Rapid Assessment of Household Sanitation Services

Vientiane, Lao PDR

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Prepared by Erick Baetings and Declan O'Leary

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Executive Summary

This study was undertaken "to conduct a rapid assessment of the adequacy of existing domestic sanitation facilities in Vientiane, especially in middle- and low-income areas where investments in these facilities are likely to be modest", with the aim to present an overview of the current status of household sanitation services in Vientiane capital and to provide useful information and recommendations that can guide future action.

Nearly all households in the capital use on-site facilities, there being only a very small portion of the city served by sewerage (a single sewer line discharging into a waste stabilisation pond, plus a few locations where small bore sewerage has been piloted). Households typically have a pour-flush toilet connected to a septic tank or soak pit that could be emptied or simply replaced when full. Housing density is generally low, open defecation is rare and there are no slums, only small pockets of low-income housing with poor sanitation, some of which have benefitted from special projects. Septic tank emptying services are widely available, with anecdotal evidence of at least twelve private contractors operating in the city.

Although the above suggests that household sanitation is generally satisfactory in Vientiane, there is no substantive data available to confirm this. Sector actors were concerned with the fact that there is a lack of reliable information to guide urban sanitation planning and development. To mitigate the risk that decision-making will be based on simple assumptions that existing arrangements are either satisfactory or unsatisfactory, it was felt that a study focusing on household sanitation services in Vientiane capital would provide valuable information to guide both ongoing and proposed initiatives to improve services in the capital. Therefore this study was commissioned to assess some of the sometimes unsubstantiated assumptions and assertions.

The major conclusions of this study are:

In the urban areas of Vientiane, the existing onsite sanitation systems are, if not already to a certain degree, expected to compromise public health as well as the overall quality of the environment in the near future. Despite high sanitation coverage as a consequence of the wide application of onsite sanitation systems by Vientiane's citizens, health and environmental problems exist due to poor design, poor construction combined with a lack of maintenance. Onsite sanitation systems are a potential source for surface water and groundwater contamination.

In the absence of centralised sewerage systems, the choice for basic onsite sanitation systems is understandable, particularly considering that all the investments are to be incurred by the individual households, sometimes at considerable costs. However, this rapid assessment acknowledges that these systems are inadequate and do not function well in specific parts of Vientiane. Particularly in areas that are prone to seasonal flooding, areas with high groundwater tables, areas with high population densities, and areas where the permeability of soil is low.

It is obvious that the design of a majority of the existing onsite sanitation systems does not address the physical constraints relating to topographical and soil conditions. Untreated wastewater discharges either via storm water drainage systems into natural watercourses (including wetlands and marshes) in and around the city, or filtrates into the subsurface where it mixes with groundwater, resulting in heavy pollution and pathogenic contamination.

The underlying causes that have led to the present situation can be summarised as follows:

- ☒ Vientiane is growing rapidly and often in an unplanned manner, which has resulted in high population densities in the city centre and other commercial areas. During the next ten years, the population of Vientiane is expected to grow by almost 40%.
- ☒ The drainage situation in Vientiane City has improved a lot since the late nineties, but drainage conditions are expected to worsen in future.

- ☒ The impact of past projects has been somewhat limited because only relatively small investments were made to improve sanitation conditions and because little sustainability was built into project designs.
- ☒ Although environmental legislation has evolved quickly in the Lao PDR, the current legal framework is said to be often rather general in nature with limited specific reference to sanitation or wastewater issues. Principal inconsistencies include conflicting provisions, unclear or sometimes overlapping institutional mandates, lack of implementing regulations, and ineffective monitoring and control mechanisms to ensure compliance with legislation.
- ☒ Sanitation has been neglected! As no single government agency has responsibility, there is no leadership on such important issues as policy, legislation, responsibilities and budget allocations. As a consequence policy and legal developments for sanitation has lagged.
- ☒ Government's ability to implement plans and achieve sanitation coverage targets depends almost entirely on project or programme financing by development partners because the government's budget allocations for sanitation are woefully inadequate.
- ☒ The existing building regulation (No. 7681, dated 29 June 2005) has a number of shortcomings with regards to the standards set for onsite sanitation systems and there is no system in place to enforce actual compliance with official regulations and standards.
- ☒ Very little is known about the removal and disposal of sludge from on-site sanitation facilities. In the absence of public services, private service providers have emerged, but at present this business is completely unregulated.

This report has come up with the following recommendations:

1. Encourage, and where necessary support, households to improve and maintain their existing onsite sanitation systems. In areas where this is technically appropriate, improvements should focus on ensuring the effective drainage of effluent by installing onsite seepage or leaching pits.
2. Provide more flexible standards and designs for onsite sanitation systems and ensure that they are developed by experts that understand the urban sanitation business. A number of technical options at varying cost are required to respond to the topography and physical constraints as well as to the different socio-economic status of Vientiane's citizens.
3. Provide technical options that can be improved or upgraded over time particularly for low-income households. Particularly for low-income households it is important that they invest in sanitation facilities that can either be upgraded or linked up to form a network in future.
4. Start investing in community based systems for areas where onsite sanitation facilities can not function effectively. This is particularly relevant in poorly drained areas which are subject to flooding and poor soil permeability.
5. Ensure that technical improvements are supported by adequate capacity building initiatives for implementing agencies. The focus should be on the development of appropriate technical responses to the prevailing physical constraints by enhancing the institutional capacity of the responsible agencies.
6. Establish and enforce a clear legal and regulatory framework to administer and manage the safe collection, transportation, disposal and treatment or reuse of onsite sanitation septage. There is an urgent need to establish an appropriate legal and regulatory framework and also to create a regulatory regime that will ensure effective enforcement.
7. Make the necessary improvements to the septage waste disposal site at KM32 to serve as a magnet for private operators. Improvements at the disposal site will make it even more necessary than now, but also easier, to increase the current uneconomical fees.

8. Investigate whether alternative or additional septage disposal and treatment plants need to be constructed. As the haulage of relatively small septage sludge volumes is considered inefficient and uneconomic –resulting in illegal dumping – haulage distances should be minimised by considering a system of decentralised waste management sites.
9. Increase public awareness through effective environmental health and hygiene promotion campaigns. Investments in physical infrastructure need to be complimented by campaigns to promote improved sanitation and hygiene behaviour (e.g. washing of hands), health awareness, and awareness of the benefits of improved environmental health and waste management. Integrate these awareness raising campaigns in MOH led "Model Healthy Villages" programme.
10. Because of the reported high prevalence of thermo-tolerant coliform contaminated ground water sources. Further and more regular investigation of the contamination risk is needed especially if households (even the 9% reported) are using ground water for their main sources.

The implementation of the above recommendations will be much more effective if the following two conditions are met:

1. Sanitation is no longer neglected by Government agencies and development partners. To be able to address the current and future sanitation and wastewater management needs of urban (and rural) areas, broad commitments are required including policies, capacities, resource allocations and innovative action.
2. Consider developing a National Sanitation Policy to better guide the development of new or the revision of existing laws and regulations. This will also assist in the advancement of sanitation and hygiene service provision across the country. It is generally one of the roles of Government to provide sector leadership, and one of the methods of expressing this is through National Policy statements which can be accepted by sector actors and supporters and has been adopted by the Government as a whole.

Acknowledgements

The Rapid Assessment of Household Sanitation Services in Vientiane, Lao PDR was executed by a team of WASH experts of SNV, Netherlands Development Organisation. The report was developed by Erick Baetings (Team Leader) and Declan O'Leary (Alternative Team Leader) under contract with WSP-EAP. In addition to the two Team Leaders the following SNV WASH experts were involved in the execution of the rapid assessment: Ekkasit Pathammavong, Phetmany Cheuasongkham, Boonlong Sangparserd and Phanmaly Silipong. Monique Beun, as the Survey Coordinator, was responsible for leading and guiding the execution of the more than 500 household surveys, and for analysing the data and preparing the input for this report.

The household surveys would not have been carried out if it wasn't for the team of dedicated, enthusiastic and active enumerators. Our thanks go to Daravanh Vongsakhone, Philailack Youtthasanti, Khamphoua Singsomboun, Kethsouda Bandavong, Monepheang Thepsisoulath, Vilaythong Thongmeunhom, Kainakhone Bounbanith, Soutthakone Phanpachit, Kerthmany Banmanivong, Abey Sipanya, Lamgnuen Manivong and Banxa Chanming.

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Glossary

CFU/100mL	"Colony forming units" per 100 millilitres. The unit of measurement for (faecal) bacteria contamination of water
Desludging	The process of cleaning or removing the accumulated septage from a septic tank or wastewater treatment facility.
Digestion	A microbiological process that converts chemically complex organic sludge to methane, carbon dioxide, and inoffensive humus-like material.
Domestic Sewage	Wastewater composed of untreated human waste coming from residential and commercial sources. Domestic sewage does not include industrial and/or hazardous wastes.
Effluent	A general term for any wastewater, partially or completely treated, or in its natural state, flowing out of a drainage canal, septic tank, building, manufacturing plant, industrial plant, or treatment plant.
Faecal Sludge Management	Also known as septage management, FSM concerns the various technologies and mechanisms that can be used to treat and dispose of sludge – the general term for solid matter with highly variable water content produced by septic tanks, latrines, and wastewater treatment plants.
Improved Sanitation	A connection to a public sewer or septic system, or access to a pour-flush latrine, a simple pit latrine or a ventilated improved pit latrine, according to the Millennium Development Goals. A more detailed definition is provided in Appendix 8.
Onsite Sanitation System	Infrastructure that aims to contain human excreta at the building or premises, comprising of septic tanks and improved latrines.
Seepage Pit	A hole in the ground that receives the effluent from a septic tank and allows the effluent to seep through the pit bottom and sides; may be lined with bricks or filled with gravel.
Septage	The combination of scum, sludge, and liquid that accumulates in septic tanks.
Septic Tank	A watertight, multi-chambered receptacle that receives sewage from houses or other buildings and is designed to separate and store the solids and partially digest the organic matter in the sewage. More details are provided in Appendix 11.
Service Provider	A public or private entity, operator or water utility that is engaged in the collection, desludging, handling, transporting, treating, and disposing of sludge and septage from septic tanks, cesspools, Imhoff tanks, portalets, sewage treatment plants.
Sewage	Mainly liquid waste containing some solids produced by humans, which typically consists of washing water, faeces, urine, laundry wastes, and other material that flows down drains and toilets from households and other buildings.
Sewer	A pipe or conduit for carrying sewage and wastewater.
Sewerage	A system of sewers that conveys wastewater to a treatment plant or disposal point. It includes all infrastructure for collecting, transporting, and pumping sewage.
Sludge	Precipitated solid matter with a highly mineralised content produced by domestic wastewater treatment processes.
Stabilisation	The process of treating septage or sludge to reduce pathogen densities and vector attraction to produce an organic material that may be applied to the land as a soils conditioner. Stabilisation as in wastewater stabilization ponds.
Wastewater	Used water from domestic, institutional, commercial and industrial activities; normally polluted with pathogens and/or organic and inorganic compounds.
Wetlands	Naturally slow moving or still, shallow aquatic systems, usually on poorly drained soils, act as a buffer, absorbing excess water and peak flows, and releasing them slowly.

Source: Adapted from USAID (2010)

Abbreviations

ACF	Agence Française de Développement
ADB	Asian Development Bank
AIT	Asian Institute for Technology
BOD	Biological Oxygen Demand
BORDA	Bremen Overseas Research and Development Association
CBS	Community Based Sanitation program
CIDA	Canadian International Development Agency
COD	Chemical Oxygen Demand
DANIDA	Danish International Development Agency
DCTPC	Department of Construction, Transportation, Post and Communication (now DPWT)
DEWATS	Decentralised Wastewater Treatment System
DHUP	Department of Housing and Urban Planning (MPWT)
DPWT	Department of Public Works and Transport
EPL	Environmental Protection Law
GDP	Gross Domestic Product
JICA	Japan International Cooperation Agency
JMP	WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation
LAK	Lao Kip (National currency of the Lao PDR)
Lao PDR	Lao People Democratic Republic
LIRE	Lao Institute for Renewable Energy
MAF	Ministry of Agriculture and Forestry
MDG	Millennium Development Goals
MOH	Ministry of Health
MCTPC	Ministry of Construction, Transportation, Post and Communication (now MPWT)
MPWT	Ministry of Public Works and Transport
Nam Saat	National Centre for Environmental Health and Water Supply
NSEDP	National Socio-Economic Development Plan
OPWT	District Office of Public Works and Transport
OSS	Onsite Sanitation Systems
PHC 2005	Population and Housing Census of 2005
PTI	Public Works and Transport Institute
SNV	Netherlands Development Organisation
SPSS	Statistical Package for Social Sciences
STEA	Science, Technology and Environment Agency
UDAA	Urban Development and Administration Authorities
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UN-HABITAT	United Nations Human Settlements Programme
UNICEF	United Nations Children's Fund

USAID	United States Agency for International Development
VIUDP	Vientiane Integrated Urban Development Project
VUDAA	Vientiane Urban Development and Administration Authority
VUDMC	Vientiane Urban Development Management Committee
VUISP	Vientiane Urban Infrastructure and Services Project
WASH	Water, Sanitation and Hygiene
WHO	World Health Organisation
WREA	Water Resources and Environment Agency
WREO	Water Resources and Environmental Office
WSP-EAP	Water and Sanitation Program-East Asia and the Pacific
WWF	World Wildlife Fund for Nature

CONTENTS

1. Introduction

The Water and Sanitation Program (WSP) is a multi-donor partnership administered by the World Bank to support poor people in obtaining affordable, safe and sustainable access to water and sanitation services. The Water and Sanitation Program-East Asia and the Pacific (WSP-EAP) works with clients and partners to formulate pragmatic approaches to achieving the Millennium Development Goals for water and sanitation.

