement of standards at current demand levels, and development of the sector to respond to growing demand are less developed – especially in relation to the stages of emptying through to treatment and end-use.

A significant constraint to responsive FSM services is the lack of demand for emptying from households. This severely constrains the market for private sector engagement or public investment in not only improved emptying, transportation and treatment options to serve a wider range of households, but also restricts households from being encouraged to improve containment infrastructure that can be emptied affordably and safely. More reliable and affordable emptying services would encourage households to invest in more durable pits and tanks, as the first stage in improved non-networked systems as part of a future mix of networked and non-networked sanitation options. This also has an impact on potential end-use of fecal sludge products given that the fecal sludge discharged from commercial customers is typically very weak strength and at present located away from the customer base.

8.3.4 Implications of the CSDA scorecard

The resulting CSDA scorecard of the FSM city service delivery assessment in Figure 9 reveals firstly that in general, Hawassa's FSM service context is progressing and considered to be developing for the three major components of the assessment. The details within each of the components of the CSDA framework and through the various stages of the service chain show a very mixed picture, influenced by the unusual contextual factors affecting the city.

When looking into the details for each of the three components, this reveals that greater attention has been given to improving the provision of household-level infrastructure and to some extent the provision of emptying services to support it. The greatest weaknesses are in relation to the existing treatment facility and the effective disposal of dried fecal sludge, or any actions to develop options for fecal sludge end-use applications. 'Treatment and Disposal' of fecal sludge in-situ (through relying on the capacity of local soils to continually absorb leachate from pits and tanks without undue impact on public health or the wider environment) may be resulting in a satisfactory outcome for now, but as areas of the city become more densely populated the infiltration capacity is likely to be surpassed. This could eventually introduce risks through localized surface ponding of effluent (especially during the rainy season where the ground becomes saturated) and increasing pit collapse.

Perhaps not surprisingly, despite the weaknesses of the emptying services, the outputs of current services people receive and overall service outcomes in terms of management of fecal sludge within the city, come out more strongly. This is affected by how existing household containment infrastructure (pits and tanks) are currently functioning (refer to Section 5.4). There were concerns voiced that the decreasing space to build new pits make these practices increasingly difficult to sustain. It is important to note that, without greater attention given to investing in the future needs of the city, risks to public health will increase. This will be particularly the case in the expanding low-income areas, where concerted efforts will be needed to address issues of inequity and lower service outcomes. This suggests that, to improve FSM services in Hawassa – and most notably for

those most vulnerable to poor services and resulting health risks – greater attention needs to be given to investment in a range of appropriate, affordable and available services.

In addition to this, there are associate needs arising to i) identify the extent for sewerage services in the central area of the city as it moves towards the construction of multi-storey dwellings and ii) plan facilities and services to respond to the expected increased demand from the development of the new industrial area.

An assessment of the combined challenges that need to be addressed to achieve sustainable services in the face of such change, together with the incentives to be addressed, resulting likely intervention options and actions to take forward are considered in the following sections.

9 Prognosis for change

9.1 Introduction

This chapter provides a Prognosis for Change (PFC), by considering the positions of various stakeholders, in particular the institutions and incentives at play. In the sanitation sector, key studies considering these questions include a multi-country study carried out by WSP with OPM (WSP, 2010) and a series of papers by the Overseas Development Institute (ODI, 2013). In addition, SANDEC's recent FSM book includes a chapter on stakeholder analysis, which is a key methodology in this kind of assessment (Strande *et al.*, 2014). Through this PFC, it is intended to understand three things, outlined below.

Firstly, a PFC considers how "institutions" function. Here, institutions are defined as "the rules and norms governing human interaction", rather than a narrower definition of organizations. Institutions can be formal, such as codified laws – one example in FSM might be a by-law about where fecal sludge can be legally dumped. More importantly, institutions also can be informal, such as social norms. For example, prevailing attitudes towards reusing fecal sludge in agriculture are an informal institution.

Secondly, a PFC considers the incentives which institutions provide to stakeholders. A stakeholder is any individual or group with an interest in the outcome of a policy. In FSM, some examples of relevant stakeholders may include (but are certainly not limited to) sludge truck companies, the City Council, or slum-dwellers. Stakeholders can be defined broadly or narrowly as required by the breadth and depth of the analysis. For example, the earlier three stakeholder examples could be narrowed to *recent entrants* to sludge truck market, the *planning department* of the city council, or *female* slum-dwellers. This would allow more nuanced analysis rather than taking whole groups as homogenous.

Finally, a PFC considers how stakeholders exert influence. Here, influence is defined as the formal or informal power to cause something or to prevent it from happening. A city council may have formal legal power, but if all their by-laws are openly flouted by service providers without fear of punishment, then their influence is very low by that measure. However, they may have informal power to influence FSM in other ways, for example in the ways their employees act regarding regulation of truck companies.

In addition, in order to be practically useful, a PFC should also consider the implications of the findings for effective engagement in a reform or change process. This involves an assessment of the options for engagement, and weighing them up in the context of the prevalent power dynamics and the likely response of stakeholders.

9.2 Methodology

In this study, developing a PFC was only one concern alongside a large number of other research priorities, as set out in Section 2.1, near the beginning of the report, which lists all the project components. There was therefore a balance to be struck. The approach in this broad study was to link a focused PFC closely to the city service delivery assessment. The aim is therefore to explain *why* the CSDA is as it is – in other words, to explore why the service delivery blockages exist, and what entry points are available to try and resolve them.

Undertaking a PFC is a primarily qualitative exercise. It relies on targeted interviews or focus groups with stakeholders, alongside secondary data in the form of key sector documents, reports and studies. As noted in the CSDA methodology section, the OPM/WEDC team did not conduct

primary data collection and preliminary analysis under this project, which was done by other consultants contracted by the World Bank. Reports from these consultants were the primary source of data for constructing this PFC. In order to keep the length of this report manageable, only a brief summary of the full analysis conducted by the team is provided in this section.

Developing a PFC requires a structure in order to be clearly analyzed and communicated. There are a bewildering number of tools available, which can be applied to particular questions so as to explore some of the issues described above. Many tools which are commonly used, including in this study, are contained in a World Bank sourcebook (Holland, 2007). Rather than take up more space with explanation here, it is better to go straight into the findings. Briefly, however, the main tools used include stakeholder mapping, process mapping and stakeholder analysis.

9.3 Findings

9.3.1 Hawassa's FSM context

As noted above, the main objective is to explore why the CSDA results are as they are. Considering the stages of the chain, the Hawassa CSDA shows good scores around containment, fairly good scores for emptying and transport, and weaker scores for treatment and disposal. Along the service delivery components, the main overall trends to note are that, for "emptying" onwards, there are specific weaknesses in planning, expenditure, equity, O&M and expansion. The aim of this chapter in the Hawassa context is to try and explain why this is the case, and what the prognosis for change is.

It is worth reconsidering Hawassa's context and the responsibilities of key actors, which were already set out in section 3 above. In summary, three key characteristics of Hawassa's context include:

(i) Rapid population growth alongside horizontal expansion of the city into peri-urban areas which are currently rural. If the current population growth rate of 4% is sustained, the population will grow from around 350,000 in 2015 to more than 600,000 in 2030. This is likely to be accompanied by increased population density.

(ii) All households use a latrine or septic tank of some kind, according to the household survey, with about 81% using an improved type of latrine. Since 42% of households share facilities with more than 15 people, one might expect rapid filling rates, but demand for emptying is low. Only about a third of households had ever experienced a pit or tank filling up. This is probably due to the soil type, which allows most of the fecal sludge to leach away into the ground. Even then, only 31% of those experiencing a pit/tank filling up actually emptied it, with the rest covering and abandoning it and using another. Overall, this means that only 10% of households in Hawassa have ever emptied a pit or tank.

(iii) Emptying services, public and private, do exist and are used, but the market is in flux with the government provider intending to double the tariff. Private providers are already charging double the government rate, and many people are willing to pay them because the waiting time for the government trucks can be 2-3 months (especially during the rainy season). The fecal sludge treatment site has been constructed to a reasonable standard, but is poorly managed (e.g. limited record-keeping, collapse of some drying bed walls, considerable bypassing of sludge). Furthermore, it suffers from limited access during the wet season on account of the poor road conditions.

Demand for FSM services will only increase until sewers are built and become operational in new, planned developments, which is unlikely to happen in the short term. With the population rising fast

and becoming more dense, and there being less space to abandon full pits and construct new ones, it is likely that emptying rates will increase.

However, some private providers complain of underutilization of their services, so it is likely that there is spare capacity which could respond to increased demand in the short term, if people are willing and able to pay the market rates. The current market situation could therefore prevail for some time and there is not likely to be any sense of urgency in reforming the situation. There are no immediate proposals for significant reform on the table, except for the likely tariff increase.

9.3.2 Mapping institutional responsibilities

As set out above, the focus of the PFC is how institutions function, the incentives which those institutions provide to stakeholders, and how those stakeholders exert influence. It is therefore important to understand who those stakeholders are, alongside their formal and informal roles. A useful tool for this is stakeholder mapping, as set out in Table 25 below.

Stakeholders are categorized by type (e.g. national or local government, private sector etc.), and their formal role in FSM in Hawassa is listed. In the next column, the reality of how they operate (often informally) is described. A final column summarizes the core challenge represented by how that type of stakeholder operates. Only an abridged set of stakeholders (e.g. only a few at the national level) is included in the interests of space.

Table 25 Mapping stakeholders and their responsibilities for FSM

Type	Stakeholder	Formal role	The reality	Core challenge
Federal gov't	Ministries of Health; Education; Water; and Finance	Set urban and rural WASH policy	Existing national plans or strategies are mostly focused on containment, with little to say on the other stages of the chain. The 'National Integrated Urban Sanitation and Hygiene Strategy' is drafted but not yet endorsed.	New strategy needs to be cleared jointly by the ministries of health, water, urban development, environment and forestry, and support given to city administrations.
Regional gov't	Regional bureaus for Water, Urban Development, Environmental protection and Health	Support towns to implement programs, e.g. capacity building or procurement	Limited engagement on FSM thus far	The regional bureaus are less relevant for Hawassa as a city, but could have a role in supporting the licensing of truck companies operating from outside Hawassa (as well as in setting regional standards). They will also increasingly need to support town utilities on FSM.
Local gov't	Hawassa City Council	Make bye-laws (including on sanitation, environment etc.) and monitor their enforcement	Currently blocking tariff increases for pit/tank emptying, perhaps due to concerns over the household reaction.	Tariffs need to be increased to ensure cost recovery and allow WSE to expand operations as required. More poor-inclusive pricing structures could be investigated.
	Hawassa City Administration	Ensure municipal services are provided (including water, sanitation and solid waste), and ensure coordination of its departments. Ensure public toilets are provided and maintained	The previous city plan was weak on sanitation, but a new Master Plan 2015-40 under preparation includes a sewerage network and developing the capacity of FSM services	

Type	Stakeholder	Formal role	The reality	Core challenge
	Hawassa City Water and Sewerage Enterprise (WSE)	Deliver water and sanitation services, including pit emptying via vacuum trucks and manage the treatment and disposal of FS.	Has two vacuum trucks but one non-functional at time of study. Considering increasing tariff but cannot do so without city council approval, so currently running at a loss and experiencing excess demand from households.	
	Hawassa City Natural Resources and Environmental Protection Agency	Ensure well-managed natural resources and environment, especially that the 'Liquid and Solid Waste Proclamation' is followed	Seems to be working well as most hotels are having FS regularly emptied by tanker and discharged at the treatment plant. May not be aware that such a high proportion of pits/tanks are unlined and so likely to be contaminating groundwater	These stakeholders should support efforts to improve the quality of non-networked sanitation infrastructure over time. This would improve the hygienic separation of excreta from human contact, as well as the emptiability of pits in the future (e.g. unlined pits cannot be emptied).
	Hawassa City Design and Construction Supervision Department	Approve building plans and supervise construction of houses, including standards of sanitation	System working in planned *kebeles*. However, new informal settlements in peri-urban areas are not inspected, with the justification that these would be demolished as the city expands. The dept. does not have jurisdiction over existing houses and their containment arrangements.	
	Hawassa City Health Department	Motivate households to improve sanitation and hygiene through Urban Health Extension Workers (UHEW) and the Health Development Army (HDA)	UEHW and HDA mainly focus on use of latrines, hand washing, and soak pits for grey water. Little focus on FSM, which is probably justified given their already broad remit (and their likely lack of understanding of the environmental and FSM service implications of different types of sanitation facilities).	
Private sector	Private vacuum truck operators	Provide emptying services at the approved tariff, if registered with the WSE. Empty FS at the treatment plant.	The 4-5 private trucks charge double the government tariff. Anecdotal evidence that when the treatment plant road is impassable during the rainy season, trucks may dump FS at the solid waste site. The other 4-5 trucks owned by hotels are not registered with the WSE so are operating illegally if providing services to the general public on the side.	Households need to improve containment infrastructure. Truck companies should advocate for tarring of the road to the treatment site (if the site will remain there) as it is negatively affecting their ability to deliver a service.
	Households	Construct and use latrines, paying for emptying pits/tanks when full	Commonly use unlined or partially-lined pits/tanks which allow FS to leach into the ground and require very infrequent emptying, if any.	
	Public toilet managers	Manage the outsourced contract for public toilets	Public toilets are anecdotally unhygienic but reportedly strongly demanded by the population. Government trucks empty public toilets	

Overall, the message of the above table is that most stakeholders seem to be performing their roles adequately and the FSM service chain is functioning well in comparison with many other cities in Ethiopia and the region. However, there are weaknesses which need to be addressed (especially proper containment and a clearer tariff structure) and things could break down quickly in the event of heavy rainfall or a rapid population influx.