The WSP-EAP Lao PDR programme is firmly built upon WSP's Global Strategy, with the majority of activities concentrated around improving the low institutional capacity at national and local levels to deliver services to its citizens. As such, WSP is currently focusing on developing a sanitation sector financing strategy; and governance mechanisms to effectively apply water supply implementing legislation to support policy and strategy actions at field level. As well as improving access to information for engagement of people in sector development; piloting the implementation of new approaches to sanitation such as CLTS; and networking among sector agencies to improve coordination. The WSP-EAP program for the 2010 fiscal year provides the following project sheets for the Lao PDR.

Project nr	Project name	Activity examples
EA/LAO/93	Sanitation Policy and Advocacy	♦ Economics of Sanitation Initiative Phase I (Impact study) and Phase II (Options study) ♦ Sanitation Financing Study
EA/LAO/95	Country Sector Coordination and Advocacy	♦ Developing a new Water Supply Law
EA/LAO/96	Marketing Good Practices in Sanitation and Hygiene to Communities	♦ CLTS pilot in Champasak and Sekong ♦ Khoun community radio pilot

Furthermore, there are a number of regional initiatives – regional knowledge building and inter-country support mechanisms – and sub-regional initiatives, primarily the ongoing SAWAP[1] programme.

The Government of the Lao PDR (GoL) has requested support from WSP-EAP to address some of the problems related to sanitation through a nationally-led approach with sector partners to raise the profile of the need for effective sanitation access and use. This is done through high level advocacy, improved access to information, education and communication (IEC) materials, and national consensus building for improvement of sanitation services particularly from the domestic private sector.

This rapid assessment is part of WSP's EA/LAO/ 93 Sanitation Policy and Advocacy activities with the aim to improve understanding and access to information. The study was requested by the Director of the Public Works and Transport Institute (PTI), within the Ministry of Public Works and Transport (MPWT), and was supervised and coordinated by the Vientiane Urban Development and Administration Authority (VUDAA).

1.1. Background

The Terms of Reference developed by WSP for the rapid assessment provides the following background.

Coverage of household toilets is very high in Vientiane. While the precise figure is unknown, the most recent data from the UNICEF-WHO Joint Monitoring Programme (2008) 'reports' that some 94% of the urban population in Lao PDR have access to sanitation, with 84% having improved facilities.

Nearly all households in the capital use on-site facilities, there being only a very small portion of the city served by sewerage (a single sewer line discharging into a waste stabilisation pond, plus a few locations where small bore sewerage approaches have been piloted). Households typically have a pour-flush toilet connected to a septic tank or soak pit that can be emptied or simply replaced when full. Housing density is generally low, open defecation is rare and there are no slums, with only small pockets of low-income housing with poor sanitation, some of which have benefitted from special projects. Septic tank emptying

[1] SAWAP: Sanitation and Water Partnership for the Mekong Countries.

services are widely available, with anecdotal evidence of at least twelve private contractors operating in the city.

All of the above suggests that household sanitation is generally satisfactory in Vientiane. There is, however, no substantive data available to confirm this, particularly in terms of:

- the design, functionality and durability of household toilets;
- the adequacy of sanitary facilities in dormitories, long-stay guest houses and other residential property under multiple accommodation;
- the extent to which safe and hygienic pit emptying and septage disposal practices are being followed;
- the incidence of toilets discharging untreated or semi-treated wastewater into open drains, water bodies, or onto open ground;
- locations where on-site sanitation cannot function effectively, for example due to periodic flooding, a high water table and/or low soil permeability; and
- Incidences of on-site sanitation causing significant groundwater pollution.

Furthermore, the capital is experiencing rapid growth, raising questions as to the medium term viability of on-site sanitation, even if existing services are functioning well. Some development agencies are evidently willing to allocate resources for urban sanitation improvements. JICA and ADB, for example, are both making, or preparing for, significant investments within or beyond the capital's urbanising areas.

1.2. Purpose of the study

There is an apparent lack of reliable information to guide urban sanitation planning and development. To mitigate the risk that decision-making will be based on simple assumptions that existing arrangements are either satisfactory or unsatisfactory, it was felt that a study on household sanitation services in Vientiane capital, focusing on the matters outlined above, would provide valuable information and insight to guide both ongoing and proposed initiatives to improve services in the capital. Therefore WSP and PTI agreed to commission a study to test some of the sometimes unsubstantiated assumptions and assertions.

The objective of the study was "***to conduct a rapid assessment of the adequacy of existing domestic sanitation facilities in Vientiane, especially in middle- and low-income areas where investments in these facilities are likely to be modest***", with the aim to present an overview of the current status of household sanitation services in Vientiane capital and to provide useful information and recommendations that can guide future action.

1.3. Scope of study and methodology

The study entailed the following:

- Desk study of relevant legislation, project and other documents, including an internet search: most of the documents that were studied during the course of the rapid assessment are included in the list of References at the end of this document.
- Interviews with main stakeholders at central and decentralised level: a total number of 33 individuals representing 17 organisations were visited during the course of the rapid assessment. The list of individuals that were interviewed as part of the rapid assessment is provided in Appendix 15.
- A number of site visits to examine previous urban sanitation improvement initiatives
- A household survey in 16 villages of the four urban districts: a total of 548 houses were included in the survey.
- A survey of multiple occupancy accommodation sanitation facilities focusing on dormitories: a total of 10 dormitories in three of the four urban districts were included in the survey.
- Water sampling testing in selected areas.
- A rapid survey of a sample of construction material suppliers in the target areas.

Although Vientiane Capital comprises of nine districts, the study was conducted across four districts that make up the core urban area of Vientiane, Chanthabuly, Sikhottabong, Sisattanak and Xaysetha districts, with a specific and exclusive focus on the "urban" villages[2].

[2] For the selection of the urban villages the 2008 data provided by the Department of Planning and Investment (DPI) was used. Only the villages as identified as "urban" by the DPI were considered.

2. Information on Vientiane

Situated along the eastern bank of the Mekong River, Vientiane is by far the largest urban area and the capital city of the Lao PDR. The urban area is located between the Mekong River and a hinterland of wetlands and ponds. The topography is relativity flat with wetlands to the east and interspersed with paddy fields.

Figure 2.1: Map of Vientiane City

Adapted from: ADB (June 2008)

The city of Vientiane is part of Vientiane Capital[3] which is divided into nine districts: five are classified as rural (Naxaythong, Xaythany, Hatxayfong, Sangthong and Pak Ngum) and four are predominantly urban (Chanthabuly, Sikhottabong, Xaysetha and Sisattanak). In 2008 the population of Vientiane Capital was about 695,000. Population figures per district are provided in Appendix 1.1.

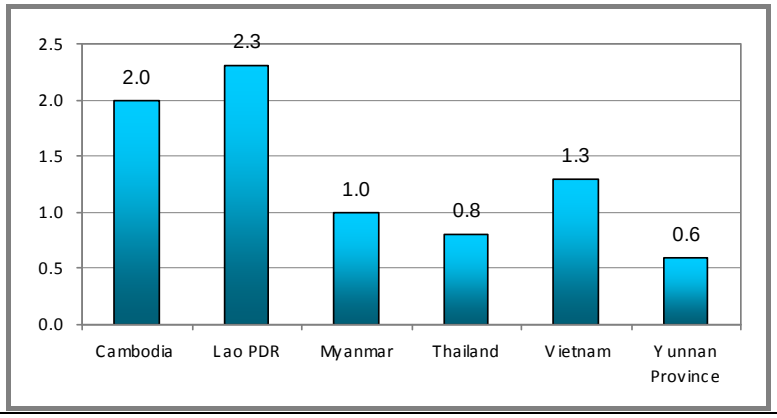
Vientiane's first Master Plan was developed by French consultants in 1962. In accordance with the plan the city was extended towards the south. In the beginning the city was growing according to this plan, however, because of rapid growth, the city slowly became disorderly. In 1982, Vientiane local authorities began to work on a new Master Plan for Vientiane City with support from UN-HABITAT. The Master Plan was put in place in 1985. During 1998-2000, the Master Plan was reviewed again, resulting in the Vientiane Master Plan 2002-2010. Residential areas continue to expand beyond the Master Plan boundaries resulting in high population densities in the city centre and other commercial areas, as well as encroachment on wetlands and green areas because of uncontrolled development. (Thammanousouth, 2009)

[3] Vientiane Capital is not to be mistaken with Vientiane Province; these are separate provinces with their own provincial level administrative setups. Vientiane Municipality, managed and administered by VUDAA, makes up part of four of the nine districts in Vientiane Capital province.

Vientiane Municipality, administered by VUDAA, consists of 100 villages or neighbourhoods with a total area of approximately 30 km^2. This area is understood to be the core urban centre of Vientiane. In 2008 the combined population of these 100 villages – representing some 46% of the total number of villages found in the four urban districts – the population was estimated to be in the region of 152,000 persons (details are provided in Appendix 1.2). The map, developed for the 2000-2010 Vientiane Master Plan, showing the boundary of these 100 core urban villages is provided in Appendix 2.

Urbanisation is one of the most important demographic trends of the 21st century, and growth has been particularly rapid in low-income countries. In the Greater Mekong Sub-region (GMS)[4], the Lao People's Democratic Republic (Lao PDR) and Cambodia report the highest population growth rates.

Figure 2.2: Population growth rates in the Greater Mekong Sub-region



Source: UNEP (2007)

Population growth rates tend to vary depending on the different sources. ADB (2001) reported that the population growth rate in the Vientiane urban area was not high, averaging about 1.2 percent per annum between 1995 and 2000. For Vientiane Capital, covering all nine districts, MAF (2002) mentioned a growth rate of 3%, whereas Khanal (2005) mentioned a growth rate as high as 4.3%. The noticeable differences can not be fully explained but part of the explanation lies in the fact that the city outskirts are expanding at a much faster rate than the city centre as a consequence of rapid economic development and urbanisation due to an increase in rural-urban migration.

The Interim Report of the Study on Improvement of Water Environment in Vientiane City (JICA, 2010) uses an average annual growth rate of 2.15% to calculate population projections for the study period covering 2009 to 2020. According to their projections[5], the population in the inner city centre is expected to decrease by an average of -0.9% over the next 11 years, whereas other areas are expected to increase by slightly more than 2.5% over the same period. During the 2009 to 2020 period the population of Vientiane is expected to grow by almost 40%.

For a capital city, the population density of Vientiane is low at about 55 persons per hectare in the urban core area, with the population density increasing at a rate of 4.7% per year (GHK, 2001). Similar population density figures can be computed on the basis of the information provided by JICA (JICA, 2010). Whereas the population density in the city centre is expected to hover around 50 persons per hectare, the population density in the surrounding areas is expected to increase by almost 50% from 21 persons per hectare at present to some 31 persons per hectare in 2020. Table 1.2 shows how Vientiane's population density compares with other cities in Southeast Asia.

[4] Cambodia, Guangxi Zhuang Autonomous Region of the People's Republic of China, Lao PDR, Myanmar, Thailand, Vietnam, and Yunnan Province of the People's Republic of China.

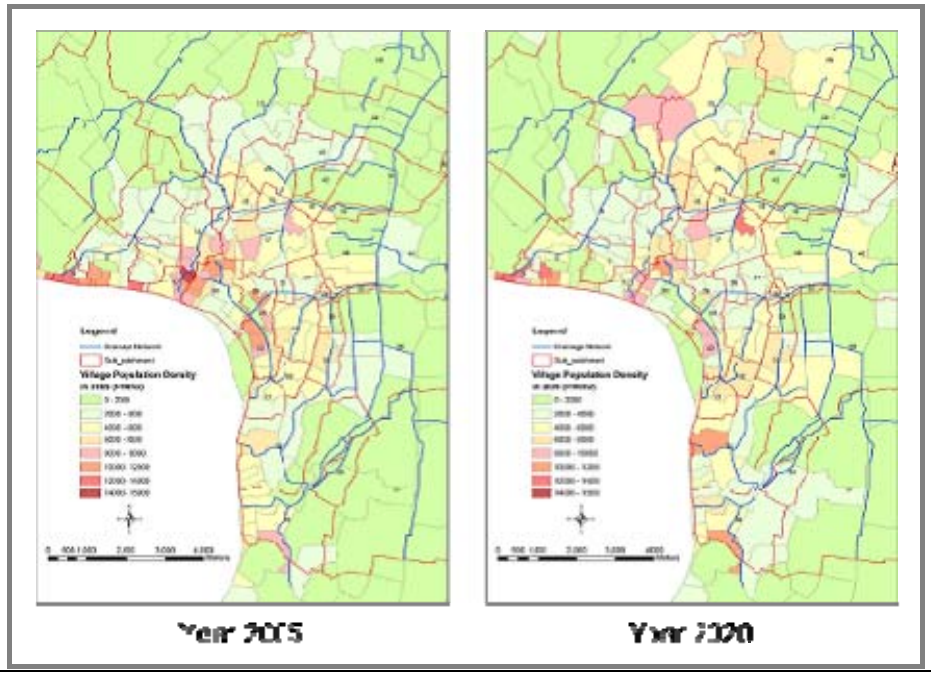
[5] The JICA study area comprises of a number of existing areas (including Hong Ke and Hong Xeng catchment areas) and new development areas. Population projections are estimated on the basis of different annual growth rates representing the different areas.

Table 2.1: Population densities in Southeast Asian cities

Rank	City	Country	Population	Hectares	Density
15	Manila	Philippines	14.750.000	139.900	105
17	Jakarta	Indonesia	14.250.000	136.000	105
20	Ho Chi Minh City	Vietnam	4.900.000	51.800	95
37	Bangkok	Thailand	6.500.000	101.000	64
84	Phnom Penh	Cambodia	1.500.000	51.800	29
89	Kuala Lumpur	Malaysia	4.400.000	160.600	27
	Vientiane	Laos	162.318	6.266	26

Source: City Mayors Statistics (2010)

Figure 2.3: Existing and projected population density in the urban area of Vientiane City



Source: JICA (2010)

As the national centre of, provincial and municipal government administrations, Vientiane has numerous government office buildings and because of the Government's, promoted economic development policies which has facilitated the growth of private sector investments, resulting in a growing number of businesses, hotels and service industries being established. The government public sector, and city's tertiary sector (commercial and trade), are currently employing over 50 percent of the labour force, dominate the city's economy. A significant portion of the country's domestic and export earning industrial production takes place in Vientiane. Tourism is also a high-growth sector, as the city is a focus for tourism and is on one of the tourism circuits in the region (ADB, 2001). As a consequence Vientiane is experiencing a construction boom. This immense growth in infrastructure presents both challenges and opportunities. Sounnalath (2002) questions whether the country is prepared for the consequences of all the development activities underway[6].

It is expected that the per capita Gross Domestic Product (GDP[7]) of Vientiane's population will increase from the current LAK 14.6 million (US$ 1,785[8]) to LAK 24 million (US$ 2,928) by 2020. This constitutes an

6 This view appears to be supported by the Minister for Water Resources and Environment, Mrs. Khempeng Pholsena, who recently said that "*Management of water resources in Laos has not matched the rapid growth of development despite the government's efforts to develop laws and regulations*„ as reported by the Vientiane Times of August 18, 2010.

7 GDP shows a scale of the economy or its impact while per capita GDP shows an economic development or economic richness.

annual increase of between 4.5% to 4.7% and an overall increase of 64%. As Vientiane's influence as the Capital is expected to be more important and significant in the future, the GDP of Vientiane City will increase not only in terms of amount but also in terms of its share of the country's overall GDP. (JICA, 2010)

2.1. Sanitation and wastewater conditions

One of the most adverse impacts accompanying the advancement in economic growth, industrialisation, and urbanisation is the increasing rate of wastewater generation. Vientiane City is no exception. Many countries are experiencing rapid economic development and the problems associated with wastewater management are often not addressed until they pose a serious threat to advancement and public health.

Constraints in adequate infrastructure development are expected to affect economic growth and the quality of life of urban residents, particularly those living in low-lying lands that flood for part of the year. Vientiane city is built on the Mekong flood plain and lies on low-lying alluvial soils. The area is flood-prone and characterised by generally high groundwater tables and clayey-loamy soils with low permeability. This has had significant implications on drainage throughout the city. The monsoon season concentrates rainfall from May to September resulting in drainage problems either through inundation from extreme rainfall events or as a result of poor drainage and surface runoff due to saturation that can lead to inefficiencies in septic tanks and soak pits for the percolation of wastewater (GHK, 2001).

Wetlands and marsh areas in and around the city are important physical features and provide critical hydrological functions such as flood control, maintaining river flows during the dry season and purification of wastewater from the surrounding urban areas. In addition to "That Luang" Marsh there are eleven significant wetland areas within and surrounding Vientiane. Of these, That Luang Marsh is the largest in size and plays a significant role in both flood control and wastewater purification for the city (Gerrard, 2004). As urban areas encroach on the wetlands, they are becoming increasingly isolated and their capacity to perform their environmental functions greatly diminishes (Phonvisai, 2007).

Drainage and sanitation system development has been based on the Vientiane Master Plan, which was written following a JICA feasibility study[9] in 1990. This provided guidelines for urban design, drainage and wastewater quality management. Currently, storm water retention, flood control and wastewater disposal and treatment are heavily reliant on the ecological functioning of That Luang Marsh (Gerrard, 2004). In the urban areas of Vientiane City, storm water is being drained by two major canal systems, namely Hong Ke and Hong Xeng. Since the early 1990s, those drainage systems have been improved through financial support from UNDP, ADB, JICA, European Union and the Government of Thailand (JICA, 2010).

According to a recent report (JICA, 2010) the current drainage situation in Vientiane City has improved a lot. In 2002, a JICA study[10] revealed that in 175 flood prone areas, flooding occurred more than 5 times a year. Although inundation along the drainage channels has never occurred since two major projects[11] were completed, drainage conditions are expected to worsen in future as sediment is accumulated in the drainage channels and thereby decreasing the flood flow area.

The impact of poor sanitation on the city as a whole is significant in terms of potential health risks. There is no centralised sewerage system, and sanitation is primarily through onsite facilities. While the vast majority of urban households have access to onsite sanitation facilities, these facilities are generally poorly designed, constructed, and often perform inadequately. Moreover, the prevailing methods and frequency for treatment and disposal of wastewater are generally inadequate. Urban drains act as secondary sewers,

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8 Wikipedia provides the following gross domestic product (GDP) at purchasing power parity (PPP) per capita figures, which is the value of all final goods and services produced within a nation in a given year divided by the average (or mid-year) population for the same year: the International Monitory Fund ($ 2,266) and the World Bank ($2,259). Accessed on 26 August 2010: http://en.wikipedia.org/wiki/List_of_countries_by_GDP_(PPP)_per_capita

9 JICA "Feasibility Study on Improvement of Drainage System in Vientiane" carried out in 1990.

10 During 2001-2002 JICA conducted "The Survey on Existing Road and Drainage Conditions in Vientiane Municipality" covering the urbanised inner city area of 27 km2.

11 The "Vientiane Integrated Urban Development Project" (VIUDP) and the "Vientiane Urban Infrastructure and Services Project" (VUISP). Details are provided in Appendix 3.

carrying industrial discharges and septic tank seepage and overflows. As a result, water in the drainage system is invariably contaminated with faecal matter from toilets and coliforms[12] from septic tank effluent.

A flat terrain, high water table, and variable soil permeability exacerbate the problems with the present system of onsite sanitation, resulting in many systems failing to operate effectively resulting in overflow of effluent, and pollution of ground and surface waters and drains (ADB, 2001).

Given the situation of flooding and sanitation systems around Vientiane there have been a series of projects aimed at improving infrastructure development, drainage and wastewater management. To fully understand the current drainage and sanitation or wastewater situation these projects were examined. An overview of the most relevant projects is given in Appendix 3, which is summarised in Table 2.2.

Table 2.2: Overview of drainage and/or sanitation projects in Vientiane

Project	Duration	Implementing agency	Financing
Rehabilitation of Sihom area	1991-1997	MCTPC (MPWT)	UNCDF/UNDP/GOL US$ 5.5 million
Wastewater Management of That Luang Marshes	1993		EU grant US$ 0.9 million
Vientiane Integrated Urban Development Project (VIUDP)	1996-2000	MCTPC (MPWT) with VUDMC (VUDAA)	ADB/JICA/GOL US$ 27.67 million
Vientiane Urban Infrastructure and Services Project (VUISP)	2002-2007	VUDAA	ADB/ACF/GOL US$ 43.67 million
Improvement of Urban Environment in Vientiane	2001-2005	DCTPC Vientiane Capital	DANIDA/GOL
Wastewater Treatment through Effective Wetland Restoration of That Luang Marsh	2007-2009	WREA	EU/WWF/GOL

In recent years there have also been a number of smaller initiatives to improve sanitary conditions in a number of selected few urban villages in Vientiane. Most of these projects were implemented by the Public Works and Transport Institute (PTI) to pilot new urban sanitation related (participatory) approaches or technologies. Community sanitation improvements focused on a combination of solid waste management and construction of drainage, communal septic tanks and public toilets. The first project to pilot and test the appropriateness of offsite sanitation systems[13], serving a number of small communities in the centre of Vientiane, was the DANIDA supported “Improvement of urban environment in Vientiane” project.

The impact of past projects has been somewhat limited for the simple reason that only relatively small investments were made to improve household level sanitation facilities. For example the two urban development projects (VIUDP and VUISP) financed by the ADB, at a total cost of more than US$ 71 million, invested basically nothing to improve household sanitation!. According to GHK (2001) the sanitation component of VIUDP failed as a result of a combination of factors associated with project design, implementation, the lack of willingness of residents to invest in improved septic tanks, and lack of government interest to enforce new regulations.

With regards to the projects that did invest in improving household sanitation conditions, often little sustainability was built into project designs resulting in discontinued use of, for example the sewer line and wastewater stabilisation ponds. The future prospect for communal septic tank systems is not much better as current operation and maintenance practices are woefully inadequate. As urban development

12 A group of bacteria that are normally abundant in the intestinal tracts of human and other warm-blooded animals and are used as indicators (being measured as the number of individuals found per 100 millilitre of water) when testing the sanitary quality of water. They are an indicator of potential contamination of water and that pathogens might be present.

13 Household toilets connected by small-bore sewers to interceptor tanks located within the communities. These tanks were again connected to the EU financed trunk sewer main.

throughout the city is growing in an unplanned manner, the limited capacity at the municipal planning level has not been able to cope with the increasing requirements of environmental protection.

One new initiative intended to enhance sustainability by minimising maintenance requirements (and costs) of communal septic tanks is worth mentioning. In early 2010 the Lao Institute for Renewable Energy (LIRE), in partnership with the Bremen Overseas Research and Development Association (BORDA), completed the construction of a demonstration Decentralised Wastewater Treatment System (DEWATS) at one of the staff dormitories of the Faculty of Engineering, Sokpaluang Campus. The ongoing JICA "Study on improvement of water environment in Vientiane City" has recently partnered up with BORDA-LIRE to jointly implement a number of new DEWATS pilots in part of Thongkhankham village and at the Khoualuang primary school in Khoualuang village in Vientiane Capital. These pilots are intended to be run as a community based sanitation (CBS) program, with a high level of community participation, and aims to minimise surface water pollution as well as encourage health and hygiene practices in urban communities. The pilot will assess the viability of the programme and test whether the CBS approach and the DEWATS technology can be cost effectively replicated in other comparable situations in the Lao PDR.

Decentralised Wastewater Treatment System (DEWATS)

DEWATS was developed by Bremen Overseas Research and Development Association (BORDA) and has been successfully piloted in parts of Southeast Asia, South Asia and Africa possibly as a "cost-effective", low maintenance solution for wastewater treatment in urban areas.

BORDA-LIRE projects offer a viable technical option in areas where neither individual onsite systems nor centralised sewerage systems can meet the demands for improved sanitation. The approach is highly demand responsive and relies on active participation as well as contributions from target communities and municipalities, and it aims to improve hygiene behaviour and sanitation infrastructure in a more integrated and sustainable manner.

DEWATS is a modular system approach to ensure efficient wastewater treatment performance. A typical DEWATS system for physical and biological wastewater treatment consists of a primary treatment system of a settling and sedimentation tank, a secondary treatment system of an up-flow anaerobic baffled reactor which digests wastewater anaerobically, a tertiary treatment in subsurface horizontal flow through sand filters with reed beds, and finally a planted gravel filter or polishing pond for oxygenation and UV disinfection from the sun's rays. Since the baffled reactors work anaerobically, sludge production is minimal and desludging is needed only if excess sludge is generated. It is reported that the quality of treated wastewater effluent that emerges into the polishing pond is good enough for landscape applications. DEWATS can attain 80 to 85% reduction in BOD and COD, 80% reduction in phosphates, 50% reduction in Total Suspended Solids (TSS), and 60% reduction in ammonia.