9.3.3 Illustrating static and dynamic problems

It is helpful to consider the issue of FSM in Hawassa in two dimensions. The first dimension is static: that is, the snapshot of how households are dealing with their fecal sludge as shown in the SFD. Here there are not too many problems, at least during the dry season, notwithstanding likely groundwater contamination from effluents leaching into the soil. The second dimension is dynamic – in other words, how the SFD may have looked like five years ago and how it may look in five years' time. Here, the city has been growing rapidly (and looks set to continue to do so) in three dimensions:

- horizontally – expansion into peri-urban areas which were previously rural
- vertically – replacement of single-storey housing with multi-storey housing, including the proposed replacement of kebele housing with condominiums, which is a government policy across the country
- demographically – 4% population growth leading to a city of >600,000 people by 2030.

Taking the dynamic perspective, the SFD may look a lot worse in five years' time if some key issues are not addressed by the city authorities. Three of the most important key issues specifically relating to FSM services are (i) containment in existing buildings, (ii) the construction of new buildings, and (iii) the performance of the emptying market. In addition, ensuring provision of adequate and reliable water supplies be essential to support the expansion of sanitation services (particularly as any sewerage systems are developed), as well as protecting groundwater and surface water sources from increased pollution loads.

With respect to new building construction, it will be important for key stakeholders to take a coherent position with regard to quality of containment and planning for the full sanitation chain. In particular, this will require dialogue between the Water and Sewerage Enterprise and the Design & Construction Department (who have the role of inspecting new buildings). As new migrants to Hawassa arrive, existing households rebuild or expand their dwellings, and developers build condominiums, they must be incentivized to invest in sanitation options which offer the potential of effective FSM. The WSE will presumably be involved in extending water supply to these new buildings, so must at the same time insist on proper containment and accessibility for emptying services (until a sewerage network is in place).

Even taking the static perspective and looking at existing buildings, it would be important to promote properly lined pits that can be safely emptied, since in the future abandonment will become less feasible due to lack of space. The Urban Health Extension Workers can have an important role in communicating this to households.

Thus far, the analysis has mostly focused on containment, but it is worth considering the rest of the service chain in more detail, in particular the emptying market and the WSE's current operations. There are three main issues, some of which were set out in Section 6:

- Slow responsiveness and associated low market share of WSE;

- Tariffs not aligned with cost recovery and willingness to pay (i.e. loss-making utility and revealed higher WTP due to private sector market share); and
- Regulation of private sector emptiers who are currently operating informally (i.e. unregulated).

These are explored in the next sub-section using a tool called process mapping.

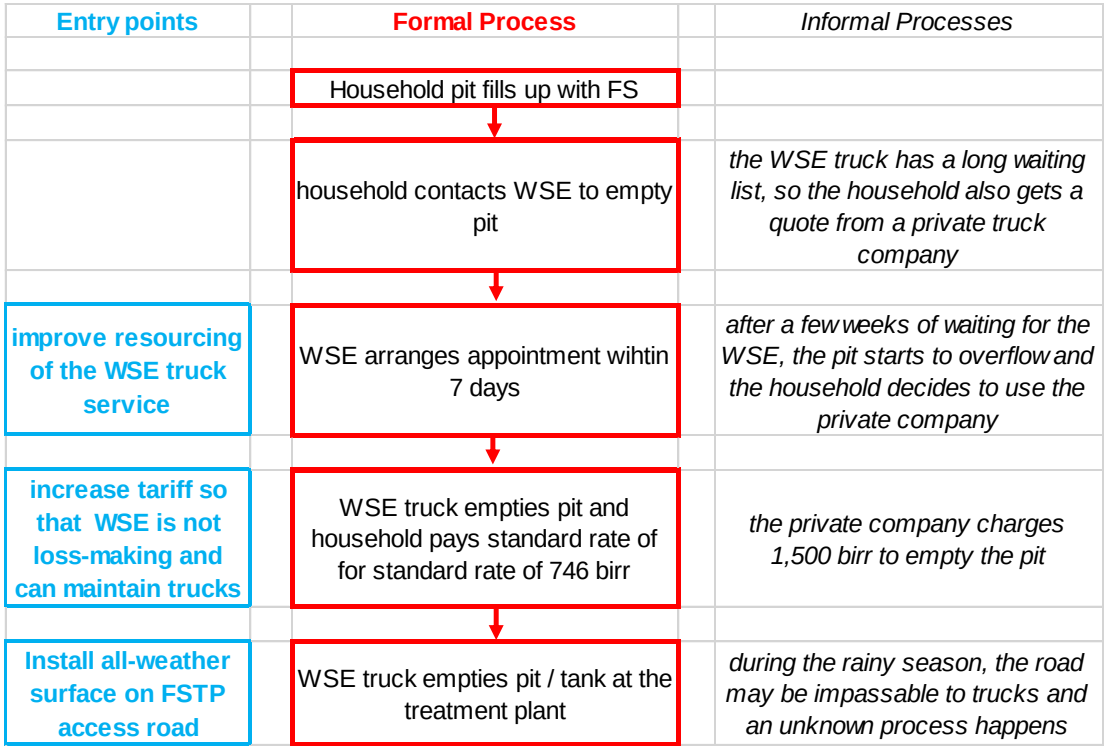
9.3.4 Illustrating the market problem

The market for emptying in Hawassa is in flux. The WSE is experiencing excess demand and the private truck operators the opposite. Tariffs and licensing in this market could be reformed. On the tariff side, private truck operators are successfully getting households to pay double the municipal rate. Given the private sector has triple the market share of the WSE according to this survey, this proves willingness to pay higher tariffs, at least on the part of households currently participating in the market. Those who are not willing to pay those rates must wait for the WSE trucks to become available. On the licensing side, there is anecdotal evidence that some truck operators are benefiting from being based “outside” of the jurisdiction of Hawassa (literally and metaphorically), reportedly coming from the town of Shashemene and elsewhere. This is inefficient given the additional fuel costs they must incur, and they have less oversight from city authorities. There may also be a role for the regional level of government here (e.g. Regional Water Bureau) given this is an issue going beyond the city.

It is possible to illustrate both these issues by using a tool called process mapping. This aims to understand the interaction of formal and informal “moments” in a process, and to identify entry points for engagement. It is important to identify the roles of stakeholders in a process, how and where they exert influence over the process, and the incentives they face in the informal system. Currently the WSE is the formal emptier. There is acceptance that the private sector operators exist. Some, but not all, are registered with the WSE – various interviewees mentioned trucks coming from outside the city boundaries. Therefore, elements of the private sector emptying market remain informal. None are licensed from a technical perspective. The market therefore contains elements of the formal and informal which are hard to disentangle.

The process for a household emptying a pit in Hawassa is shown in Figure 10 below. The central column shows the formal process which is supposed to be followed by the household and the WSE. The right-hand column, however, shows elements of the informal process, i.e. what really happens in many cases. The left-hand column then shows possible entry points for reform.

Figure 10 Process mapping for emptying a pit in Hawassa



There is no question around whether the WSE should be operating trucks. There is a clear benefit to them being able to service public buildings and public toilets, as well as being in place for emergencies, as well as providing indirect economic regulation in the market place through competition with private operators. Arguably, however, the private sector may be better placed to serve households on a day-to-day basis, since they are more responsive to demand and have better incentives to deliver a good service. This is supported by cross-country evidence as well as the current situation in Hawassa. The WSE is currently operating at a loss on its emptying service because the tariffs it charges are lower than its running costs – if the emptying service was in the private sector they would quickly go out of business. The WSE and its staff have little incentive to improve the emptying service because it is subsidized by the rest of the business and nobody is losing their job. The incentives at play are further discussed below.

This issue of how the emptying market should be structured is something to be discussed at the level of the city administration, which has jurisdiction over the WSE (a market actor). It is inevitable that this market will grow. If the household emptying market is left primarily to the private sector, then some kind of licensing and/or regulation would be necessary to help them make the change from informal to formal providers. One possible reform, and stakeholders' likely response, is discussed below.

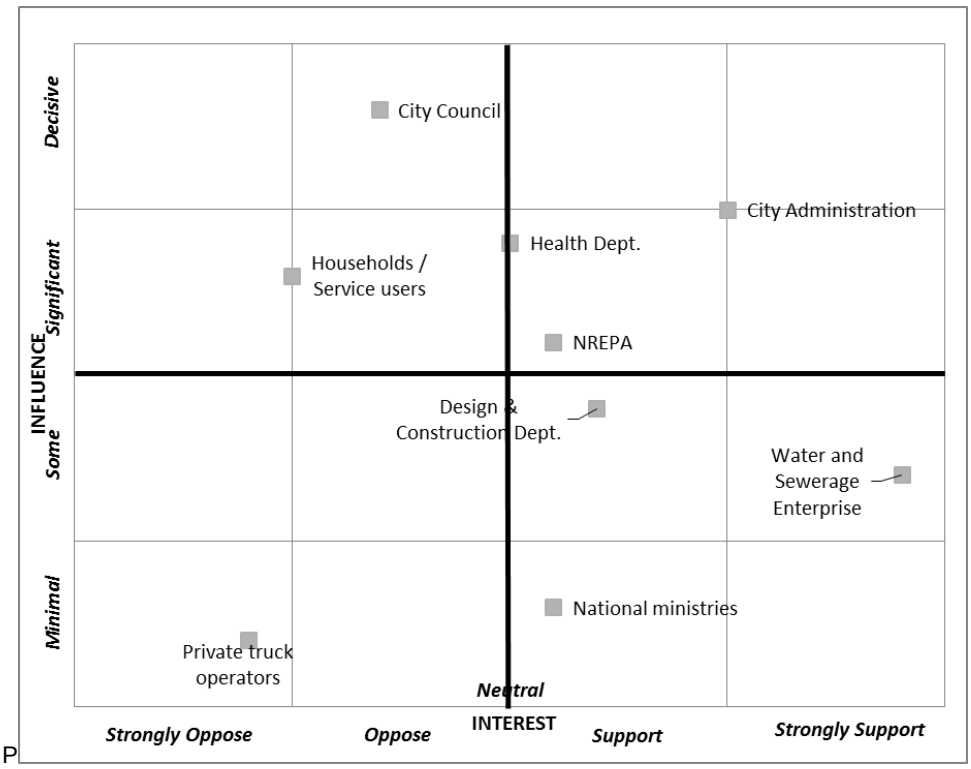
9.3.5 Stakeholders' likely response to reform

This section discusses likely responses of stakeholders to increases in government emptying tariffs and licensing of private sector emptiers. The former is potentially desirable because the WSE's service is currently operating at a loss and households are clearly willing to pay more. The latter is potentially desirable because households are likely to get a better and cheaper service from a formal market with transparent pricing and competition. In this context of incomplete information on the part of consumers, and the resulting unpredictable pricing, private sector emptiers are likely to increase their producer surplus (and by extension, profit).

It is inevitable that demand for services will increase over time with population growth and densification (making abandoning pits unviable), and more trucks will enter then market. Many aspects of the private sector emptying market are informal, and some form of regulation or licensing would bring them into the formal sphere. Most truck companies are already registered as businesses under Ethiopian law, and some are registered with the WSE as service providers to the public, as noted above. Others are supposed to operate for their institutions only (mostly hotels) so are operating illegally if they serve the public (which some reportedly do on the side). Still others are coming from outside the city boundaries. There are many approaches to licensing or regulation which could be explored. One idea is explored further below.

The likely response of stakeholders to the proposal of a simultaneous increase in government tariffs and licensing of private sector emptiers is explored in Figure 11, with further discussion below. The magnitude of the increase in tariffs is assumed to be c.50% (to around 1100 birr). The private sector could still charge whatever they like if the market will bear it (which currently is reportedly up to 1500 birr). If these reforms were proposed separately this could be analyzed separately with different results.

Figure 11 Stakeholder analysis matrix for "simultaneous increase in government tariffs and licensing of private sector emptiers"



P

Increasing tariffs is rarely popular with households anywhere in the world, because some will have to pay more, but the fact is that the private sector has three times the market share at sometimes double the government tariff. Nonetheless, households cannot be expected to be in favor of tariff increases. The city council, given their political role, are reportedly opposing tariff increases at present (as happens in many countries), presumably for fear of becoming unpopular. Ensuring equity is also a reasonable concern but arguably the best way to ensure equity is a functioning market with well-known prices that ensure a good service. With respect to licensing regulators, households may be marginally in favor if they thought they would get a better service but are unlikely to be that interested. The city council may be slightly in favor of anything which formalizes

markets in Hawassa, but their response to the proposed tariff increase is likely to dominate. The city council obviously has more influence over the decision, but they will be aware of public opinion.