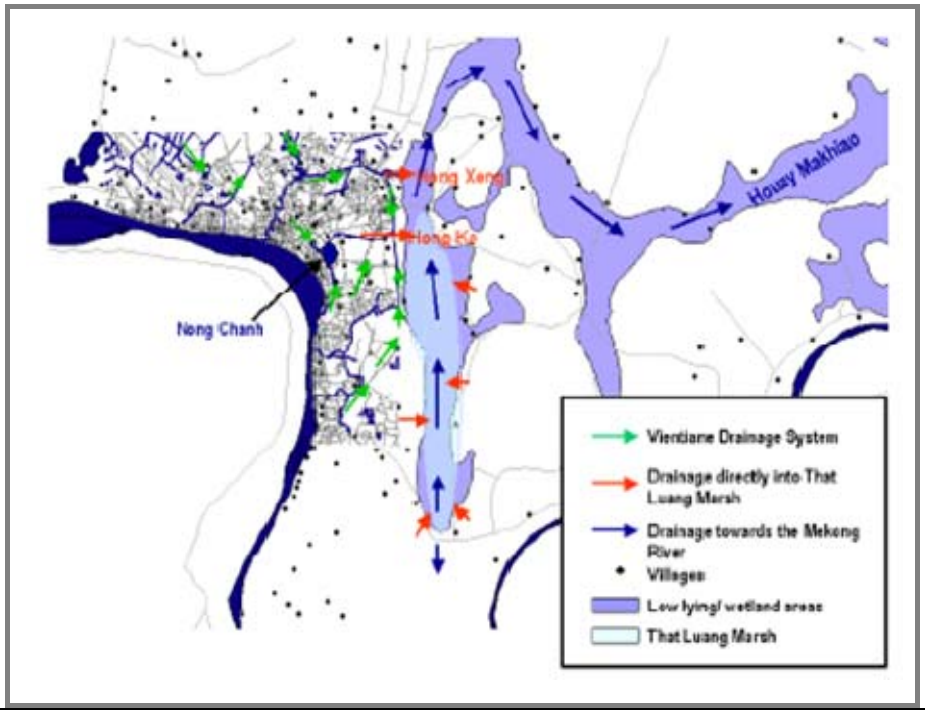
The possible advantages of DEWATS include the capacity to treat 1 to 1000 m^3 of organic (domestic and industrial) wastewater per day; reducing pollution; low primary investment and low operation/maintenance costs; reliable, modular and sustainable designs build with local materials; minimal land acquisition; and no external energy inputs required and the possibility to produce energy by installing an additional biogas digester.

Source: JICA (March 2010); http://www.borda-net.org; and http://www.lao-lire.org

The DEWAT or other small bore decentralised sewage systems may have advantages and it is likely why they merited inclusion in the draft urban sanitation strategy. But by the end of the assignment the effectiveness and cost efficiencies of the DEWAT pilot remains system in Vientiane remain unclear, and an impartial and objective evaluation of the cost effectiveness and operational efficiencies of these system may be needed before replication rather than solely relying on having a promoted and advocate application of the technology.

This rapid assessment reveals that flooding continues to occur away from the main drainage network developed during the past ten years, and stagnant polluted wastewater still lies in open road side storm water drains. In many cases flood prone areas will flood every time it rains. Flooding in the urban area of Vientiane is not deep but frequent flooding causes damage to infrastructure and inefficiencies in onsite septic tanks and soak pits leading to leakage of wastewater directly into the drainage system. There are almost 300 km of drainage channels within the urban area. Lack of routine cleaning, maintenance, and rehabilitation constrains the proper functioning of the systems[14]. In particular the poor - living in low-lying areas, which flood regularly during the rainy season - continue to be exposed to unhealthy conditions.

Figure 2.4: Drainage system in and around Vientiane



Source: Gerrard (2004)

The rapid growth of Vientiane is likely to challenge all levels of government. Irregular layouts and high density of housing make installation of sewers difficult. Space available for household latrines is often limited and access for sludge removal trucks to empty pits or septic tanks is problematic in certain areas.

14 The JICA (2010) study report reveals that in particular the lack of adequate resources for regular operation and maintenance is the main constraint at present. JICA calculated that it would cost LAK 8,398 million (US$ ~1 million) to remove all the accumulated sediments, which is almost 24 times higher than VUDAA's annual budget allocation of LAK 300 to 350 million (US$ 37,300- 43,500/pa) for maintenance of drainage channels.

3. Legal and Institutional Framework

3.1. Legal framework

Article 17 of the 1991 Constitution of the Lao PDR states that: "All organisations, all citizens must protect the environment and natural resources: land, subterranean, forests, fauna, water sources and atmosphere." Pursuant thereto, the Government of Lao PDR has taken a number of important initiatives towards environmental protection to ensure the sustainable socioeconomic development of the country in line with the long term development agenda as formulated in the National Growth and Poverty Eradication Strategy (NGPES) and the National Socio-Economic Development Plans (NSEDP). These initiatives include the Environmental Protection Law (No 02/99 of 3 April 1999), the Decree on Implementation of the Environmental Protection Law (No 102/PM of 2002), the Law on Hygiene, Disease Prevention and Health Promotion (No 01/NA of 10 April 2001), the Law on Water and Water Resources (No 02/96/NA of 11 October 1996), and other legislation as shown in Table 3.1 below, which are described in more detail in Appendix 4.

Table 3.1: Legal and policy framework for urban sanitation

Legislation	
Water and Water Resources Law	No. 02/96/NA of 11/10/1996
Regulation on Monitoring and Control of Wastewater Discharge	No 1122/STENO of 1998
Domestic Wastewater Regulation	STEA, May 1998
Environmental Protection Law 1999	No. 02-99/NA of 03/04/1999
PM Decision on Management and Development of the Water Supply Sector	No. 37/PM of 30/09/1999
Hygiene, Prevention and Health Promotion Law	No 01/NA of 10/04/2001
PM Decree to Implement the Law on Water and Water Resources	No. 204/PM of 09/10/2001
PM Decree on the Implementation of the Environmental Protection Law	No. 102/PM of 2002
Decision (draft) on regulation of wastewater discharge in towns and municipalities	Draft June 2010
Urban Wastewater Strategy and Investment Plan 2008-2010	Final draft October 2008
Agreement of the National Environmental Standards 2010	No. 2734/PMO.WREA of 2009

The increasing awareness of environmental protection and natural resource management in the Lao PDR culminated in the adoption of the Environmental Protection Law in 1999. This Law provides a broad and holistic approach to environmental management in the Lao PDR, with sustainable utilisation of natural resources being one of its prime objectives. The current Law is an exceptionally general document which outlines the broadest of environmental policies. Article 5 of the Law provides that the Government shall ensure that environmental preservation is included in and is harmonised with the national socio-economic development plans. This represents a far-sighted approach by the government to ensure, in principle, that environmental considerations are incorporated into developmental processes and decision-making. The Law also mandates that all persons, juridical entities and organisations utilising natural resources in the course of their activities shall contribute financially towards environmental protection.

Although environmental legislation has evolved quickly in the Lao PDR, the current legal framework is fractured and complex. Inconsistencies have surfaced in different legislation as a result of different ministries/agencies leading the development of sectoral legislation. Principal inconsistencies include conflicting provisions, overlapping mandates given to different ministries, and a lack of implementing regulations and supporting environmental standards. (World Bank and STEA, 2005)

With regards to earlier urban sanitation work[15] it has been has revealed that there were shortcomings in terms of lack of clearly defined responsibilities. The lines of authority demarcating the jurisdiction of the

[15] COWI (2008); Robinson (2009); WSP (2010)

central government agencies are not altogether clear. Due to the cross-sectoral nature of environmental issues, various ministries/departments/agencies are involved in matters related to the environment. Agencies appear to have overlapping mandates for urban sanitation, but the interface between agencies is not clearly articulated. One could easily get the impression that nobody is really in charge. As no single government agency has responsibility, there is no leadership on such important issues as policy, standards, responsibilities and budget allocations. Policy and legal developments for sanitation has lagged, and has been frequently overshadowed by a sole focus on urban water supply. Currently there is no overall sanitation policy for the country (WSP, 2010).

In the absence of a clear legal framework UN-HABITAT and the ADB supported small-town water supply and sanitation projects have developed individual district level sanitation management ordinances: "Decision of District Governor on Sanitation Management in the District Town". The Decision is in accordance with the Environmental Protection Law (No. 02/99/NA) and the Decree on Environmental Protection Law, Implementation (No. 102/PM). They have been issued to enhance, promote and ensure the management and supervision of sanitation in district towns and it puts emphasis on latrine construction and other types of wastewater management in urban areas[16] for the sustainable protection of the environment and to safeguard public health. These kinds of initiatives are commendable and need to be applauded, however, in the absence of a national sanitation or wastewater policy there is a danger that these local legislations - put in place to resolve current problems - will not meet future requirements and the overall vision of the sector[17].

The shortcomings of the present legal framework can be summarised as follows:

- Often rather general in nature with limited specific reference to sanitation or wastewater issues
- Unclear or sometimes overlapping institutional mandates as a result of sectoral legislation developed by different ministries
- Lack of implementing regulations for use at the devolved levels
- Limited monitoring and control mechanisms in place to ensure compliance with environmental legislation.

The Government is aware of these shortcomings and is working to address them. For example the Water Resources and Environment Administration is revising the 1999 Environmental Protection Law[18] and the Ministry of Public Works and Transport is in the process of finalising the Urban Wastewater Strategy and Investment Plan 2008-2020 (Drafted in 2008) and the Decision on Regulation of Wastewater Discharge in Towns and Municipalities (Originally drafted in 2008 and updated in June 2010)[19].

3.2. Institutional framework

There are quite a number of ministries and institutions that are concerned with the urban sanitation and wastewater sector. Their responsibilities are described in legislation such as: the Environmental Protection

16 According to the Decision's Scope of Use, the Decision is to be used as a reference for design, construction and inspection of latrines, drainage and other types of wastewater treatment from houses, offices, institutions, factories, industries and other public and private sites, including the final treatment site within the district town.

17 For example Article 4 of the Decision states "Approved latrines for use in the urban areas comprise of two types: pour-flush latrine and pour-flush latrine with septic tanks. Those with sufficient funds should construct pour-flush latrines with septic tanks." As noble as this may sound, leaving the decision to individual households is unlikely to address the problems associated with onsite sanitation in areas that have high population densities, unfavourable soil type and porosity, high groundwater tables or that are prone to seasonal flooding. Similarly, although treatment and disposal of wastewater are dealt with in Section III, there are no provisions or specific articles that provide a regulatory framework and guidelines for the final disposal of wastewater from onsite sanitation facilities by private septic tank desludging operators.

18 Personnel communication with Mr. Ketkeo Salichanh, Director of Policy and Law Division, Department of Environment of WREA on 20 July 2010.

19 Personnel communication with Mr. Bounthong Keohanam, Director Division of Urban Development, Department of Housing and Urban Planning of the Ministry of Public Works and Transport on 23 July 2010.

Law, Law on Water and Water Resources, Law on Public Health, Law on Urban Planning etc. An overview of the most relevant institutions is provided in Appendix 5, summarised in Table 3.2.

Table 3.2: Overview of institutions with mandates for urban sanitation

Institution	Level
Water Resources and Environment Administration (WREA) and its Department of Environment (DOE)	Central
Water Resources and Environmental Office (WREO)	Provincial
Ministry of Public Works and Transport (MPWT) and its Rural and Urban Development Division (UDD) of the Department of Housing and Urban Planning (DHUP)	Central
Public Works and Transport Institute (PTI) of MPWT	Central
Provincial Department of Public Works and Transport (DPWT)	Provincial
District Office of Public Works and Transport (OPWT)	District
Urban Development and Administration Authorities (UDAA)	Municipality
Ministry of Health (MOH)	Central
National Centre for Environmental Health and Water Supply (Nam Saat)	Central

One continuing issue is that lack of clear demarcating official decrees and instructions to try and separate who is responsible for what, and which is agreed across and between all the different state actors. At present roles are ambiguously and generalised and do not provide sufficient information to guide sector stakeholder. Prime Ministerial Decision PM37/1999 "Prime Ministerial Decision on Management and Development of Water Supply Sector" remains the lead document on sanitation (see annex 19).

- This indicates the roles for the Ministry of Public Works and Transport (Article 2.1) and its sub-ordinate entities including the:
    - The Water Supply Regulatory Office (WASRO) which assumed the roles of the Water Supply Authority (WASA)- in terms of " Setting norms, regulations, technical standards and technical-economic specifications …..wastewater management systems".
- As well for the Ministry of Health where
    - It's Centre for Environmental health and Water Supply (Article 2.2) may have possible roles in terms of being "responsible for the management of technical aspects in promoting rural water supply, and urban and rural environmental hygiene". However "environmental hygiene" is undefined?
- By far the clearest role is given to the Provincial Government including Vientiane Capital (article 2.5 37/PM) where it is responsible for the "coordination, facilitation, and investment support in the development of water supply and wastewater management systems, and environmental hygiene"; As well as
    - Collaboration with the Department of Public Works and Transport (DPWT) of the province concerned in finding out suitable solution to assist low income households which cannot afford the cost of sanitary facility.
    - Direction of water supply and sanitation sector project implementation in the province concerned.
    - Institutional arrangements for the implementation and management of centralised wastewater management systems as for water supply when these systems become economically and financially viable, but until such time on site treatment will be pursued and the implementation and management of the facilities shall be the responsibility of the individual owner, and
    - Rural water supply, and urban and rural environmental hygiene in the province concerned.

In interpreting this it would appear that the provincial government (of Vientiane Capital) is in the lead and can and should delegate responsibility to whom it see's best fit to guide and support urban sanitation "until such time" that more centralised wastewater management systems become feasible.

A familiar recurring problem relates to the shortage of trained manpower, as well as financial resources. After the enactment of regulations, trained manpower is needed to effectively implement and enforce these regulations and to deal with violators. In general funding is also severely limited and additional funding is needed from local and foreign sources, to adequately finance various environmental protection efforts. In addition, as a consequence of inadequate human and financial resources, regular or structural environmental monitoring and testing efforts appear to be lacking.

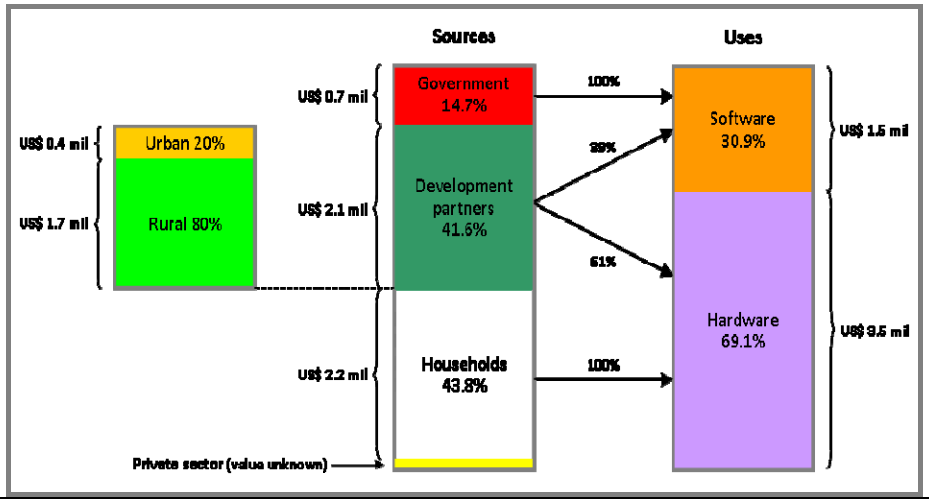
3.3. Sanitation sector financing

Lao PDR has made substantial progress in public financial management in the past several years. Even so there are no reliable figures for public expenditures on sanitation and hygiene promotion. Interviews with government officials and development partners at all levels confirmed repeatedly that there is practically no capital investment in sanitation or water supply from the government budget (WSP, 2010). Similarly JICA (2010) states: "Although details of budgets for water environment were not revealed by any related authorities and financial data are not managed and stored systematically, all the related authorities claimed that they do not get enough budget and personnel to carry out their responsibilities.

A recent WSP (2010) "Lao PDR Sanitation Financing Study", undertaken to support both the government of Lao PDR and its development partners in planning levels of financial support, types of initiatives, and formulation or revision of policies and strategies for basic sanitation and hygiene, revealed that total expenditure on basic sanitation and hygiene promotion in Lao PDR was in the order of LAK 42.8 million (US$ 5.0 million) in 2008/09. Approximately 14.7% came from the government (largely in the form of staff time/salaries and administrative expenses), 41.6% from development partners, and 43.8% from individual households to finance latrine construction.

While the level of private sector contribution could not be determined within the study period. About 69.1% of the financing is for hardware (which includes household labour for latrine construction) and about 30.9% for software, which covers anything that is not hardware: hygiene promotion and education, project operations and administrative costs, and capacity-building. Detailed figures are provided in Appendix 6 and summarised in Figure 3.1.

Figure 3.1: Expenditure on basic sanitation and hygiene promotion in 2008/09



Source: Adopted from WSP (2010)

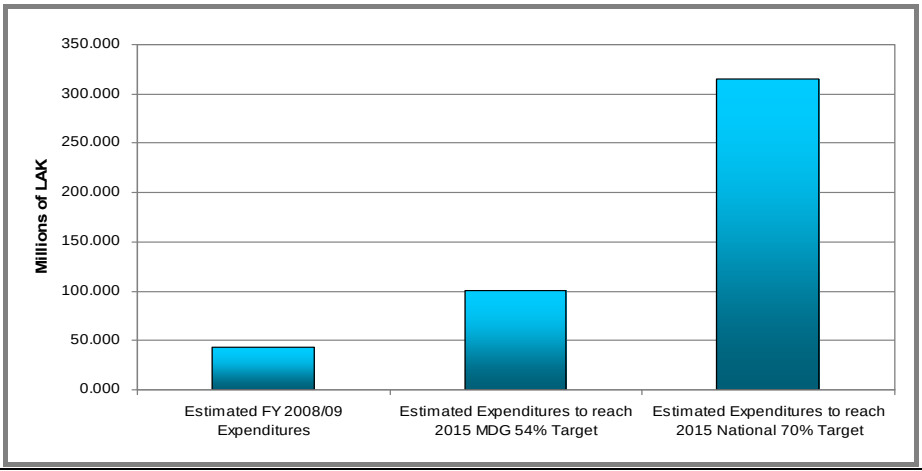
During the fiscal year 2008-09, development partners contributed an estimated US$ 2.1 million towards sanitation. Most of this (61%) was spent on hardware while software (training, community development, hygiene and latrine promotion, project management, etc.) accounted for 39%. Development partners are devoting more financial resources to rural areas (where it is recognised that the greatest needs exists), with

80% of all sanitation spending occurring in rural areas. This means that only some 20%, equal to some ~US$ 0.4 million, may be available to invested in urban areas.

Government's ability to implement plans and achieve sanitation coverage targets depends almost entirely on project or programme financing by development partners. This is because the government's operational expenditures for sanitation, especially at district and provincial levels, are woefully inadequate. There are few funds available for hygiene promotion or for staff operations or community outreach, and what little is available covers all forms of health and hygiene promotion; very little is dedicated to sanitation. As a result, provincial and district officials are charged with meeting coverage targets without the resources to do so.

According to the WSP (2010) report, annual expenditures for sanitation and hygiene should at minimum double – and perhaps triple – if the original Millennium Development Goal coverage target of 54% of the population with access to improved sanitation is to be reached by 2015. Although Lao PDR has made substantial progress toward that goal, the rate of population increase is likely to make the goal unattainable at current expenditure levels. If a target of 70% coverage is used, annual expenditures would have to increase by about seven time's current levels, as illustrated in Figure 3.2.

Figure 3.2: Estimated total sanitation and hygiene promotion expenditures



Source: WSP (2010)

If Government expenditures are maintained at 14.7 percent of total expenditure, the report suggests that annual Government budgets for sanitation and hygiene should increase from current estimated levels of LAK 6.3 million (US$ 0.75 million) to approximately LAK 16.4 million (US$ 1.9 million) in the next five years to meet the MDG target. Government expenditures should increase to LAK 46.3 million (US$ 5.48 million) to meet a 70% coverage target. Given that the Government contribution has been in salaries and some administrative costs, these increases seem unlikely if they continue in the current mode. An increase that also changes the nature of expenditures to operational support for hygiene promotion, capital expenditure, household latrine financing programs, and other effective means of support would be ideal.

Lao PDR's Health Budget 2011-2015

The Executive Summary of the Seventh Five-Year Health Sector Development Plan (2011-2015) shows that in the past five years (6th NSEDP) some US$ 8.94 per person per year was spent on health; US$ 3.06 less than originally estimated. The share of the Government's own budget was US$ 1.84 per capita per year, of which only 9.4% was spent on health prevention[20] programs, whereas 47.8% was spent on curative health programs. Patients contributed 1.10 US$ per person per year, and US$ 6 per person per year was contributed by the international development partners.

The budget needs for the next five years are estimated at US$ 24 per person per year; "*the bare minimum to be able to reach the MDG goals by 2015*". This means an increase in the share of the Government budget from ~5% in the past five years to at least 7-10% in the coming five years.

The provision of water supply and sanitation (latrines) is mentioned in the section on Model Healthy Villages; one out of nine health priority plans[21]. No budget details are provided in the Executive Summary, it is therefore impossible to assess whether the water supply and sanitation targets are realistic and achievable.

Source: MOH (August 2010)

20 Water, sanitation and hygiene promotion interventions are part of the health prevention programmes.

21 There appears to be some inconsistency in the Seventh Five-Year Health Sector Development Plan (2011-2015), whereas the proportion of the population with access to improved sanitation is targeted at 60% by 2015. The aims for the creation of model healthy villages - which includes access to hygienic toilets - are set higher (by 2015: at least 65% of all remote villages, 70% of all semi-remote villages, and 75-85% of other villages are model healthy villages).

The WSP 2010 "Lao PDR Sanitation Financing Study" only estimates the expenditures required to reach the MDG (54%) or 70% coverage targets, it doesn't include the costs of increasing the service levels of existing sanitation facilities. However, both the Urban Wastewater Strategy and Investment Plan 2008-2020 and the interim report of the JICA Study on Improvement of Water Environment in Vientiane City include estimates for improving existing service levels in Vientiane City to enhance proper wastewater management.

Appendix 7 provides investment details as prepared by COWI (October 2008) and JICA (March 2010). Both documents agree not to invest in centralised sewerage systems prior to 2020. However, the selected technological options and their investment costs differ significantly. COWI opts for a mix of decentralised and onsite wastewater systems with an investment cost of some US$ 20 million. JICA's 'most recommendable' option (alternative 3) consists of a mix of (decentralised) communal septic tanks and in-stream treatment facilities[22] at a cost of some US$ 40 million.

So sanitation issues have been neglected! Addressing the current and future sanitation and wastewater management needs of urban (and rural) areas require broad commitments - including policies, capacity and resource allocations - and innovative action. It is evident that the development needs of the country exceed the funding capacity of the Government.

Vientiane may not yet experience severe pollution problems brought about by industrialisation and urbanisation. However, as urbanisation rates are likely to increase significantly as a consequence of rapid economic development, environmental challenges in the form of having to cope with substantial increases in amounts of human waste are expected to increase in parallel. To meet these new challenges, an effective legislative and institutional framework, coupled with adequate human and financial resources, must be put in place. Capacity-building efforts are critically needed to develop the requisite technical, legal and administrative capabilities. Greater coordination of authority amongst central ministries, as well as between these and provincial governments, is required to secure coherent policy formulation and implementation.

[22] Alternative 3 is expected to cover some 60% of the population (approximately 128,000 people) in the Hong Ke and Hong Xeng basins (excluding Nom Pasak basin).

4. Wastewater Management in Vientiane

Despite tremendous gains over the past two decades, safe sanitation remains mainly a public health and environmental concern. While access to improved sanitation is gradually improving, the WSP 2009 study "Economic Impacts of Sanitation in Lao PDR" concludes that in 2006, the Lao PDR lost an estimated LAK 1.9 trillion (US$ 193 million) due to poor sanitation and hygiene, equivalent to approximately 5.6% of GDP.

As explained in further detail in Appendix 8, the Millennium Development Goal (MDG) target to half, by 2015, the proportion of people without access to safe drinking water and basic sanitation, defines an improved sanitation facility as one that hygienically separates human excreta from human contact. The most recent (2010) JMP estimate, using 2008 data, shows that 86% of urban households and only 38% of rural households have access to improved sanitation, giving a combined national coverage of 53%.

Table 4.1: JMP progress on sanitation: Lao PDR country estimates for 2008

	Estimated coverage for use of sanitation facilities in 2008			
	Improved	Shared	Unimproved	Open defecation
Rural	38%	2%	8%	52%
Urban	86%	5%	3%	6%
National total	53%	3%	6%	38%

Source: WHO/UNICEF (2010)

The challenge to achieve the MDG targets for sanitation, as well as the MDG child health target of reducing by two-thirds the mortality rate of children under the age of five between 1990 and 2015, is related to the effective management/treatment of human excreta. But achieving this also needs to consider the supporting management systems and not the solely the promotion of sanitation facilities. Although on paper, these 'improved' sanitation facilities count towards reaching the MDG targets, in reality most facilities drain untreated, or at best semi-treated, effluents into public drains, waterways and predominately ground with possible implications for ground water contamination. Without adequate septage management and sewage treatment, even so-called 'improved' sanitation facilities will remain a significant source of waterborne diseases and water pollution. (USAID, 2010) with the risks being possibly greater in concentrated build up areas.