With respect to private truck operators, they can be expected to oppose both reforms. Formalization and licensing will decrease the likelihood that they capture more producer surplus (because pricing and terms may become more normalized), and they will incur costs by conforming with regulations (e.g. around safety equipment etc.). Their influence over the decision is likely to be low, however, unless the owners are well-connected people which is unlikely to be the case. If they are involved in the discussions as suggested above, this would increase their influence (but also make them more likely to support proposals which they see as fair). The formalization of their role could also bring them benefits later on (which they may not perceive at the time) in terms of the size of the market increasing. For example, as the market is functioning well and Hawassa's FSM services are seen to be successful, it could mean more parts of the city staying on non-networked sanitation services rather than converting to sewerage over time.

On the supportive side, relatively unimportant stakeholders are the health department, the Design & Construction Department and NREPA and federal ministries. All are likely to have a broad interest in FSM services improving in Hawassa, but all are marginal with respect to the proposed reform. The health ministry leads on sanitation in general, but has little jurisdiction over the specific issues in question (tariffs and licensing). The only way they are relevant is in their influence over the city administration and city council.

The city administration can be expected to be in favor of the proposed reforms, in contrast to the city council. This is likely because, as a technocratic institution with an interest in Hawassa being seen as successful, they will want to see services improving and the environment protected. As the guarantor of the WSE, they will be keen to improve cost recovery so as to avoid having to subsidize it. They also have significant influence given their overall leadership on municipal services. Their relationship with the city council is important in this respect.

Finally, the WSE can be expected to be in favor of both reforms. The increase in the tariff will stop them losing money on emptying services, and will make the market less disjointed. They may well increase their market share, but it is not clear that this is their objective. With respect to licensing, the same rules will surely apply to them, but a more formal private sector will improve overall FSM services in the city which the WSE should be keen to see. Their influence over these decisions is low as compared to others, but the city administration is likely to consider them as important stakeholders in any decision so their view is likely to carry some weight.

With respect to concrete approaches to licensing, the best initial approach may be to formally license operators who are permitted to serve households and/or discharge fecal sludge at the plant. The aim would be to protect customers, workers and the environment. Licenses could be granted annually after providers fulfil certain criteria which could include: (i) technical inspection of emptying equipment, (ii) vehicles are roadworthy, (iii) workers have access to deworming, (iv) workers have adequate safety equipment. These would best be discussed in an open forum including the emptiers themselves so they are committed to any outcome, as was done successfully in the case of Dakar, Senegal. In terms of the institution best-placed to manage the licensing, it could not be the WSE because they are a market actor. The Regional Water Bureau may be better placed. This is not a specific recommendation of the study but rather an explanation of the issue. Discussion of intervention options is in the next chapter.

Overall, it may not be too difficult to get agreement for licensing of private service providers, given the increasing role they are playing in the city. The tariff increase is a more thorny issue. However,

the city council may well agree to it if they can be persuaded that willingness to pay is already high and it is likely to be richer households who use the services anyway.

9.4 Implications for FSM in Hawassa

This section concludes the PFC by setting out a summary of the implications of this analysis for FSM in Hawassa.

Overall, the market for FSM services is functioning. The few households whose pits fill up are able to get them emptied safely, and the fecal sludge is in general safely disposed at the treatment plant. Given that FSM is dysfunctional in so many cities, this is fairly good by comparison. However, demand for services in Hawassa is likely to increase with a larger and denser population, and those households who have relied on covering and abandoning full pits are unlikely to be able to do so in the future. Overall, only about 10% of households in Hawassa have ever emptied a pit or tank, but this figure is likely to rise. The status quo of abandoning pits is not sustainable. There will not be space to do so, and it risks the integrity of the lake which the city holds dear.

The question is whether the city administration is likely to be able to respond to increased demand for FSM services. Currently the answer appears to be no, given the excess demand experienced by the WSE trucks even under current market conditions. A key implication of this analysis is that the city administration should be planning ahead in much more detail. The CSDA shows that the basic elements of service delivery are there, but important weaknesses in planning, expenditure, O&M and expansion remain. These are the key challenges. The message of the PFC is that in the medium-term the city administration must get households and the city council on board with any plans, since they will have implications for containment infrastructure. In the shorter-term, they must resolve the issues in the market which is currently in flux due to the variability of prices. The private sector can and should play an increasing role in service provision. Formalizing their role through licensing, alongside an increase in tariffs, is likely to support this.

10 Intervention options

This section proposes interventions to improve fecal sludge management services in Hawassa and provide an effective enabling environment within which those services can be appropriately developed and sustainably managed. These interventions are informed by the survey data that highlight problems with existing services (as most clearly represented in the fecal waste flow diagrams). The interventions most directly affecting service delivery are then considered in the context of results from using the broader detailed diagnostic tools, in particular the city service delivery assessment (CSDA) and the Prognosis for Change (PFC), as presented in other sections of this report.

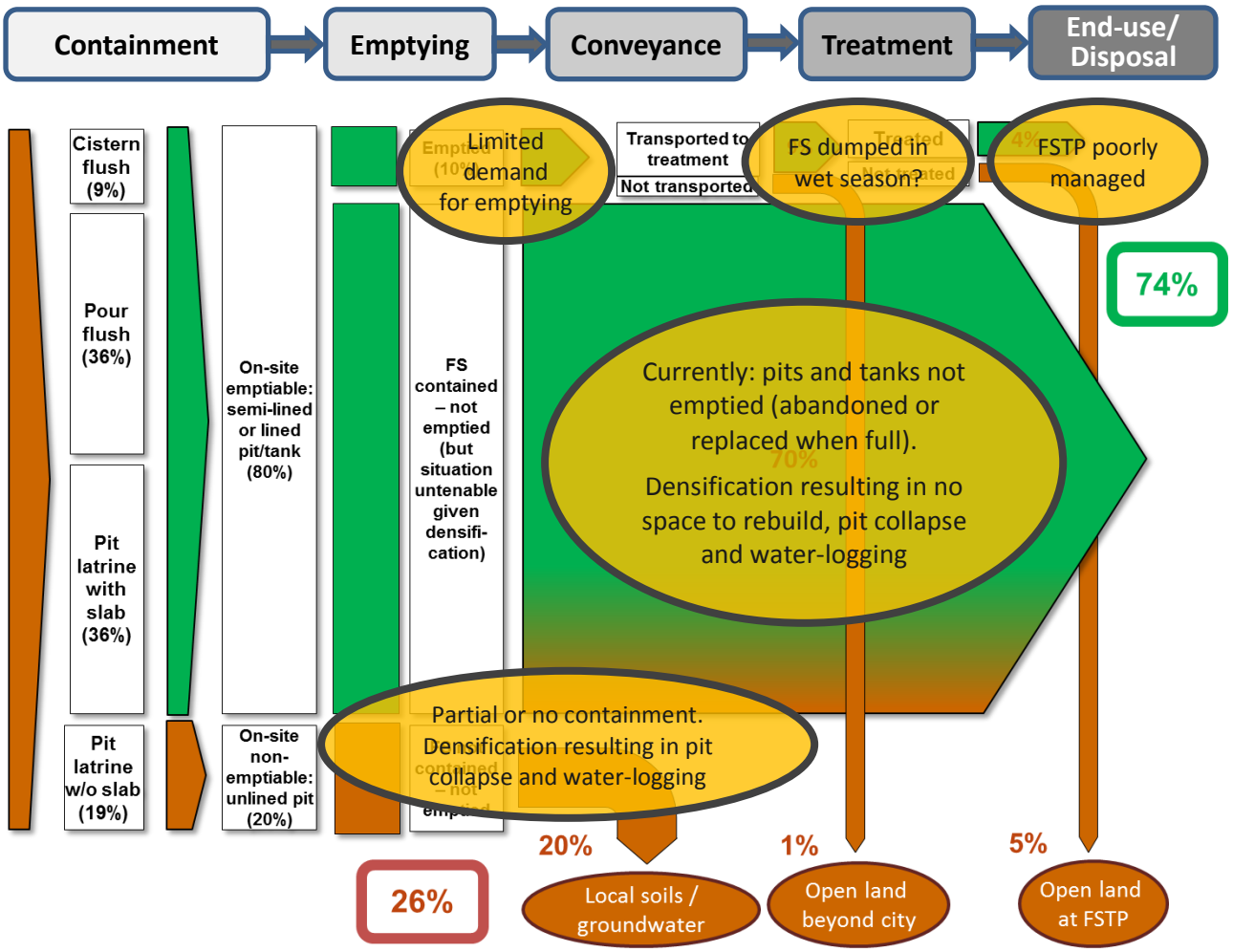
The intervention options presented here are intended to support the further development of detailed recommendations as and when other more detailed studies are undertaken in the city. As such, this section does not identify or propose specific and detailed actions to be taken, who is best placed to undertake those actions, what information is needed in advance of taking action (such as additional feasibility studies), or the likely outcome of those actions.

10.1 Identified weaknesses, through the service chain

The key starting point for presenting weaknesses in the existing services is the fecal waste flow diagram, as it identifies the extent to which fecal sludge is managed (or not) through the current sanitation service chains.

From the diagram, “problems” or “weaknesses” in the process of managing wastewater and fecal sludge at the key stages in the chain can be highlighted, pointing to areas where interventions are needed to improve the *status quo*.

Figure 12 City-wide fecal waste flow: results and key problems



10.2 Proposed solutions, through the service chain

Taking the key problems highlighted in Figure 12 above, it is possible to identify feasible solutions to address them, based on findings from the FSM study, and discussions with key stakeholders within the city. These proposed solutions are grouped according to the type of containment/ discharge arrangements (i.e. the system type), considering possible interventions through the later stages of the service chain.

At the level of analysis possible from this study using city-wide data, the solutions are not identified on the basis of specific locations within Hawassa. This level of detailed analysis requires further data sets and investigation. These findings can however offer guidance as to the types of interventions to be explored in more depth as part of further work.

Table 26 on the following pages sets out possible technical interventions, whereas the sections following the table consider interventions more related to the enabling environment of urban sanitation, with a focus on FSM services. The options in the table are not necessarily mutually exclusive and do not specify interim or staged approaches. These are discussed in the following sub-section.

In summary, the key messages for action through the service chain are:

Containment: Standards of latrines must address quality relating to the construction of different components of latrine (pits, pit lining, slabs, etc.), promote hygienic standards that can more easily be maintained (e.g. cleanable slabs) and ensure easy access for emptying (e.g. design and location of access points). Promoting the uptake of such standards may need to consider the use of targeted subsidies to ensure minimum standards of facilities can be realized by all households across a range of options. For septic tanks, a program to inspect the existing construction quality can then promote, facilitate or enforce upgrading to correctly built and operated tanks. In addition, for multi-occupancy and informal housing, attention is needed to reduce the levels of sharing where this is excessive, with standards around required provision of additional private or public latrines set to support this. Where current facilities cannot be emptied, promotion can be focused on replacing or retrofitting (unlined) pits and tanks with smaller containment units designed for a regular emptying cycle, such as every 2-3 years.

Emptying and transport: For low-income areas actions should consider the introduction of small-scale emptying equipment, such as the hand-powered Gulper pump in use elsewhere in East Africa, coupled with a simple means of transport such as a donkey cart or motor tricycle fitted with a plastic water tank. As conventional tankers can operate in many parts of Hawassa (due to the planned nature of access roads and housing plots), it may be helpful to consider a mix of “low-tech” operators with simple equipment (mechanical and manual pumps), “high-tech” operators working with vacuum tankers and passive tanks (i.e. operating with no pressure or vacuum) for hauling removed fecal waste to the treatment site beyond the city boundary. An enhanced role could be identified for those private tanker services who come under the jurisdiction of the City Administration, as they become registered/ licensed, regulated and operate to agreed performance standards. Their role could be further strengthened through the gradual introduction of scheduled desludging as containment infrastructure improves and emptying services become more available, affordable and in demand. In addition, experience from elsewhere shows that, in order to run a viable business, operators need control over when and where they can discharge the pit contents.

Planning for increasing emptying capacity as demand increases will be essential. To support this, a price review and price adjustment mechanism will be needed. Year-round access to the current fecal sludge treatment plant must be ensured, including the upgrading and maintenance of the access road.

Treatment and end-use: At the existing treatment plant, systematic monitoring of tanker effluent discharge and plant effluent is necessary. The plant operators and manager must be fully trained to understand and carry out their roles to ensure good practice operation, maintenance and oversight of the facility, with incentives to achieve optimal treatment capacity from the plant. At the same time, more suitable site(s) to increase treatment capacity and effectiveness will be needed, accounting for future demand and possible markets for end-use products. Over the medium term, land will be needed for this and/or sewage treatment, and given the difficulty of siting such facilities, the process of identification and acquisition of the land should start as soon as possible, to avoid serious problems in 10-15 years’ time.

An assessment of the market for a range of possible end-use products can then lead on to seeking capital funding and partnerships with plant operators for the preferred option. The experience from Dakar, Senegal of the *FSM Market Structuring Program* (PSMBV) would be worth exploring further. This program identifies institutional structures, customer-based services, private sector

incentives and regulation, as well as technical innovation and development through the full FSM service chain.[31]

Environmental protection: Finally, in relation to protecting the groundwater from excess pollution and Lake Hawassa from the implications of this: studies should be conducted or continued to identify major risks, mitigate against them and install appropriate sewered sewerage options into critical areas, where necessary.

[31] More details can be found on the website: http://www.onasbv.sn/en/

Table 26 Technical interventions to improve service delivery, based on existing system type

System type / key problems	Potential solutions					
	Containment	Emptying	Conveyance	Treatment	Disposal	End-use
On-site: emptiable Emptied • Limited demand for emptying services • Possible dumping of FS on route to treatment plant (FSTP) • FSTP poorly managed	Improve design and construction standards for pits and tanks – including more effective pit lining options Improve pit access arrangements, to enable easier emptying In rapidly densifying areas and those with groundwater pollution concerns, consider upgrading to include small piped networks, based on detailed technical assessment of current facilities and services (including water supply) and feasibility of alternatives	Promote use of a wider range of appropriate, low-cost pit lining options, as part of sanitation marketing Inspect current facilities and promote / facilitate / enforce upgrading of pit/tank sub-structures if necessary Incentivize households to construct pits that can be emptied periodically, rather than abandoned or replaced – including use of twin-pit arrangements Ensure pits and tanks are built with access points for emptying that are appropriately sized and accessible to emptiers Introduce scheduled desludging Identify opportunities to test and potentially scale-up a wider range of small-scale emptying equipment options – both manual (e.g. Gulper) and	Improve access route and conditions to the FS treatment plant – to ensure year-round access is possible Consider and pilot mixed use of both 'low-tech' and 'high-tech' emptying equipment transferring FS to passive (i.e. no vacuum) haulage trucks, to take excreta to FS treatment sites.	Improve management and monitoring of FS treatment processes Identify the need to extend treatment capacity – either at the existing site, or additional location(s) Identify a more suitable site(s) for current and future treatment – linked to market potential	Systematically monitor tanker discharge at treatment plant inlet and plant effluent quality Ensure safe handling and disposal of dried FS, when not in demand as end-use product Undertake studies to identify major pollution risks to Lake Hawassa. Install well-managed, effective sewered and non-sewered services in critical areas, if needed to protect the lake	Assess the market for a range of possible end-use products: e.g. agriculture. For preferred option, seek capital funding and partnership with a plant operator Locate new treatment plant(s) to ensure optimum access to markets

System type / key problems	Potential solutions					
	Containment	Emptying	Conveyance	Treatment	Disposal	End-use
		mechanized (e.g. VacuTug) [32]				
On-site: emptiable Not emptied • Pits and tanks not emptied (abandoned or replaced when full). • Densification leading to no space to rebuild, pit collapse and water-logging	For *formal* areas: - introduce low-cost but improved construction options and standards: e.g. improved single or twin-pits - ensure correct construction of septic tanks (1- or 2-compartment, with soakaway or infiltration trench). Promote as an option where appropriate, affordable and accessible to emptying services As unlined pits fill, abandon, seal & replace with smaller emptiable unit or septic tank (based on income level). For lined pits, empty when full. If large, retrofit smaller pit or convert to ST. For *low-income areas*: As above, plus:	For *formal* areas: As for Emptied above For *low-income areas*: As for Emptied above, plus; - ensure communal facilities are correctly built and located for periodic emptying - pilot and develop emptying service providers and techniques for mobile communal or public latrines and other appropriate innovations	For *formal* areas: As for Emptied above For *low-income areas*: As for Emptied above, but focused on use of localized *mobile* FS transfer stations to support areas with increased demand for emptying (especially using smaller-sized emptying equipment)	As above	As above	As above

[32] Details of a range of emptying technologies is given in Sections 4.5 and 4.6 of *Faecal Sludge Management: Systems Approach for Implementation and Operation*: http://www.eawag.ch/en/department/sandec/publications/faecal-sludge-management-fsm-book/

System type / key problems	Potential solutions					
	Containment	**Emptying**	**Conveyance**	**Treatment**	**Disposal**	**End-use**
	- alternative management arrangements for plots with more than one household, to ensure all households have access to a toilet of some kind					
On-site non-emptiable: Unlined pit/tank • Partial or no containment. • Densification resulting in pit collapse and water-logging	Promote replacement or retrofitting of existing infrastructure with smaller containment units, designed for 2-3 year (max) emptying cycle, to achieved improved standards of simple pits and septic tanks Consider piloting and introducing a range of simple, but durable alternative pit latrines, e.g.: - twin-pit composting toilet - *Fossa Alterna* - twin-pit urine-diversion toilets (UDTs)	Increase the variety and geographical reach of emptying services to serve additional facilities: see above	As above	As above	As above	As above

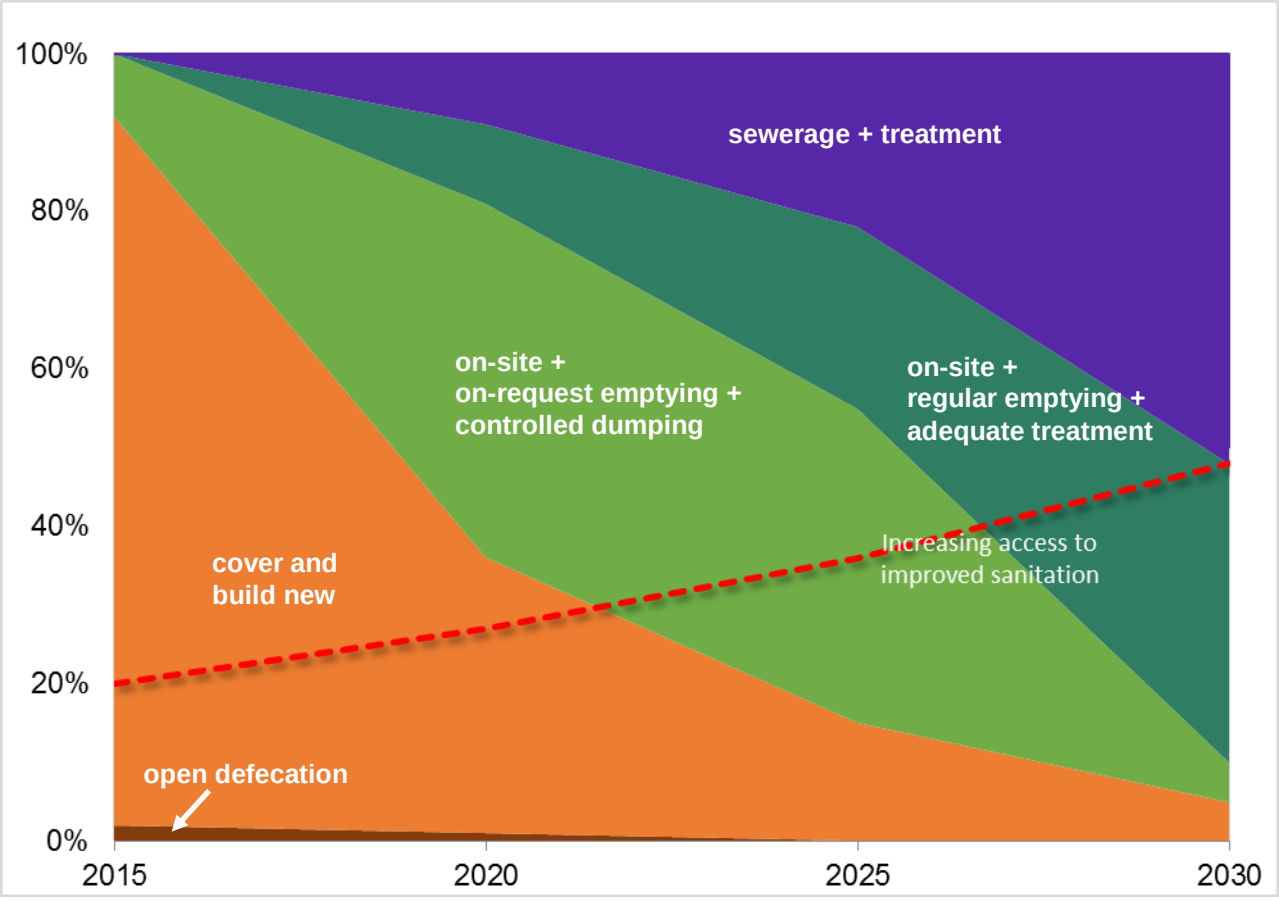
10.2.1 Towards city-wide incremental improvements

This section has so far identified and proposed recommended actions to improve service delivery options for on-site sanitation systems in Hawassa. There is clearly a need to anticipate the extent to which networked sewerage will become a part of future sanitation service options as the city expands, becomes more densely populated and receives improved access to reliable water services. Recommendations for sewerage services (including treatment options) do not form a part of this study. However, a strategy to incrementally and sustainably transition towards greater use of networked sanitation options, reduce reliance on unimproved services and gradually improve all on-site systems will be essential.

This can be visually represented in Figure 13 below, which shows a broad "trajectory of change" over time for city-wide sanitation in Hawassa. This starts at 'Time 0' with the current situation. The key strategies for achieving improved on-site facilities and accompanying effective off-site sewered options are that:

- over time, any open defecation and use of manual emptying options (reported as non-existent in the household survey, but considered to be possibly in use and/or becoming used as the city population grows rapidly) must quickly disappear. In addition, the extensive current practice of covering pits when they become full and digging new pits or reverting to 'other options' must be phased out.
- in their place, the use of on-site facilities with either on-request or regular emptying and controlled dumping or designated treatment must increase. Alongside this must be a gradual development of sewerage options (decentralized, non-conventional and conventional arrangements), with treatment, as the urban density increases.

Figure 13 City-wide sanitation strategy for Hawassa: a graphical representation



10.3 The Service Delivery Context: priorities to address

Based on analysis of broader findings from the FSM study, the following sub-sections consider the key areas of the Enabling Environment (as defined and grouped within the Service Delivery Analysis of *Enabling, Developing and Sustaining* components) and identifies actions to support any infrastructure-focused investments in Hawassa. While drawing on the CSDA results, it also draws on good practice and relevant experience from elsewhere.

NOTE: It should be noted that this study focuses on the provision of current and future services for fecal sludge management in Hawassa, where households are using on-site sanitation services and are likely to do so for some time into the future. The authors of this report recognize that Hawassa city authorities are planning the construction of an industrial district to accommodate the expanding population and associated industry, with the inclusion of a sewerage network and treatment plant. A sewered component of enhanced sanitation service access does not form part of the scope of this study – not only due to the focus on FSM, but also to the assumption that any process associated with a future planned introduction of sewerage to existing settlements will be subject to extensive feasibility studies covering a range of possible options followed by detailed design of the preferred option.

10.3.1 Enabling: policy, planning and budget

Policy: the federal policy and strategy framework for sanitation and FSM is relatively well developed. The resulting area for attention is to ensure the translation of federal FSM-specific policy and strategy objectives so that they are incorporated into regional strategic plans and objectives for integrated WASH services in SNNPR and Hawassa city in particular. The One WASH National Program (OWNP) is a strong federal mechanism for driving this process forward, given its high political profile, buy-in from the four key Ministries and external support from leading donors. With the Integrated Urban Sanitation and Hygiene Strategy recognizing the roles of the Ministry of Urban Development and Ministry of Environment, Forestry and Climate Change, there is a clear opportunity to develop plans and objectives focused on addressing the sewerage and FSM needs for Hawassa in an integrated way. At the city level, these plans and objectives must account for the needs of all citizens.

Institutional roles: key stakeholders operating within Hawassa City Administration know their roles around sanitation and FSM services and perform them well – at least to the extent that they are required to ensure provision of latrines, management of treatment facilities and ensuring environmental standards are maintained. However, there remain areas where the planning function within the municipality requires strengthening, to enable closer integration with regional strategic plans and objectives, and to make the best use of the upcoming Integrated Urban Sanitation and Hygiene Strategy. WSE would benefit from having a stronger role, in close collaboration with the regional Water Bureau, for regulating private sector providers, as well as strengthening its internal capacity to oversee a wider range of integrated non-networked sanitation, FSM services and sewerage services for Hawassa. Plans and objectives affecting all the relevant regional bureaus must ensure that attention is given to equitable services, if stakeholders are to develop sustainably managed, comprehensive and inclusive sanitation services to address the growing and changing service needs of city residents in the future. For this to happen, attention should be given to improving the monitoring and enforcement of service functions, and developing the capacity of WSE, and the Health Department in particular, to engage with the community and ensure needs are being addressed. This process will be supported by more promotion of sanitation services (sanitation marketing and behavior change communication) and perhaps the introduction of smart subsidies targeted at the poorest and most vulnerable. In addition, mechanisms to support and encourage stronger inter-agency cooperation, reporting arrangements and response standards will

be essential for FSM services to be sustainably delivered, monitored and incrementally adapted to suit the changing urban environment within the city.