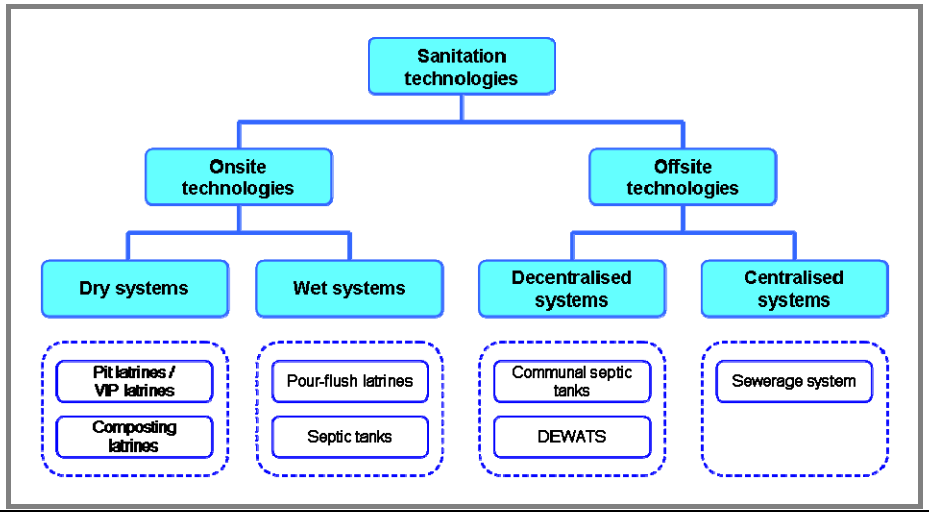
4.1. Sanitation technologies

In most urban areas in Lao PDR, on-site sanitation systems without treatment or with poorly functioning treatment are basically the only available option. Worldwide, onsite sanitation systems are being promoted widely as they can play a key role in increasing access to improved sanitation. Particularly in rural and peri-urban areas where space availability and population density are not constraining factors on its adoption and where onsite sanitation can be substantially cheaper and easier to promote than sewerage networks.

Sanitation systems can be divided into 'onsite' and 'offsite' technologies. Onsite sanitation systems aim to contain human excreta at the point of generation (the household level). Onsite sanitation can be classified into two main categories: 'wet' which require water for flushing; and 'dry' which do not require any water for flushing. This type of infrastructure comprises of (improved) latrines, septic tanks and other household level technologies that do not involve sewerage.

Offsite sanitation systems transport human excreta to another location for treatment, disposal or use. Offsite sanitation can be classified into two main categories: 'decentralised' and 'centralised'. Decentralised systems include systems where groups of two or more houses are linked to a (small bore sewer) network leading to a communal treatment system. Wastewater systems serving one or several communities are termed centralised systems. The different systems are illustrated in Figure 4.1.

Figure 4.1: Sanitation technologies



Source: Adapted from COWI (2008)

Decentralised systems represent an appropriate technological option for urban areas that face problems with high population density but where financing for larger centralised treatment systems is not available. In the current situation in Lao PDR in terms of institutional capacities and finances, the concept of on-site and communal (decentralised) systems appears the more favourable (and possibly least cost) solution compared to centralised systems. (COWI, 2008)

4.2. Local building regulations

The procedure for applying and obtaining a building permit, including the responsibilities of the different agencies, is described in the Ministry of Public Works and Transport's Ministerial Decision No. 7681 (dated 29 June 2005), which replaced the earlier Regulation No. 1512 (dated 28 September 1991). The steps and procedures on how to apply for and obtain a building permit are described in Appendix 9.

All applications for building permits are initially processed at district level. Building permits are issued as follows:

- The four urban districts of Chanthabuly, Sikhottabong, Sisattanak and Xaysetha can issue building permits if the cumulative floor space is less than 200 m^2;
- VUDAA issues building permits if the floor space exceeds 200 m^2 and if it falls within VUDAA's jurisdiction (100 municipal villages); and
- The Department of Public Works and Transport of Vientiane Capital issues building permits if the floor space exceeds 200 m^2 and if it falls outside VUDAA's jurisdiction.

Requests for building permits for the construction of new houses must include a standard septic tank design and a wastewater drainage site plan. The first standard for septic tanks was approved in 1991 and included in the 1992 DHUP "Manual on Construction Regulations". The current standard is identical to the one adopted in 1991. The standard septic tank design consists of three compartments and its overall size depends on the number of users. The same standard is also used for non-domestic buildings (e.g. hotels, offices, dormitories, hospitals, etc.), irrespective of WREA's wastewater standards[23] which sets different wastewater discharge standards for different classification of buildings.

The septic tank designs obtained from the Public Works and Transport Offices in Chantabouly and Sisattanak districts are in principal the same. The only noticeable difference is that the design obtained

[23] WREA's 2010 "Agreement of the National Environmental Standards" includes the same wastewater discharge standards as previously set by the Ministry of Industry and Commerce.

from Sisattanak district includes a seepage (soak away) pit that will allow excess liquid (septic tank effluent) to seep into the ground and to be absorbed into the surrounding soil. We were informed that in general the standard advocated by VUDAA is to discharge septic tank effluent in the city's drains – this because "*seepage pits might not work in all areas due to high water tables*"[24]. A copy of the standard septic tank design is shown in Appendix 10.

There appear to be a number of shortcomings with the existing building regulations (No. 7681, dated 29 June 2005), namely:

- Although all applications for the construction of new buildings require the inclusion of a standard septic tank design and a wastewater drainage site plan, there are no regulations in place that require someone to obtain a building permit if that individual decides to improve existing or install new onsite sanitation facilities.
- The standard septic tank design consists of a simple drawing (A4 size) and at present no additional construction and/or operation and maintenance guidelines are provided. This seems to be completely inadequate considering the limited general knowledge and specific understanding of all concerned with regards to the proper functioning of septic tanks.
- There is no system in place to enforce actual compliance with official septic tank standards as building sites are not visited to inspect the construction of septic tanks[25].

Septic tanks are small scale sewage treatment systems common in areas with no connection to centralised sewerage system. Although there is nothing really complex about how a septic tank works, many septic tanks throughout the world are not functioning properly for a variety of reasons. The main concerns with the design, construction and functioning of septic tanks in Vientiane are:

- Size: As time is needed for bacteria to digest the waste, the tank needs to be large enough that fresh influent can sit for a while before being displaced as semi-treated effluent. The size of septic tanks might be compromised considering the costs of building a septic tank. Another issue is that the standard design provides a number of different sizes, depending on the number of users, but a standard size for the average family or household occupancy size in Vientiane is missing. Whereas the average family size is around 5-6 members, the standard design provides details for a septic tank for either 4 or 8 users. This means that you end up with either an undersized septic tank that does not function properly, or an oversized septic tank that costs too much.
- Dividing wall: When wastewater enters the first chamber of the tank, solids should be allowed to settle on the bottom and scum to float to the surface of the tank. The dividing wall between the first and second chamber is necessary to prevent solids and scum from moving to the second chamber. Only the liquid component should flow through the dividing wall into the second chamber. Although the standard design provides at best some sketchy construction details, one gets the impression that the holes in the dividing wall are not correctly placed being too low, too big and numerous on the dividing wall, possibly allow solids to flow to the second chamber.
- Manhole covers: Septic tanks need to be accessible for regular inspection and desludging purposes. Although the standard design includes the provision of manhole covers, one for each of the three chambers, these were basically not found during the household surveys. A significant majority of the septic tanks inspected during the rapid assessment had at most one 6" diameter desludging hole. It is assumed that this is done because of ease of construction and a subsequent reduction in construction costs.
- Effluent disposal: In a properly designed and constructed septic tank the excess liquid flows out of the tank and is then dispersed throughout the soil by leaching through a land drainage system or drain field. Alternatively, a soak pit or leach pit can be used to disperse the effluent by allowing it

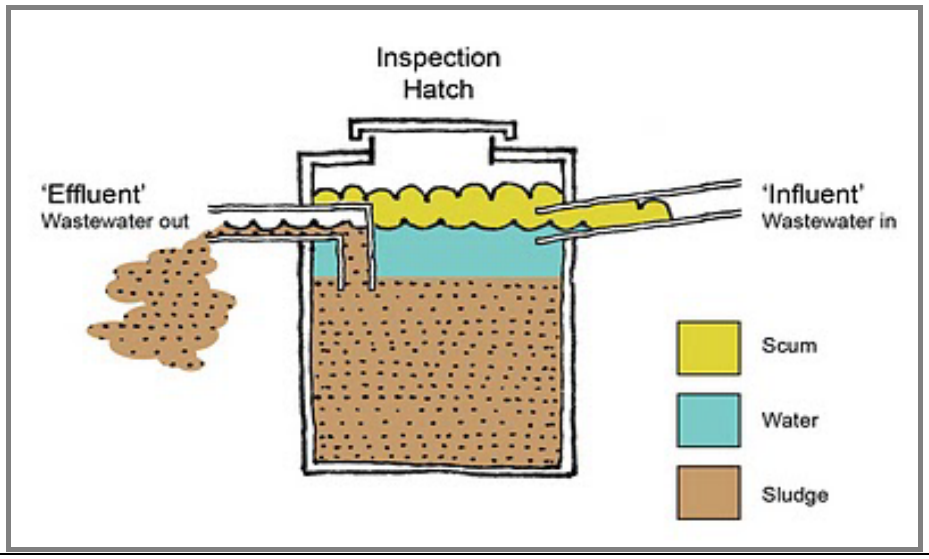
[24] Personnel communication with Mr. Amphavanh Manivanh, Head of Housing and Urban Planning Division and Mr. Veha of the Bridge and Road Section, VUDAA, on 20 July 2010.

[25] During the Progress and Consultation Meeting held on 6 August 2010, the participants acknowledged the current gaps in the implementation and enforcement of (environmental) regulations. One of the groups reported that "we don't get invited to inspect the construction of septic tanks."

to infiltrate into the surrounding soil. During the rapid assessment neither drain fields nor soak pits were discovered, causing great concern for the likelihood of surface and/or groundwater contamination. As discussed earlier, not all sites are suitable for septic tanks. Of primary concern is the type and porosity of the soil and also the depth of the seasonally high water tables.

- Desludging: As the rate of accumulation is faster than the rate of decomposition, the accumulated sludge must be removed at some point. If this is not done timely the sludge will gradually fill the tank and reduce its efficiency. Regular septic tank pumping[26] is the only way to prevent septic tank systems from clogging and to extend the life of the septic system. The findings of the household survey revealed that septic tanks are only emptied if and when the tank is full. If sludge is not cleaned out, but instead allowed to reach the outflow pipe, any new delivery will cause scum and sludge to be displaced as effluent. This is illustrated in Figure 4.2. Clearly this is not good practice. As the findings of the household survey will show, in many cases the effluent pipe or filter will become blocked and scum followed by sludge will back up into the toilet.

Figure 4.2: Potential risk of irregular septic tank desludging



Source: http://arkitrek.blogspot.com/2008/03/in-shit-septic-tank-guide.html

Because the proper functioning of a septic tank is so heavily dependent upon the user, there is a huge risk that septic tanks may contaminate ground water, surface water or yards as a result of inadequate design, use, and/or maintenance. The principal contamination of concern is microbiological (e.g. pathogenic bacteria and viruses). As will be highlighted in the following chapter, many house owners have for one or another reason decided not to construct a septic tank. Where septic tanks have been installed, they are often not built to standard and function more as improved latrines. A more detailed description of the design and functioning of septic tanks is given in Appendix 11.

4.3. Septage collection and disposal practices

While substantial progress has been made over the past decades in increasing access to sanitation in Vientiane, very little is known about the removal and disposal of sludge from on-site sanitation facilities. The responsible agencies do not seem to address the issue of what people do with the sludge and septage

[26] While desludging frequencies vary, it is typically considered best practice to desludge septic tanks once every three to five years, or when the tank becomes one-third full. Studies have shown that after this period, sludge decomposes, solidifies, and can no longer be removed by suction alone. Frequent desludging also helps reduce the pollution levels in the liquid effluent. (USAID, 2010)

that accumulates inside onsite sanitation systems (OSS). Except for a few sporadic cases there is no evidence that manual desludging is common practice in Vientiane. In the absence of public services, private service providers have emerged to empty OSS with vacuum trucks. However, even the number of private service providers was not known[27].

4.4. Registration and regulation

All privately owned operators are expected to register with the Department of Industry and Commerce, however, nobody really seems to know the number or whereabouts of these operators. It also became clear that at present there is no regulation[28] in place to administer and manage the safe collection, transportation and disposal or reuse of onsite sanitation septage. Furthermore, there is also no system in place to monitor the services and practices of private service providers.