Service provision and planning: beyond containment, FSM emptying services through to treatment and end-use need greater attention – especially in response to the growing population and limited budgets to address current and future needs. With improvements to improve containment and ease of emptying of household sanitation infrastructure, demand for fecal sludge emptying and transport services can be generated that in turn incentivize growth in those stages of the chain. Enforcement of building codes by the Design and Construction Supervision Department needs to be stronger if correctly-built pit latrines and septic tanks are to be rolled out through the city.

Budget: anticipated funding from the One WASH National Program needs careful planning and management, to target priority areas appropriately. A significant infrastructure-based component of the OWNP budget is the provision of additional public toilet blocks within the city. This provision must be planned with the full service function in mind, with appropriate containment arrangements (such as septic tanks) installed and connected to emptying services and/or eventual connection into piped networks as these become available and within a suitable distance from the blocks. Examples of such arrangements include toilet blocks discharging into decentralized (or semi-centralized) treatment facilities such as anaerobic baffled reactors (ABRs) with effluent discharged through planted drying beds, or connected into the expansion of centralized sewerage systems.[33]

10.3.2 Developing: equity and outputs

Choice / reducing inequity: attention is needed to increase the scope, flexibility and availability of emptying services – but this will only come in response to improvements made in containment facilities. Standards for the correct construction of on-site facilities will be needed – with sanitation marketing and other promotional activities to encourage uptake of a range of technical options. This may be enhanced through the use of carefully targeted subsidies. Introducing scheduled desludging on a gradual basis can support improved emptying reliability and quality of arrangements.

Outputs: the FSM service chain functions well in comparison to many other comparable cities. Most notable weaknesses for attention, as in so many other cities, are around the construction of safe pits and tanks, and the treatment and end-use/disposal of treated fecal sludge. Options to enhance treatment capacity are being explored and should consider for example covered drying beds (as used in Kampala, Uganda or Lusaka, Zambia), with attention to optimal location, management and performance. Developments in the earlier stages of the service chain can offer incentives to those running emptying services to increase access, reduce costs and improve service levels.

10.3.3 Sustaining: O&M, expansion and service outcomes

Service standards and cost recovery: a more robust monitoring system for discharges at the fecal sludge treatment plant should be initiated, to identify the extent of capacity overload, if any, and to enable monitoring of the plant's functionality. Movement of trucks should be more closely monitored, supported by improved transport routes – especially the access road up to the fecal sludge treatment plant – and monitoring operations at the solid waste disposal site, to ensure no discharge of fecal sludge there during the rainy seasons. Addressing cost recovery issues will require attention given to developing appropriate mechanisms for generating revenue streams. This may be in the form of a 'sanitation tax' added onto water sales – where the costs are

[33] Details of treatment technologies can be found in the *Compendium of Sanitation Systems and Technologies*: http://ecompendium.sswm.info/sanitation-technologies

associated with the level of service provided. Such an approach is successfully being implemented in Hai Phong, Vietnam where households connected to the sewer are charged a fee for wastewater services, while households who are not connected to the sewer are charged a lower 'environmental fee'. Any proposals for Hawassa should ensure sufficient revenue is raised to cover costs associated with collection, treatment and disposal of fecal sludge, as well as sewerage service functions.

Demand and sector development: Demand for FSM services is low and limited in coverage. This is reflected by the lack of FSM actors serving households (more focus is to the commercial and industrial dwellings) and inadequate government response to the growing scale of the problem. Sector development needs to come first, with improved service options available, marketed and more widely applied. It may be best to focus use of municipal tankers for serving public institutions and emergency responses, while developing a regulatory framework for non-municipal service providers. Greater clarity in the process of registration, licensing and regulation of the existing private providers, with transparency in costs and review of pricing mechanisms will support the development of these services to required standards. Initial external financial support and "friendly regulation" can help more actors enter the market. Demand will only achieve any significant level for service options to become self-sustaining when prices are affordable and services more responsive.

10.4 Resulting prioritized interventions: guidelines for action

Considering results from the City Service Delivery Assessment and Prognosis for Change (Sections 8 and 9 respectively), it is possible to recommend where actions are most needed in relation to the non-technical components of the enabling environment (such as policy and planning, institutional arrangements, capacity and financing), to support technical responses.

For such actions to be effective, recommended interventions must respond to how well developed the enabling environment currently is. Based on the assessed status of FSM service development using these tools, the following Service Delivery Action Framework tables present a range of non-technical, 'institutional' interventions. Actions are grouped according to the current status of the enabling environment: Basic, Intermediate or Consolidating.

The set of recommended actions have been developed from good practice and informed by the experience of the authors in relation to the enabling environment for urban sanitation. They are tailored to how well developed the enabling environment currently is, with a view to strengthening it. As the actions account for the current realities in a city, they must be recognized as essentially sequential and should be viewed as dynamic; that is, actions are proposed as being at the Basic stage before moving towards the Intermediate, then the Consolidating stages. Where a city is identified to already be delivering FSM service needs from one of these stages, the resulting set of actions are taken from the 'next stage'.

The recommended sets of actions are shown within the boxes that have a bold outline and shading.

As progress is made through these stages, actions can shift from being mainly about identifying, reviewing or building awareness of services, through to actions that are more about establishing, strengthening and promoting commitment to services, and on towards actions that are about strengthening, consolidating and expanding engagement to achieve a more sustainable range of enhanced services. The actions also move from prioritizing public health protection (which may include developing temporary measures), to ensuring the protection of the environment and looking at the potential for the re-use of fecal sludge end products. In the case of Hawassa, it is

clear that a strong focus on protection of Lake Hawassa from adverse effects of contamination is a significant priority – and specific interventions may be necessary to ensure this is maintained as sanitation services are addressed.

The actions proposed for Hawassa in the Tables that follow (Table 27 parts a), b) and c)) can be considered to be most appropriate to the current situation both in Hawassa and in Ethiopia more broadly, associated with the status in relation to the "trajectory of change" in Hawassa (see Figure 13) as the enabling environment develops and strengthens.

As well as protecting Lake Hawassa, any improvements to sanitation services in the city should also seek to achieve the following overarching aims:

- Ensure the needs of vulnerable family members (including elderly and disabled people, pregnant women and small children) are considered in the provision of facilities and services; and
- Adopt an integrated response to addressing sanitation, solid waste and drainage infrastructure and services. Only in this way can equitable, functional and sustainable services be delivered.

Table 27 Service Delivery Action Framework: Hawassa city

a) National level actions

Action point		Basic actions *Critical interventions for public health protection*	Intermediate actions *Strengthening existing foundations*	Consolidating actions *Focusing on sustainable services (and downstream interventions)*
National	**Policy, legislation and regulation**	• Review national sanitation policy and ensure FSM is included • Review the regulatory framework around the protection of public health and the environment from poor sanitation	• Set norms and minimum standards for public health and environmental protection • Establish a legal basis from which to regulate FSM services	• Require local regulation and its enforcement • Develop a policy and regulatory framework to incentivize improved treatment and re-use options for FS where feasible
	Institutional arrangements	• Review institutional arrangements for sanitation – ensure FSM is included • Identify an institutional framework for FSM services with defined roles, responsibilities and coordination mechanisms	• Establish an institutional framework for FSM services with defined roles, responsibilities and coordination mechanisms • Establish institutional roles for FS treatment and re-use options • Propose incentives for improved FSM	• Strengthen the institutional framework to enhance all FSM service outcomes, with fully recognized and implemented roles, responsibilities and coordination mechanisms • Establish incentives for improved FSM
	Planning, monitoring and evaluation	• Build awareness of FSM in national planning entities and relevant sector ministries (works, housing, health, environment, etc.)	• Develop plans to enhance public access to FS emptying services • Establish a monitoring framework against standards of FSM services – focusing on household and institutional emptying services • Establish systems to evaluate service quality	• Establish a framework to monitoring quality standards of all FSM services, including FS treatment facilities and re-use arrangements • Develop plans to enhance treatment capacity and re-use technologies
	Capacity and technical assistance (TA)	• Identify the scale of the existing capacity gap and the technical assistance required to address FSM service needs	• Build public and private sector capacity for city-wide FSM services	• Strengthen public and private sector capacity for city-wide FSM services, including good FS treatment and markets for re-use
	Financing	• Build awareness and agreement around the budgetary requirements for FSM services	• Develop programs with FSM funding windows and incentives for cities	• Mobilize finance for FS processing, re-use and disposal

b) Local level actions

Action point		Basic actions • *Critical interventions for public health protection*	Intermediate actions *Strengthening existing foundations*	Consolidating actions *Focusing on sustainable services (and downstream interventions)*
Local	**Legislation and enforcement**	• Review and, if required, establish byelaws, and ensure that they address on-site systems and FSM services	• Strengthen byelaws and their enforcement • Introduce regulation of service providers • Establish incentives to increase disposal at recognized FS transfer and treatment sites	• Consolidate regulation of pollution of receiving waters or the like • Introduce penalties for indiscriminate FS dumping by service providers • Enforce use of emptiable facilities
	Institutional arrangements	• Review local institutional arrangements for sanitation – ensure FSM is included • Identify an institutional framework for FSM services, with agreed and defined roles, responsibilities and coordination mechanism	• Establish an institutional framework for FSM services, with agreed and defined roles, responsibilities and coordination mechanism • Establish institutional roles for FS treatment and re-use options • Identify appropriate incentives for improved FSM	• Strengthen institutional roles for managing improved FS treatment re-use facilities and options • Implement appropriate incentives for improved FSM
	Planning, monitoring and evaluation	• Conduct rapid diagnostic studies by area, with a gender and pro-poor focus • Develop local plans for FS services, finance and institutional needs • Plan and design FS treatment options	• Establish revenue streams (e.g. water bill surcharge, extra property tax) • Refine and implement local service plans • Establish systems for monitoring and evaluating achievement of service standards	• Introduce plans to enhance treatment capacity and re-use arrangements • Strengthen monitoring and evaluating of FS treatment facilities and re-use arrangements against service standards
	Promotion	• Stimulate customer demand and WTP for FSM services	• Disseminate information about FSM services and regulations to the public	• Stimulate market demand for re-use of FS
	Capacity and technical assistance (TA)	• Identify capacity gaps and TA required to help improve FSM services • Promote the emergence of private sector emptying services • Implement basic (possibly temporary) measures to more safely dispose of FS that is currently dumped in the environment	• Promote or support development of improved, emptiable containment facilities • Strengthen FSM service providers (business development, financing options, etc.) • Pilot scheduled desludging (if applicable) • Pilot use of FS transfer stations (if applicable) • Build or rehabilitate FS processing plants	• Consolidate and expand use of scheduled desludging, transfer stations, etc. – based on outcome of pilot studies • Develop business models for re-use of treated FS
	Financing	• Identify the extent of financing required to address service improvements to the poorest	• Introduce specific pro-poor financial arrangements (such as targeted subsidies)	• Identify opportunities for financial flows generated from the sale of FS end products

c) User-level actions

Action point		Basic actions • *Critical interventions for public health protection*	Intermediate actions *Strengthening existing foundations*	Consolidating actions *Focusing on sustainable services (and downstream interventions)*
Users	**Planning**	• Consult with communities to identify what they need and want • Identify the gap between the range of technical options and services currently available, and what communities' say they need and want	• Gain user feedback on improved FSM services • Improve technical options and services, in response to user feedback	• Gain user feedback on current and future FSM services, including FS re-use options • Expand on the range and quality of technical options and services, in response to user feedback
	Tenant sanitation	• Map the tenure status (tenure "mix"), resulting sanitation pathways and stakeholder relationships • Engage and consult with landlords on constraints to FSM services	• Develop sanitation options within planning frameworks and approaches that are appropriate to the tenure "mix" within the city • Develop assistance and enforcement packages for landlords	• Strengthen tenure-status informed sanitation options in future planning frameworks and approaches • Focus on enforcement of service quality for landlords

11 Conclusions and recommendations

The study has identified three key challenges facing Hawassa in ensuring continued provision of safe sanitation services to all citizens of the city, including the development of FSM services. These are in relation to:

- Addressing growth and associated densification of settlements throughout the city
- Ensuring equitable services as areas expand and service levels for household facilities adapt;
- Addressing the limitations and constraints of the existing treatment plant while improving the location, access, treatment and management of future treatment; and
- Achieving sustainable growth and expansion of services through all stages of the service chain, to match increasing demand.

Whatever interventions are proposed as a result of detailed, extensive and focused studies to address these challenges, the findings of this study recommend that they must be sure to address:

- The extent to which sewerage options are needed and implemented for certain areas – such as industrial zones, in high-density areas and where on-site systems place a clear risk to polluting Lake Hawassa;
- Land requirements for future treatment plants, including wastewater treatment, fecal sludge treatment and solid waste disposal perhaps at a co-located site;
- Improving standards of containment facilities, especially for *kebele* and compound housing, with a particular focus on low-income areas;
- Building the capacity and appropriate division of roles for service providers, perhaps with a view towards the roles being focused around:
  - customer services (i.e. what people pay directly for in terms of containment and emptying), where the private sector is often best placed to provide services;
  - public services (that can be financed through taxation), in terms of the roles of facilitation, regulation and monitoring performance standards of the private sector actors, as well as management of treatment, disposal and end-use facilities; and
  - integrating new infrastructure and services with enhanced drainage, water supply, solid waste management and urban upgrading.

Key recommended actions for Hawassa City Administration

In the medium-term (containment and emptying):

- consult households and Hawassa City Council in the development of city-wide sanitation plans, especially where they affect changes to standards affecting containment infrastructure (septic tanks, pits and eventual connection to sewers); and
- identify priority area for development of sewerage networks – based on likely pollution risks to Lake Hawassa and saturation of soils.

In the shorter-term (emptying, transport and treatment):

- rehabilitate and improve access to the treatment plant, and install adequately trained staff and effective operational and monitoring systems;
- resolve market-based issues for FSM services, through price review and negotiating an increased role for formalized private sector provision through licensing and regulation, alongside an increase in tariffs; and

- identify and negotiate land purchase, to co-site a FSTP, WWTP and solid waste site.

References

Ayenew T. and Tilahun N., 2008, Assessment of lake-groundwater interactions and anthropogenic stresses, using numerical groundwater flow model, for a Rift lake catchment in central Ethiopia, Lakes & Reservoirs; Research and Management 2008 **13**: 325-343

Cairncross S. and Feachem R., 1993: pp.11-25, *Environmental Health Engineering in the Tropics: An Introductory Text*, 2nd Edition, Wiley and Sons, Ltd, UK

CSA, 2015, *Population and Housing Census Report-Country*, Central Statistical Agency, Addis Ababa, Ethiopia

DHS, 2011, *Ethiopia Demographic and Health Survey 2011*, Central Statistical Agency, Addis Ababa, Ethiopia. March 2012

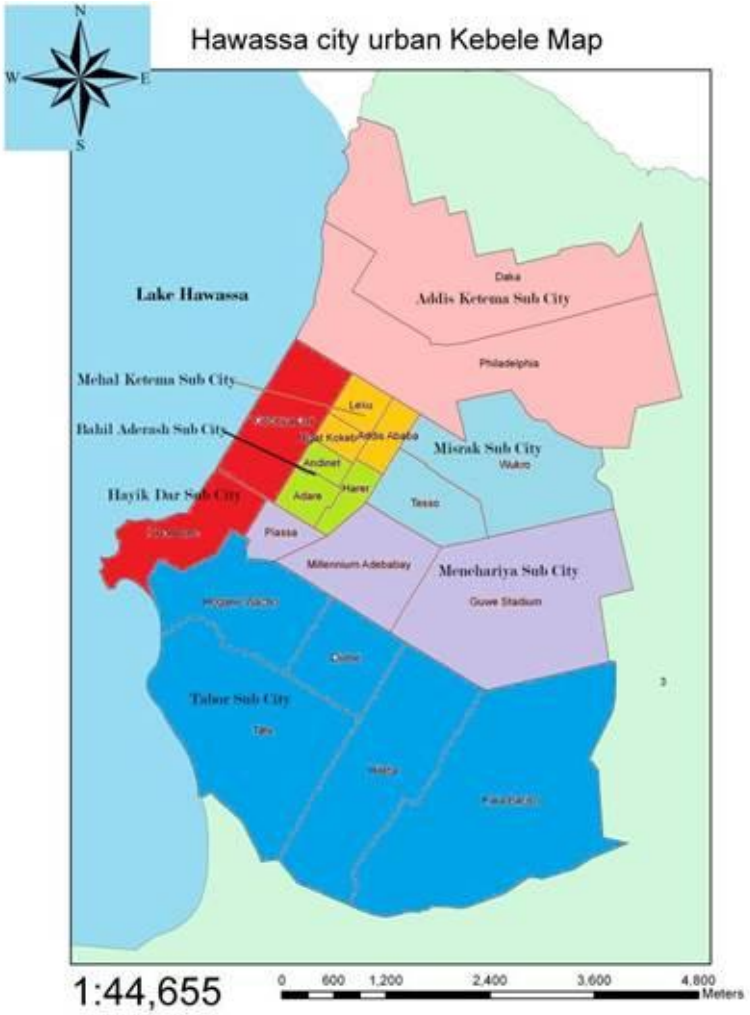
Holland, J., 2007, *Tools for institutional, political, and social analysis of policy reform: A sourcebook for development practitioners*, Washington, DC: World Bank.

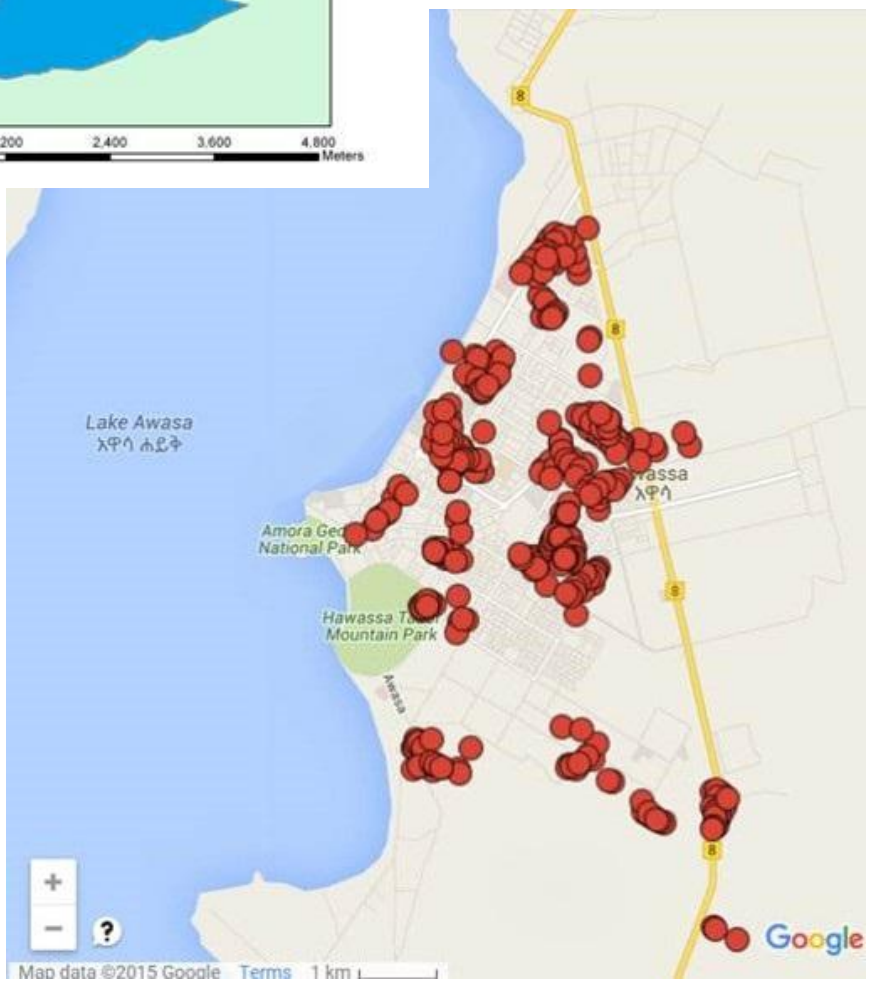
Peal A., Evans B., Blackett I., Hawkins P. and Heymans C., 2014. Fecal sludge management (FSM): analytical tools for assessing FSM in cities. Review paper. Journal of Water, Sanitation and Hygiene for Development: 04.3, pp. 371-383. IWA Publishing

Strande, L., Ronteltap, M. and Brdjanovic, D. (eds.), 2014, *Fecal Sludge Management: Systems Approach for Implementation and Operation*, London, UK: IWA Publishing

WHO/UNICEF, 2015, JMP report: Ethiopia – Estimates on the use of water sources and sanitation facilities: Updated June 2015

Annex A Map showing city-wide sample locations





Annex B CSDA scoring table

			Containment	Emptying	Conveyance	Treatment	End-use disposal	Comment
Enabling: What are current policies, planning issues and budgetary arrangements?	Policy	**Policy:** Is FSM included in an appropriate, acknowledged and available policy document (National/ local or both)?	1	1	1	0.5	0.5	There are various policies, strategies, protocols & other related working documents, most of which are at national level but applicable across the country, namely: 1. The Constitution of the Federal Democratic Republic of Ethiopia (August 1995): Article 90.1 states that "to the extent the country's resources permit, policies shall aim to provide all Ethiopians access to public health and education, clean water, housing, food and social security". Article 92.1 states also that the "Government shall endeavor to ensure that all Ethiopians live in a clean and healthy environment. 2. The National Health Policy (1993): in Article 3 states ''……developing safe disposal of human, household, agricultural and industrial wastes and encouragement of recycling", and "developing measures to improve the quality of housing and work premises for health." 3. The National Hygiene & Sanitation Strategy (December 2005) 4. National Protocol for Hygiene and "On-Site" Sanitation (June 2006) 5. National Manual on Latrine Technology Options 6. WASH Memorandum of Understanding-signed among Ministries of Health, Education, Water, Irrigation & Energy; and Finance & economic Development. The national MoU has been cascaded down to Regions (first in 2006, revised in November 2012). 7. WASH Implementation Framework (WIF) signed among the above mentioned four Ministries/sectors (August 2011) 8. ENVIRONMENTAL POLICY OF ETHIOPIA 9. National Guideline for Environmental Impact Assessment (July 2000) 10. NATIONAL GUIDELINE FOR URBAN WATER UTILITIES TARIFF SETTING 11. National Integrated Urban Sanitation and Hygiene Strategy, which is under preparation. In addition, the upcoming Integrated Urban Sanitation & Hygiene Strategy will definitely incorporate FSM with more details considering CONTAINMENT, EMPTYING, TRANSPORT, TREATMENT AND DISPOSAL.
		Institutional roles: Are the institutional roles and responsibilities for FSM service delivery clearly defined and operationalized?	1	0.5	0.5	0	0	In addition to the MoU and WIF, the Integrated Urban Sanitation & Hygiene Strategy is going to clearly define institutional roles in FSM. Under Hawassa City Administration, and regional level Bureaus the following institutions are taking parts in FSM and service delivery processes: Hawassa City Administration Hawassa City Municipal Services Hawassa City Water and Sanitation Enterprise Hawassa City Health Department

			Containment	Emptying	Conveyance	Treatment	End-use disposal	Comment
								Hawassa City Finance and Economic Development Department Hawassa City Natural Resources and Environmental Protection Agency Hawassa City Works and Housing Authority Water and Sewerage Enterprise Bureau of Finance and Economic Development Urban Sanitation, Beautification, Development & Park Services Design and Construction Supervision Authority Urban Sanitation, Beautification, Micro and Small Enterprises Development Agency Land Development and Management Office Regional Water Bureau (PMU)
		Regulation: Are there national and/or local regulatory mechanisms (i.e. bylaws and means of enforcement) for FSM?	1	0.5	0.5	0	0.5	The following regulatory mechanisms can be mentioned in relation to FSM: 1. Proclamation No. 200/2007, Public Health Proclamation,19 November 2007: in Article 12 (Waste Handling and Disposal) that: 1. Any person shall collect waste in a specially designated place and in a manner which does not affect the health of the society. 2. No person shall dispose solid, liquid, or any other waste in a manner which contaminates the environment or affects the health of the society. Article 13 (Availability of Toilet Facilities) goes on to state: 1.Any institution or organization providing public service has the obligation to organize clean, adequate and accessible toilet facilities for its customers, 2. Any city administration is responsible to provide public toilet and ensure its cleanliness, In addition, Article 20.2 states also that "any person who disposes waste outside a garbage container in an manner that can cause the contamination of the environment or can create a health hazard, is punishable with simple imprisonment from three months to three years and with fine from Birr 1000 up to 9000." Proclamation No. 661/2009: 'Food, Medicine and Health Care Administration and Control Proclamation No. 661/2009'. This proclamation also has regulation for its implementation, and it is officially referred as 'Food, Medicine and Health Care Administration and Control Council of Ministers Regulation No.299/2013. Part Four of this Regulation deals with HYGIENE, ENVIRONMENTAL HEALTH AND COMMUNICABLE DISEASES CONTROL, under which article No. 39 is on Waste Handling and Disposal: • It shall be prohibited to burn or dispose by any other means a poisonous or contagious waste without obtaining permit from the appropriate organ. • No person may engage in recycling or disposal of poisonous or contagious wastes without obtaining permit from the appropriate organ upon fulfilling requirements set by the Authority. • The appropriate organ shall, prior to the designation of a place for disposal or recycling of waste, confirm that the