4.5. Private service providers

As part of the rapid assessment an effort was made to obtain a comprehensive overview of Vientiane's septage hauling operators. A total of 17 private operators that are engaged in the collection, desludging, handling, transportation and disposing of sludge and septage from septic tanks or other kinds of onsite sanitation facilities were tracked down; 15 of them were interviewed. An overview of the outcome of these interviews is summarised in Appendix 12.

☛ **On average somewhere in the range of 1,100 to 1,500 m^3 of untreated or at best semi-treated septage is collected and hauled across the city each month!**

The interviews with the 15 private service providers revealed that they own a total of 25 vacuum trucks (18 small and 7 large trucks). The smallest operator owns just one vacuum truck and the largest operator owns four vacuum trucks. They reported that septage collection services are on average ~30% higher during the rainy season. Where the total number of pit emptying services during the dry season reaches some 190 services per month, this increases to some 250 services per month during the rainy season[29]. Pit emptying services range from 2 to 3 per month for the smallest operator up to 30 to 40 per month for the largest operator. Pit emptying services costs range from LAK 150,000 (~US$19) up to LAK 800,000 (~US$100, with an average of LAK 256,000 (US$31), depending on volume, distance travelled and other considerations.

13 out of the 15 operators dispose of their septage regularly – but not exclusively – at the solid waste dumping site at KM32. One operator has its own dumping site in Nakae village, Xaithany district, and one operator dumps it exclusively at a Ketsana plantation in Tadmoon area, Sikottabong District! Eight operators use alternative dumping sites during the dry season such as paddy fields (4) and the Ketsana plantation (4).

Problems faced by the 15 operators are all exclusively related to the dumping site at KM 32, namely: 1) eight operators complained that the KM32 dumping site is too far, and that as a consequence the time and fuel costs involved are not making it a profitable business. 2) eight operators (only 3 of the earlier 8) mentioned that the access road on the KM32 dumping site is too difficult to navigate with heavy trucks. 3) four operators mentioned the non-availability of water at KM32 for cleaning the vacuum trucks after dumping, and 4) one operator mentioned that there was some unfair competition due to the lack of regulatory oversight as a number of competitors avoided the KM32 dumping site (being too far) and instead opted to dump the septage 'illegally'.

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27 GHK (2001) mentions that there were only seven private operators with a total of 10 vacuum tankers in 2000/01. JICA (2010) mentions a total of 9 companies with 17 vacuum tankers in 2009/10. When asked VUDAA staff had no clear idea about the number of operators and/or vacuum trucks.

28 It is expected that the Ministerial Decision on Management of Wastewater Drainage in Towns and Municipalities, which is being finalised at present, will provide guidelines for the removal and disposal of OSS septage.

29 The increase in pit emptying services during the rainy season was confirmed by Mr. Bounta, Head of the Solid Waste Disposal site at KM32 on 17 July 2010. It is also confirmed and further explained in the presentation of the results of the household survey in the next chapter.

☛ **There is also evidence of indiscriminate and illegal dumping of septage in rural villages in the vicinity of Vientiane capital**

There are a lot of unconfirmed reports, but also some evidence, of indiscriminate and illegal dumping of septage into fishponds, on fields or wherever the driver of the vacuum tanker finds a location to dump it in the vicinity of Vientiane capital[30]. Sometimes a small amount of money can be obtained from a farmer or pond owner. Considering the high costs of fertilisers, septage can be a cheap alternative for farmers. The wastewater standards applicable for septage and effluents from OSS facilities are WREA's "2010 National Environmental Standards". The standards specify allowable concentrations for wastewater discharge into water bodies. If this regulation is followed stringently, it would be against Lao PDR's law to dump untreated septage into the environment.

Although it was beyond the scope of the rapid assessment to assess the extent of illegal dumping, its existence was confirmed during a visit to Dong Xiang Di village in Naxaythong district. The village chief was able to confirm three cases of illegal septage dumping during the 2009/10 dry season within the village boundaries. Two of the three truckers that dumped septage 'illegally', were fined by the village authorities (LAK 150,000 (US$19) and LAK 400,000 (~US$50), and the third trucker was stopped in time by the owner of the paddy field where the attempted dumping was taking place [31]. Out of the 15 operators interviewed, eight acknowledged that they used alternative dumping sites during the dry season. Out of these eight, four said that they use paddy fields in the vicinity of Vientiane to offload septage. Not surprisingly considering the sensitivity of this subject, only one of them admitted that they were selling[32] septage to paddy field owners.

KM32 dumping site

The current waste disposal site at KM32 replaced the previous KM18 dumping site in 2008, as that (old) site had was no longer tenable due to it proximity to populated settlements . The KM32 waste disposal site was developed with support from a Korean company as compensation for taking over the KM18 site. A rudimentary and undeveloped waste stabilisation pond was created for the dumping of OSS septage. The square pond measures roughly 150 by 150 meters with a depth of some 3 meter with theoretical capacity of ~67,500 cubic metres (m^3). No wastewater treatment facilities have been developed at the site, the only treatment that takes place is the occasional tossing of lime in the stabilisation pond to reduce foul stench. It must be mentioned that if land is available at low cost, a properly designed and operated waste stabilisation ponds could be a cost effective method for treating wastewater. Another onsite issue is that no water supply provisions have been made that would facilitate the cleaning of vacuum trucks before they leave the wastewater dump site[33].

Although the former site was developed and managed with support from JICA, the present waste disposal site is managed solely by VUDAA without any external support. There are five full-time VUDAA employees and 12 temporary workers deployed at the site. On average some 60 solid waste disposal tipping trucks per day visit the site. The income collected (LAK 15 per kilogram) is insufficient to operate and manage the site properly, let alone generate enough funds to finance the required site extension in the near future.

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30 GHK (2001) analysed the issue of illegal dumping and reported that the proportion of waste being taken to the treatment works is between 25-50% of the total generated waste and thereby verifying reports that septic tank cleaning companies operating in the private sector regularly illegally discharge waste to natural watercourses or, where a demand exists, sell the waste to local farmers.

31 Personnel communication with Mr. Khonsy, village chief of Dong Xiang Di village, on 17 July 2010.

32 Charges were reported to be in the range of LAK 50,000 for a small truck to LAK 100,000 for a large truck.

33 At the original KM18 site, the JICA supported "Solid Waste Management System Vientiane" project had financed the installation of water supply to the sanitary landfill.

Figure 4.3: Waste stabilisation pond at KM32

With regards to the dumping of OSS septage, operators are charged LAK 10,000 (US$ 1.22) for small trucks and LAK 15,000 (US$ 1.83) for larger trucks at present[34]. Apparently these rates were originally set in 1998, and since then have never been revised upwards. Records are maintained by VUDAA staff at the site. The June 2010 records show that some LAK 750,000 (US$ 91) was collected from a total of 69 vacuum trucks[35] during that month. The fees collected are well below what is necessary to operate and further develop the current septage disposal site.

Although there is no hard evidence, it is expected that the relocation of the dumping site from KM18 to KM32 has increased the risk of illegal dumping and indiscriminate reuse of septage, as operators' hauling costs have increased substantially. It is said that the new dumping site receives as much as 20 to 30% less septage vacuum trucks than the former KM18 dumping site[36].

Considering the above and the potentially high environmental and human health risks of the current unregulated and uncontrolled septage collection, transportation and disposal (or reuse) practices, septage management regulations[37] – including monitoring, inspection and reinforcement – need to be put in place urgently. In addition, increased funding and a review and reform of the current tariff structure will be necessary to be able to operate and manage the waste disposal site in compliance with national environmental standards.

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34 In 2000/01 private companies were charged LAK 4,500 to discharge waste at the KM18 disposal facility (GHK, 2001). This is roughly equal to LAK 27,000 (US$ 3.31) at present price levels if corrected for increases in the consumer price index!

35 According to GHK (2001) on average 230 trucks per month were discharging septage at the former That Luang treatment plant! It this information is correct it would mean an enormous decrease in 'controlled' septage disposal.

36 Personnel communication with Mr. Bounta, Head of the Solid Waste Disposal site at KM32, on 17 July 2010.

37 USAID (2010) suggests that, besides clear legal and regulatory requirements for scheduled desludging, and septage collection and treatment, a manual of practice should be issued that can guide service providers on how to properly contact customers, inspect and clean tanks, take safety precautions, transport the waste, and maintain equipment. It also suggests ways to prevent illegal dumping by putting procedures in place that tie records to payment for collection.

5. Conditions of Sanitation Facilities in Vientiane

The lion share of the rapid assessment consisted of two separate surveys. The first concerned a household survey to assess the coverage, use and adequacy of household toilets, and the second concerned a survey of accommodation under multiple occupancy to determine the perceived adequacy of the sanitary facilities and to identify any functionality related problems. Both surveys will be presented and discussed in this chapter.

5.1. Results of the household survey

The household survey was conducted to provide an overview of the current situation with regard to household sanitation services in a selected number of districts in Vientiane Capital. The household survey was expected to provide input for the following outputs of the rapid assessment:

1. The coverage, use and adequacy of household toilet facilities in the study area, particularly in terms of functionality and durability; the safe containment of excreta and disposal of wastewater; and the avoidance of groundwater pollution.
2. Common operation and maintenance arrangements and practices including the extent to which safe and hygienic pit emptying and septage disposal practices are being followed.

A survey of existing household sanitation facilities was conducted during the months of June and July 2010. Over 500 households in predominantly middle- and low-income areas in Vientiane City were interviewed about their current sanitation practices, perceptions of existing sanitation conditions, expenditures, and their knowledge of improved sanitation options. The results of the survey and related research will be discussed in the following sections. A separate report presenting the detailed findings of the household survey has also been prepared.

5.1.1. Methodology

Sampling methodology

The target population of this survey was the urban population of the four districts in Vientiane Capital that make up Vientiane municipality administered by VUDAA. Within the selected districts a cluster sampling approach was used for household sampling. As the survey was to focus on urban middle- and low-income areas, the clusters were selected from geographic areas expected to accommodate specific income brackets. Within the cluster target areas random sampling procedures were applied to get as much as possible a representative sample, in order to enable inferring the results from the sample back to the larger target population. However, considering the methodology used for selecting the villages, this has not been a representative sample and caution should be taken when interpreting the results.

In accordance with the Terms of Reference the survey focused on middle- and low-income areas, “as investments in domestic sanitation facilities are likely to be modest in these areas”, and on locations where “onsite sanitation cannot function effectively”, for example due to periodic flooding, high water tables and/or low soil permeability. Likewise population density was expected to have a bearing on the effectiveness of onsite sanitation. As a consequence the following three criteria were adopted for selecting the survey locations:

1. Locations with low- and middle income households
2. Locations that are either flood-prone, high water tables and/or low soil permeability; and
3. Locations with relatively high population density.

As no relevant and reliable data are available for any of these indicators, survey locations were identified on the basis of discussions with relevant district and village authorities. Guided by the above three criteria, 16

villages were selected during a meeting with representatives of VUDAA, the four district Departments of Public Works and Transport and SNV consultants. Figure 5.1 shows a map with the 16 selected villages.

Figure 5.1: Map of Vientiane with the 16 selected survey villages

Source: Google Earth

Although a sample size of 500 households had been determined in the Terms of Reference, the sample size was increased by 5% for the actual survey to allow for discarding of interview errors. A confidence interval of 4.36 was calculated using the sample size calculator developed by Creative Research Systems[38]. The total sample size of 525 households was distributed proportionally over the four districts and the 16 villages on the basis of their total number of urban households. This was done to ensure an equal distribution of household samples over the four districts. Table 5.1 shows the distribution over the four districts.

Table 5.1: Sampling size versus actual household surveyed per district

District	Urban totals		Sampling size		Actual survey	
	No of villages	No of households	No of villages	No of households	# of HH surveyed	Actual as % of sample
Sikhottabong	36	9.869	4	130	140	108%
Chanthabuly	37	11.778	4	109	103	94%
Sisattanak	40	10.853	4	166	177	107%
Xaysetha	39	14.975	4	120	128	107%
Totals	**152**	**47,475**	**16**	**525**	**548**	**104%**

Within the selected villages, the areas or clusters for the household interviews were selected after consultations with local village authorities of the 16 selected villages. Therefore, in each village, a meeting was organised with these authorities to discuss and select – supported by a transect walk, mapping exercise

[38] Creative Research Systems can be accessed on http://www.surveysystem.com/sscalc.htm#two

and a discussion on the socio-economic conditions in the various areas of the village – the relevant target areas based on the same criteria as for the village selection.

The basic sampling unit was the household and for this survey a household was defined as "an aggregate of persons, generally but not necessarily bound by ties of kinship, who live together under the same roof and eat together or share in common the household food". Only one household per house was interviewed, since sanitary facilities are determined rather per house than per household. Individual houses were selected by calculating a sampling interval, which allowed every xth house to be picked for the household interviews. The starting household was picked randomly from the target area, drawing a number within the sampling interval.