			Containment	Emptying	Conveyance	Treatment	End-use disposal	Comment
								disposal or recycling of waste at such place may not cause damage to public health. • No person may discharge liquid waste to the environment unless treated in accordance with standards to be issued by the appropriate organ. Furthermore, No. 42 deals specifically with Toilet of Public Facility, under which it says: Any toilet of a public facility shall fulfill the requirements set by the Authority. On the other hand, a section formally known as *Code Enforcement* established under city administrations, including Hawassa City is particularly engaged in enforcing of regulations in the various socio-economic areas including sanitation. The code enforcement section carries out its duties either by directly conducting monitoring tours across the city or when it receives complaints from residents. In its regulatory activities, the Code Enforcement section has the right to contact and mobilize police force as appropriate.
		Service provision: does the policy, legislative and regulatory framework enable investment and involvement in FSM services by appropriate service providers (private or public)?	1	0.5	0.5	0.5	0	Similar to the other sectors, private sector investment in sanitation service delivery has been permitted. As part of the country's economic policy, private investment in all sectors is highly encouraged. The Government even facilitates investments by availing land, permits investors to import required machineries free of tax, and many other opportunities. To coordinate such private investment activities, the Government also established its structures from federal down to district levels. Accordingly, during our assessment visit, we learned that the *Enterprises Development Office*, in general and the *Small and Micro Enterprises Development Office*, in particular is practically dealing with the organization, capacity building (by provision of training, required materials provision), facilitating of loan, etc. for small-scale enterprises that would like to be engaged in sanitation service delivery. In addition to availing loan, the Enterprise Development Office also provide training to members of micro and small-scale enterprises on areas of business/financial management, customer handling, marketing, and the like. The office also closely follow up and monitor the enterprises to sort out challenges they are encountered and take remedial action timely. However, from our discussion with the enterprises development office staff, so far, there is no enterprise working on FSM at any stages of the service chain. As a matter of fact, in Ethiopia, alternative technologies, for instance small-sized vehicles for emptying and transport are hardly used/introduced. All the available vacuum trucks are conventional ones which are expensive and out of the spectrum of small and micro enterprises presumed objectives. But still, as mentioned above, the City Administration Trade and Industry Department is the responsible office to facilitate private investment for private sector /companies who applied in the different investment areas. Accordingly, the few private companies currently engaged in FSM particularly on emptying and transport had received the support in terms of loan, tax exemption while importing the vacuum trucks, etc. There is however a degree of uncoordinated / unregulated operations of private vacuum truck operations and no coordination in relation to end-use of safe disposal options.

			Containment	Emptying	Conveyance	Treatment	End-use disposal	Comment
	Planning	**Targets:** Are there service targets for (each part of) the FSM service chain in the city development plan, or a national development plan that is being adopted at the city level?	1	0.5	0.5	0	0	In relation to human waste disposal, existing targets at all levels (National, Regional or District levels) are on increasing access to latrines/sanitation facilities and increasing the number of Open Defecation Free Communities across the nation. Moreover, the *One WASH National Program* (OWNP), which is the biggest WASH development program of the country that is planned to be implemented in two phases: Phase I from July 2013 to June 2015 and Phase II from July 2015 to June 2020, has set out the following targets: • Increasing sanitation access from 65.8% to 100% (nation-wide, both in rural, urban and pastoral settings) • In Urban settings, the main activities include study and design, capacity building and management support, environmental and resettlement safeguards, immediate service improvements and expansion and augmentation of water supplies. Sanitation and urban environmental improvements will include desludging equipment and facilities, management of wastewater and public toilets in selected locations. No evidence of targets for end-use options or disposal means (either in-situ on at treatment site)
		Investment: Is FSM incorporated into an approved and used investment plan (as part of sanitation) - including ensuring adequate human resources and Technical Assistance? (Ideally a medium term plan, but if not, at least an annual plan)	0.5	0.5	0.5	0	0.5	Regarding investment plan, the OWNP mentioned above can be considered as an investment plan for improving sanitation service delivery at national level. On the other hand, the fact that the City of Hawassa is in the process of preparing a new master plan, which pledges to give appropriate focus on sanitation can be considered as one important step towards an investment plan for the city's sanitation including FSM. There remains however no clear indication that an investment plan is addressing resource or technical assistance gaps.
	Budget	**Fund flows:** Does government have a process for coordinating FSM investments (domestic or donor, e.g. national grants, state budgets, donor loans and grants etc.)?	1	0.5	0.5	0.5	0.5	In the above mentioned One WASH National Program, the required cost for the targets set for Urban Sanitation estimated to be USD 95.7 million and sector partners and donors have already allocated part of it. In addition, using the OWNP as a predefined mechanism for fund mobilization, the additional fund required to fully address targets set on urban sanitation improvements including FSM is planned to be solicited during the courses of the program implementation. The OWNP further elaborates 'effective institutional arrangements and procedures need to be in place to ensure the smooth flow of funds as well as the timely availability of adequate financial resources and to track their use.' Accordingly, the document has well defined about essential issues such as guiding principles for Program financing, assumptions for Program financing, sources and size of project funding for the Program, mitigation measures for budget availability and utilization risks and other related considerations. From the discussion with Hawassa City Administration, Water Supply and Sewerage Enterprise Manager, it was also learned that his office has been working development partners such as the World Bank. As an example, he mentioned that the newly constructed drying bed was financed by the grant received from the WB. However, investment in the treatment plant is previous, with no current investment plan to improve capacity or potential for end-use. No coordinated investment in operation of emptying services, transport, or safe disposal of un/treated FS

<table>
<tr><th></th><th></th><th></th><th>Containment</th><th>Emptying</th><th>Conveyance</th><th>Treatment</th><th>End-use disposal</th><th>Comment</th></tr>
<tr><td></td><td></td><td>Adequacy & structure: Are the public financial commitments to FSM commensurate with meeting needs/targets for Capex and Opex (over the coming 5 years)?</td><td>1</td><td>0.5</td><td>0.5</td><td>0.5</td><td>0.5</td><td>The One WASH National Program document has been stated the Urban Sanitation Financial Requirement by Activity (USD) as follows:
<table>
<tr><th>No.</th><th>Activity</th><th>Requirement (USD)</th><th>%</th></tr>
<tr><td>1</td><td>Public Toilets</td><td>47,568,132</td><td>49.7%</td></tr>
<tr><td>2</td><td>Sewerage Expansion</td><td>29,515,286</td><td>30.9%</td></tr>
<tr><td>3</td><td>Vacuum Trucks</td><td>7972967.786</td><td>8.3%</td></tr>
<tr><td>4</td><td>Program Mg’t and Capacity building</td><td>4,349,266</td><td>4.6%</td></tr>
<tr><td>5</td><td>Urban Health Extension Work</td><td>4,349,266</td><td>5%</td></tr>
<tr><td>6</td><td>Sludge drying Bed</td><td>1,928,931</td><td>2.0%</td></tr>
<tr><td></td><td>Total</td><td>95,683,849</td><td>100%</td></tr>
</table>
Some budget allocation to sludge drying beds, but in the past and nothing identified at scale needed to adequately address current and future challenges.
WES are running tanker operations at a loss (rely on cross-subsidy from HCA)</td></tr>
<tr><td rowspan="2">Developing: What is the level of expenditure, degree of equity and level of output?</td><td>Capital expenditure</td><td>Capital funding: What is Capex expenditure per capita on FSM (3 year average)?</td><td>0.5</td><td>0.5</td><td>0.5</td><td>0.5</td><td>0</td><td>During the last three years, the Hawassa City Administration has been invested a significant amount of fund for the procurement of 2 Vacuum Trucks, the construction of new disposal site, staff salary and many other FSM related expenses. The amount of investment, comparing to the previous years, has been increasing in the last consecutive years. The per capita investment of FSM for last year is roughly estimated to be less than 2.00 USD, which is believed to be very low.
From the detail interviews we had with the Deputy Mayor and Manager of the Water Supply and Sewerage Enterprise of the city, we have confirmed that the city administration has recognized that the problem of FSM would be much more than the current one as the population increases and the socio-economic development activities expands. Accordingly, the city administration is looking for a comprehensive sanitation plan that can accommodate expected problem of sanitation including FSM in the city.</td></tr>
<tr><td>Equity</td><td>Choice: Is there a range of affordable, appropriate, safe and adaptable technologies for FSM services available to meet the needs of the urban poor?</td><td>1</td><td>0.5</td><td>0.5</td><td>0</td><td>0</td><td>Ranges of technical options and technologies for FSM have been applied in the city. In the low-income areas of the city, we have witnessed that the city administration in collaboration with NGOs such as Jerusalem Children and Community Development Organization (JeCDDO) communal latrines are constructed and being used properly. Similarly, at selected areas, public latrines are constructed and outsourced to locally organized business associations, and are providing services to the public at reasonable service fee while the associations have taken the responsibilities of operation and maintenance of the facilities.
Moreover, as told by the Deputy Mayor, the city administration is planning to construct more public latrines where they are highly demanded; and in other pockets of areas, mobile toilets will be placed for the public use.</td></tr>
</table>

			Containment	Emptying	Conveyance	Treatment	End-use disposal	Comment
		Reducing inequity: Are there specific and adequate funds, plans and measures to ensure FSM serves all users, and specifically the urban poor?	1	0.5	0.5	0	0.5	As mentioned above, in relation to FSM, the urban poor are being addressed by a joint effort of the city administration and NGOs. In our personal visit to one of the low-income areas called '*Addis Ababa Kebele'* (Misrak Sub-city), communal latrines constructed and handed over to users are basically four-room blocks where one room is specially designed for disabled. Overall, however there remain limited services that currently reach the poorest areas of the city.
	Outputs	**Quantity / capacity:** Is the capacity of the FSM chain growing at the pace required to ensure access to FSM meets the needs and targets that protects public & environmental health?	1	1	1	0	0	In Hawassa City, the continuous development of capacity in the area of sanitation service delivery is quite visible. The city administration's commitment to keep the city clean and green is remarkable. This commitment was well described by the Deputy Mayor, who utterly underlined that '*'the agenda of sanitation (proper management of both liquid and solid waste) and therefore, ensuring a safe, clean and healthy Hawassa is the cardinal/primary responsibility of the Mayer.''* As mentioned earlier, the city administration's commitment is well expressed by the decisions it made to own two vacuum trucks, construct a new fecal sludge disposal site, which is relatively fulfills minimum technical standard, and assigning the required skilled and non-skilled workers who are engaged in this particular task full time. There is however no identified use of dried FS at the treatment plant currently.
		Quality: Is the quality of FSM sufficient to ensure functioning facilities and services that protect against risk through the service chain?	1	1	1	0	0.5	Similar to the growing FSM service delivery capacity of the city, the quality of service is also improving through time. However, given the discrepancy between the number of tanker emptying trips and the number of tankers discharging to the treatment plant during the rainy season, the functionality of treatment and end-use stages are likely to be compromised.
		Reporting: Are there procedures and processes applied on a regular basis to monitor FSM access and the quality of services and is the information disseminated?	1	1	0.5	0.5	0.5	From our interviews and interactions with concerned FSM stakeholder offices under the city administration, we have learned that each stakeholder office has well defined duties and responsibilities, which further translated and shared to each of the worker assigned at various levels as a job description. Accordingly, based on the existing work procedures defined by the civil service agency, reports are prepared and submitted periodically (daily, weekly, monthly) by each of the worker following the administrative/organization structure. Sample of these reports were reviewed during the KIIs. Similarly, each of the FSM stakeholder office compile and submit/present performance reports to the city administration monthly; and every three months/quarterly the city administration organizes a forum where all offices congregate and carry out a detailed deliberation on the various activities progress, achievement and challenges encountered by the offices to look for appropriate and timely remedial measures. The performances of offices under the city administration is popularized through various mass medias, such as local FM radios, TV broadcasts, local newspapers, bulletins, newsletters, etc. There remains however a lack of data available about the number of trucks running, the operation of the treatment plant and practices around use/disposal of dried FS.

			Containment	Emptying	Conveyance	Treatment	End-use disposal	Comment
Sustaining: What is the status of operation and maintenance, what provisions are made for service expansion and what are current service outcomes?	O&M	**Cost recovery:** Are O&M costs known and fully met by either cost recovery through user fees and/or local revenue or transfers?	0.5	0.5	0.5	0	0.5	From our interview with the Manager of Water Supply and Sewerage Enterprise, we have learned that the Enterprise has been fully recovering its budget from the service charge/fee it collects from users; and confirmed us that the Enterprise is well of covering its budgetary requirements for its routine FSM service delivery operations/endeavors. On the other hand, however, the Manager told us that his office has also been received budget supports from the city administration and sector development partners for new and expansion projects, including FSM that require substantial investments. Scores are influenced by the extent to which transportation and treatment services are (apparently) currently running at a loss.
		Standards: Are there norms and standards for each part of the FSM service delivery chain that are systematically monitored under a regime of sanctions (penalties)?	0.5	0.5	0.5	0	0	Apart from the strategies, protocols, proclamations and regulations mentioned earlier, which are very general ones (on sanitation and hygiene or solid and liquid waste), specific standards on each of the FSM service chain: CONTAINMENT, EMPTYING, CONVEYANCE, TREATMENT AND DISPOSAL, is not available. Even so, we have found out that the city administration through its offices, such as Land Development and Management Office, Design and Construction Authority, and Building Approval Office ensures the fulfillment of basic requirements for any new construction including living quarters. The four construction parameters that are considered to be checked are: Architectural, Structural, Electrical and Sanitary. Accordingly, the inclusion of toilets and other sanitary structures in the design and construction of houses is checked by the relevant technical officers from the mentioned offices. From our discussion with Frezer Kaleb (Sanitary Engineer), Messay Ashenafi (Structural Engineer) and Dawit Getachew (Architect) at the Design and Construction Authority of Hawassa City, we further learned that they have a predefined checklist to carry out the monitoring activities in each of the four parameters. Even though the existing standards are related mainly on containment but also some elements of the standard, such as the need to have ample access to buildings has contribution to easy emptying and then transport. There are no clear standards applied for construction or levels of sharing of facilities, or monitoring of any standards for end-use / disposal
	Expansion	**Demand**: Has government (national or city authority) developed any policies and procedures, or planned and undertaken programs to stimulate demand of FSM services and behaviors by households?	0.5	0.5				The National Hygiene & Sanitation Strategy (December 2005) clearly indicates that the country's hygiene and sanitation promotion endeavor rests on three core pillars. Simply put they are: 1. Creation of enabling environment, 2. *Creation of demand* for hygiene and sanitation services among the public, through participatory learning, advocacy, communication, social marketing, incentives or sanctions to forge behavior change 3. Improved access to strengthen the supply of sanitation through appropriate technology solutions, product and project development, and support to local producers and artisans. Based on this, therefore, the Health Extension Program, which is being implemented both in rural and urban settings, particularly focus on public awareness creation that is intended to create demand for sanitation and hygiene services and also other basic health care services by the public. Accordingly, from our encounter with the Hawassa City Administration Health Department authorities, we have learned that The urban health extension program which is basically executed by the health extension workers is well functioning in the city. Currently, there are 86 urban health extension workers working in the 8 sub-cities. In addition, all 66,000 households of the city are organized in a 1 to 5 network through which households are closely discuss on

			Containment	Emptying	Conveyance	Treatment	End-use disposal	Comment
								issues such as environmental sanitation, including FSM and other health related issues; five of the 1 to 5 networks again form one Health Development Army (6 x 5=30 persons), which handles issues that are not addressed at the 1 to 5 network; likewise the system extended to health center level then to the city administration health department. Currently however, demand for services does not appear to be growing, or responding accordingly to likely demand.
		Sector development: does the government have ongoing programs and measures to strengthen the role of service providers (private or public) in the provision of FSM services, in urban or peri-urban areas?	0.5	0.5	0.5	0.5	0.5	As mentioned earlier, the Government of Ethiopia has well incorporated sanitation sector development in its national development programs/plans such as the Growth and Transformation Plan (GTP), the Health Sector Development Programs and currently in the One WASH National Program. The other important point to be mentioned here is that the current shift in the government's development strategy, which is to give equal attention to both rural and urban settings can be considered as a good opportunity for urban areas to benefit from and be able to improve and expand sanitation services including FSM. At this very moment, Hawassa City Administration is preparing a new City Master Plan that will be used until 2040. A document we accessed from the city administration shows that in order to come up with an effective new master plan, limitations of the previous Integrated Development Plan (IDP) have been identified by all concerned stakeholders. Accordingly, among the identified problems or shortcomings of the previous IDP, its weakness in addressing/considering solid and liquid waste management well stated. This implies that the new city plan will give appropriate consideration for the city's sanitation issues, including FSM. While plans are in place however, there is no indication of a coordinated response at present with resulting expansion of services.
	Service outcomes	**Public Health:** What is the magnitude of public health risk associated with the current FS flows (through the stages of the FS service chain)?	1	1	1	1	1	In Hawassa City, even though there is no conventional sewerage system, majority of households have a latrine, in low-income areas, communal latrines are used and public latrines are made available mainly for public use. In addition, the urban health extension program, which is well functioning across the city (continuous awareness creation on sanitation and hygiene among inhabitants and close follow up and supervision of households by the health extension workers) can justify that the public health risk posed by fecal sludge is low. Likewise, the survey made on the FSM of the city has confirmed that practices which can cause critical public health risk, such as manual fecal sludge emptying, illegal dumping, etc. are not done.
		Quantity: Percentage of total FS generated by the city that is managed effectively, within each part of the service chain	0.5	0	0.5	0.5	0	Similar to the rest of Ethiopian cities, majority of Hawassa households use on-site sanitation facilities; in most cases households rather dig new pit when the previous one get filled. Those households, who have no ample space to dig new pit, use existing emptying service either from the municipality/the city administration water and sewerage Enterprise or private service providers. It is not common practice to see fecal sludge draining directly to public drainage, to rivers or any other illegal way by households, private or public institutes. Scoring reflects that: <50% of FS effectively containment, <50% of emptiable pits/tanks emptied and transported, >50% treatment capacity (either at the FSTP, or in unemptied pits/tanks), and <50% effective disposal (in-situ or at FSTP)

			Containment	Emptying	Conveyance	Treatment	End-use disposal	Comment
		Equity: To what extent do the city's FSM systems serve low-income communities? (Containment, Emptying and Transport services only)	1	0.5	0.5			In Hawassa city, significant portion of the inhabitants are low-income families who are hardly able to pay fecal sludge emptying and transport service charge, which is about ETB 700.00-1400.00 per one truck (based on the capacity of the vacuum truck); in this regard, it was found out that there is variation on the amount of service charge requested by municipality and private service providers (the service charge requested by the municipality is a bit higher than that of private service providers). Accordingly, unless otherwise the city administration look for an appropriate mechanism, such as down payment system for those low income households, it is difficult to ensure equity across all inhabitants on FSM system the city has arranged.

Annex C Public health risk assessment: scoring used

Transect walks: Participants used a standard reporting format to allocate scores to help represent a qualitative assessment of the relative impact from physical and environmental conditions on being able to achieve effective and safe FSM services in that locality.

Categories included in the conditions that were recorded included: drainage infrastructure and use (noting the presence of storm water, greywater and/or blackwater); evidence of open defecation, dumped fecal sludge or solid waste; public latrine coverage; access to water points; housing density; conditions of roads and paths. Each category was pre-allocated 5 observed responses, ranging from very poor conditions (scoring 5) through to very good conditions or no evidence found (scoring 1). Scores of 1 therefore represent the lowest impact and 5 the highest impact on FSM services. Results from the 40 transect walks (10 in city-wide PSUs and 10 in low-income area PSUs) are shown in Table 28 below.

For certain categories relating to FSM (for example evidence of open defecation, fecal sludge, blackwater in drains) that scored 3 or more, participants identified the location of the observation, how often the particular risk occurred in the area, by asking members of the community for information, and the mechanism for human contact and contamination route (through people walking in bare feet, entering drains, blackwater in drains overflowing near to homes, etc.).

Tables showing the format for all scoring conditions during the Transect Walks and for collecting further details where high risks were seen, are available from the links in Annex D.

Definitions used to identify scores for housing density, paths and road access are shown in the following table.

Category	Definition	Score
Housing and public space arrangement	Less well or poorly organized development, with highly restricted access for public service vehicles and no clearly defined public spaces.	5
	Less well organized development, with mostly temporary housing, limited access for public service vehicles and very few clearly defined public spaces.	4
	Well organized development, with semi-permanent and/or temporary properties, limited access for public service vehicles and only a few clearly defined public spaces.	3
	Well organized development, with permanent and/or semi-permanent properties, but restricted access for public service vehicles and public spaces, including some open spaces	2
	Well organized development, with permanent and/or semi-permanent properties, good access for public service vehicles and public spaces, including open spaces.	1
Paths Routes wide enough for pedestrians and possibly motorbikes	Very narrow paths that can be used by pedestrians only (too narrow for motorbikes)	5
	Poorly maintained dirt paths wide enough for motorbikes	4
	Well-maintained dirt paths wide enough for motorbikes	3
	Gravel or paved paths, in poor condition, wide enough for motorbikes	2
	Gravel or paved paths, in good condition, wide enough for motorbikes	1
Roads Routes wide enough for vehicles (cars, 3-wheelers (‘Bajaj’) and donkey carts)	Unsurfaced roads, wide enough for small carts or 3-wheeler, but not for car access.	5
	Unsurfaced roads wide enough for cars to pass	4
	Gravel or paved roads, wide enough for small carts or 3-wheeler, but not for car access	3
	Gravel or paved roads, wide enough to allow two cars to pass	2
	Well maintained gravel or paved road, wide enough for two cars to pass	1

Table 28 Transect walk – results of scored observations

Note: 5 = highest observed risk level, 1 = lowest observed risk level

Category of observation / PSU	1. Drainage (storm water and greywater)	2. Drainage (blackwater)	3. Access to water points	4. Evidence of solid wastes	5a. Evidence of human fecal materials – through OD	5b. Evidence of human fecal materials - through dumped fecal sludge	6. Evidence of animal fecal materials	7. Household latrine coverage	8. Public latrine coverage	9. Presence of wastewater and/or fecal sludge treatment facilities	10. Housing density	11. Paths	12. Roads
City-wide (Sub-sample A)													
PSU 1001	1		1	3	1	1	4	2	1		1	1	1
PSU 1003	3		2	3	2	1	2	2	4		1	1	1
PSU 1006	3		2	2	1	1	4	3	1		2	1	1
PSU 2003	1		3	3	1	1	4	2	1		1	1	1
PSU 2006	1		1	1	2	1	1	1	1		1	1	1
PSU 2007	2		3	4	1	1	4	4	1		4	4	2
PSU 3003	2		2	2	1	1	4	1	1		2	3	2
PSU 3004	2		2	3	1	1	1	1	1		2	3	2
PSU 3006	4		3	4	2	4	4	4	4		4	4	2
PSU 4006	3		3	4	3	1	3	4	1		4	4	2
PSU 4008	3		2	3	1	1	2	4	1		3	1	1
PSU 4009	1		3	1	1	1	1	3	1		2	1	1
PSU 5002	1		2	4	1	1	2	2	1		1	1	1
PSU 5003	1		2	2	1	1	2	2	1		1	1	1
PSU 5006	3		2	2	1	1	2	3	1		3	1	1
PSU 5007	3		2	5	1	1	2	3	1		3	1	1
PSU 5008	3		2	4	1	1	2	3	1		3	1	1
PSU 6001	2		2	4	1	1	2	2	1		1	3	1
PSU 6003	2		2	5	1	1	1	1	1		1	1	2
PSU 6013	1		1	4	1	1	1	1	1		1	2	1
PSU 6014	1		1	5	1	1	1	1	1		1	3	1
PSU 6017	2		1	4	1	1	2	1	1		1	3	1
PSU 7001	3		3	3	2	1	2	3	1		4	4	2
PSU 7002	3		2	5	2	1	2	2	4		1	3	1
PSU 7017	3		3	4	4	1		4	1		4	3	2
PSU 7036	3		2	4	4	1	4	2	1		3	3	4
PSU 7046	3		1	4	2	2	3	2	1		1	1	1
PSU 7068	4		1	4	1	1	3	2	1		1	1	2
PSU 7077	3		3	4	2	1	3	3	1		3	2	1
PSU 7095	1		2	3	1	1	2	2	1		1	1	1

Category of observation / PSU	1. Drainage (storm water and greywater)	2. Drainage (blackwater)	3. Access to water points	4. Evidence of solid wastes	5a. Evidence of human fecal materials – through OD	5b. Evidence of human fecal materials - through dumped fecal sludge	6. Evidence of animal fecal materials	7. Household latrine coverage	8. Public latrine coverage	9. Presence of wastewater and/or fecal sludge treatment facilities	10. Housing density	11. Paths	12. Roads
Low-income areas only (Sub-sample B)													
PSU 2005	2		2	5	2	1	5	4	4		3	3	2
PSU 4001	1		2	4	1	1	3	2	1		4	1	1
PSU 4007	3		3	3	2	1	3	4	3		4	1	1
PSU 6009	3		2	4	2	1	2	3	3		3	1	1
PSU 7004	3		2	5	1	1	2	3	1		4	4	1
PSU 7024	3		3	4	2	1	4	4	1		4	3	2
PSU 7043	3		2	2	1	1	2	2	1		3	3	2
PSU 7071	3		3	4	2	1	4	5	1		4	4	2
PSU 7080	3		3	4	3	1	3	4	1		4	4	2
PSU 70104			1	2	1	1	1	1	1		2	1	1

Annex D Links to data collection instruments

This annex will contain hyperlinks to all data collection instruments (e.g. household questionnaire) once the full World Bank study is completed.