Data collection, data entry and analysis

The survey was executed through semi-structure interviews with household representatives of the sampled houses. Based on the survey objectives a questionnaire was developed and pretested. Some of the questions were ascertained through observations by inspecting the facilities. Sanitary facilities were inspected only after obtaining permission by the household interviewee. Pictures were taken of all toilets and septage storages that allowed cross verification between the findings and the visual evidence. Six enumerator teams, composed of one male and one female enumerator each in order to address gender sensitive issues with same sex interviewers, were trained for four days and thereafter conducted the 548 interviews.

Two survey supervisors supported by a survey coordinator, were responsible for organising and managing the survey, including introduction and rapport building with the local village authorities and selection of the target areas within the villages. They guided, coached and supported the enumerator teams in conducting the interviews. The survey supervisors observed the teams and provided daily backstopping support to verify correct behaviour standards and to ensure completeness and reliability of data.

Data entry and analysis of the collected data was performed with the statistic software package SPSS 11.5. Data cleaning was performed by the survey coordinator to check for missing values and outliers. A general random test on data entry quality was performed. Quantitative data were tabulated and descriptive statistics analysed. Where applicable, cross tabulation and correlation statistics were conducted. Data are presented in graphs and charts. Qualitative information from open questions has been categorised and summarised in the report. Altogether this provides a user friendly analysis of the current situation.

Limitations

As a consequence of the requirements specified in the Terms of Reference, the survey is not based on a representative sample. Instead the survey targeted specific areas that were expected to face household level sanitation problems, such as flood prone areas, areas with high groundwater tables, low and middle income areas, high density population areas, as well as newly urbanising areas. Therefore, the results of this survey are only representative for these kinds of urban areas in Vientiane and the findings cannot be extrapolated to the whole of Vientiane.

5.1.2. Findings

The main findings of the household survey have been provided in Appendixes 13.1 to 13.4. The findings presented in these appendixes have been segregated by village and by district for ease of comparison. However, the findings discussed in the following section are predominantly presented as totals for the total sample size.

Household information

The survey covered a total of 548 houses. The distribution of the survey sample over the four districts is summarised in Table 5.1. One respondent per house was interviewed. The mean respondent age was 43 years (minimum 15 and maximum 85) with a normal distribution over the age categories. A majority (66%)

of the respondents were women, and about 20% of the households in the survey sample were female headed.

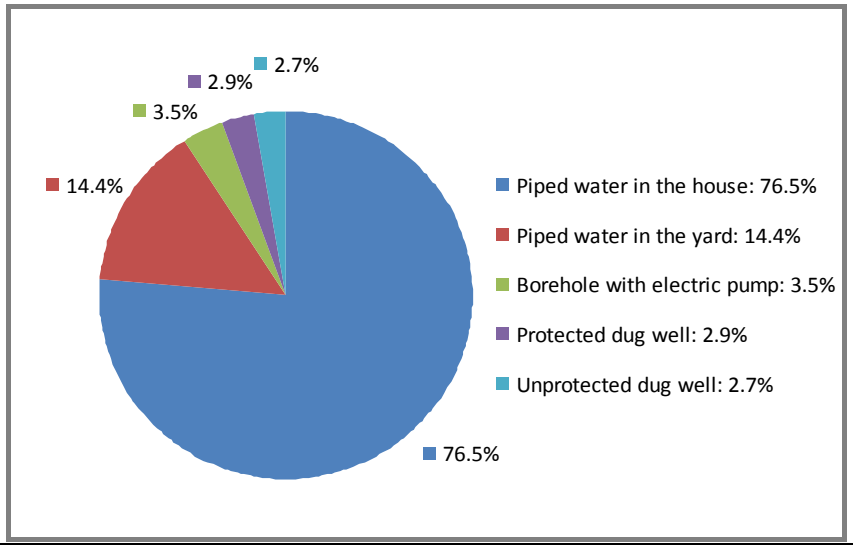
The average number of persons living in one house was 5.5, with a minimum of one and a maximum of 25 persons. This finding is comparable with the Population and Housing Census of 2005 (PHC 2005) that provides a similar figure of 5.6 persons per household for Vientiane Capital. In 17% of the houses, more than one household (two up to four) was found. Almost 90% of the households were owners of their house, 4% were tenants, 3% lodgers and 2% lived in "tied accommodation" provided by their employer. The proportion of house owners is higher and that of tied accommodation is lower than in the PHC 2005 (respectively 87%, and 3.7%). This is expected as dormitories and other forms of multiple occupancy accommodations were excluded from the household survey. Roughly a quarter (26%) of the houses and/or their premises were used for economic activities. This is expected to influence their needs for adequate water supply and sanitation facilities.

As all land in the Lao PDR used to be owned by the Government, many private houses have been built on Government land. In recent years changes in the land use legislation have been introduced and people are now getting land titles and buying land as private property. This situation should be taken into account when considering investments in housing and sanitation facilities.

Access to water sources

A reliable water supply is essential for good sanitary and hygienic practices like flushing toilets and hand washing. 91% of the surveyed houses had access to piped water, either in their house (77%) or in their yard (14%). Because of the costs of piped water, 2% of the households indicated they used piped water only as second priority, and one household did not use it at all. Instead they used either protected wells (5) or boreholes with an electric pump (3). 9% of the households are fully dependent on groundwater sources. 35 households (6.4%) had access to an improved groundwater source in the form of boreholes with electric pumps (3.5%) or protected wells (2.9%). 15 households (2.7%) only had access to an unimproved water source in the form of an unprotected hand-dug well.

Figure 5.2: Primary source of water supply



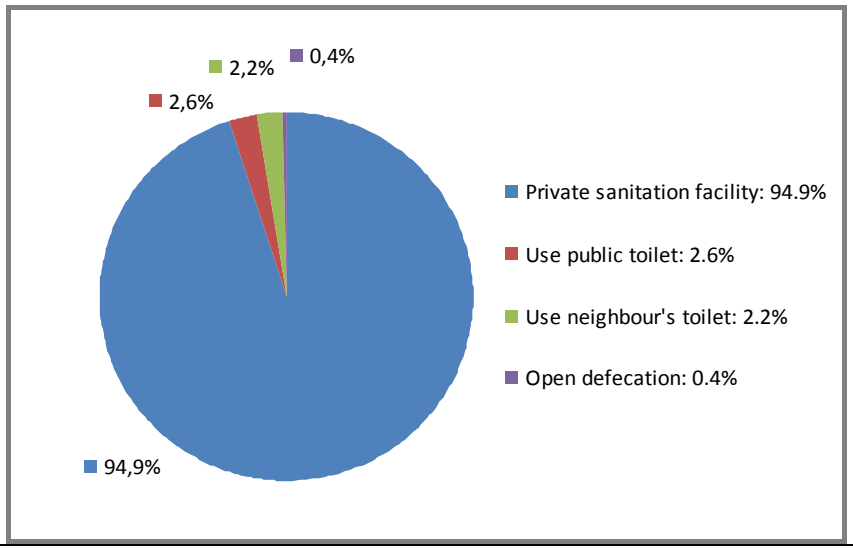
Almost all households had year-round water supply. Only 2.4% of the households mentioned they suffered from lack of water during some periods in the year. This varied from 1 week to three months per year; on average they had no access to water for 5.4 weeks per year. Protected dug wells and boreholes suffered relatively more frequently from interrupted water supplies.

The above findings mean that more than 95% of all the surveyed houses have sustainable access to an improved water source. These findings compare positively with the WHO/UNICEF Joint Monitoring Programme figures, which states that 72% of the urban population in the Lao PDR had access to an improved water source (55% piped water supply, and 27% other improved water source) in 2008. If the findings are compared with the PHC 2005 findings for Vientiane Capital, where only 42.5% piped water supply was reported, the water supply situation in the selected urban villages is even better. The difference in findings can be explained by the difference in sampling areas. The JMP figures are based on all urban areas in the Lao PDR, while the PHC 2005 covers all nine districts of Vientiane Capital, including rural districts.

Access to sanitation

The survey found high sanitation coverage with 95% of the respondents reporting that they had access to one or more private sanitation facilities, and only 5% of the respondents reporting that they did not have access to private sanitation facilities. Of these 28 houses, 2.6% (14) used public facilities available in their neighbourhood, and 2% (12) used the toilet of their neighbours[39]. Only two households (0.4%) admitted to practice open defecation in the nearby fields or forest. However, the interviewers were under the impression that probably a few more households might be using this option.

Figure 5.3: Access to sanitation facilities



These findings show better sanitation coverage than the most recent data from the WHO/UNICEF Joint Monitoring Programme, which reported that 86% of the urban population of Lao PDR had access to improved sanitation in 2008. The PHC 2005 reported that some 83% of Vientiane Capital's households had access to either a modern toilet (9.2%) or a normal toilet (73.6%). According to PHC 2005, 11.3% of all households in Vientiane Capital did not have any sanitation facility.

Not all persons living in a house with sanitation facilities were using them. In 10% of the households (51), infants or young children under the age of 5 years did not yet use the facilities, as one can expect. In 1% of the households (4) also adults or youngsters did not use the facilities, instead they either used a toilet at work or university, or at the house of a relative where they spent most of the day. In one household the use of a public toilet was mentioned. In total 69 people did not use their own facilities, including the infants and small children too young to do so on their own.

Sanitation facilities

[39] According to the JMP definitions (Appendix 8), sanitation facilities are not considered improved when shared with other households, or open for public use!

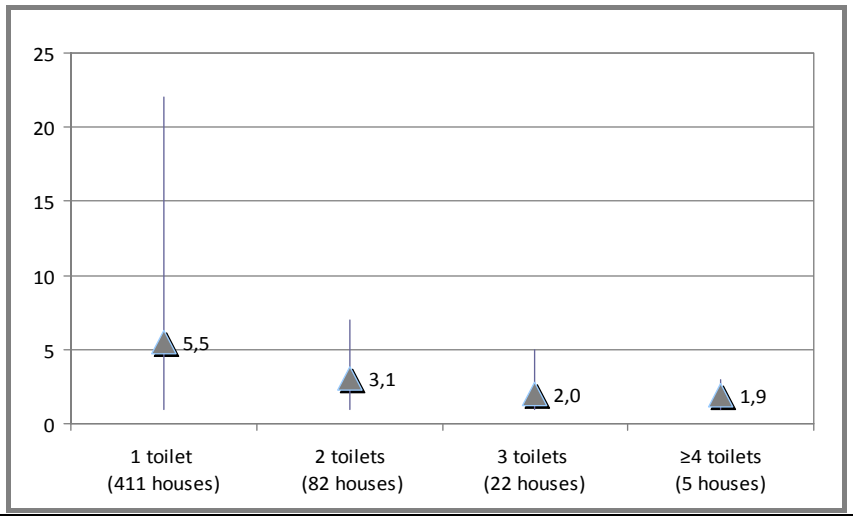
The 520 houses with sanitation facilities had a total of 664 toilets, 581 septage storage pits or tanks and 13 (2.5% of houses) other forms of wastewater disposal options. As can be expected in predominantly middle- and low-income areas, 79% (411) of the surveyed houses had only one toilet. Of the other households, 21% (118) had two or more toilets, of which 10% (54) had two or more septage storage pits or tanks.

Table 5.2: Number of toilets and septage storages per house

Number of toilets	Number of septage storage tanks or pits				Totals	
	1 storage	2 storages	3 storages	5 storages	#	%
1 toilet	402	9	0	0	**411**	*79.0%*
2 toilets	47	35	0	0	**82**	*15.8%*
3 toilets	6	9	7	0	**22**	*4.2%*
4 toilets	2	0	1	0	**5**	*0.6%*
5 toilets	0	0	0	1	**1**	*0.2%*
6 toilets	0	1	0	0	**1**	*0.2%*
Totals	**457**	**54**	**8**	**1**	**520**	***100%***
In %	*87.9%*	*10.4%*	*1.5%*	*0.2%*	***100%***	

The 664 toilets were used by 2851 household members. This results in an average of 4.3 persons (users) per toilet, with a minimum of one and a maximum of 20 persons. The number of users per toilet for houses with increasing numbers of toilets falls from 5.5 persons in houses with a single toilet to less than two in houses with four or more toilets. The most populous houses had only one toilet. As an observation it can be said that some respondents mentioned that the large number of household members was a reason to build an extra toilet.

Figure 5.4: Utilisation rates per toilet



Toilets

56% of the toilets were located inside the house, 42% were situated outside, detached from the main house, and 2% were part of the main house structure but could only be entered from outside. There are relatively more detached toilets in locations identified as low-income areas.

The year of construction of the toilets ranged from the end of the 19th century till as recent as this year. Some toilets were actually being constructed at the time of the survey. About a third of the toilets were constructed in the last five years (2006-2010), a quarter was built between 2001 and 2005, and a fifth in the five years before that (1996-2000). This means that more than half of the toilets (57%) were less than ten years old. Some 4% had been constructed more than thirty years ago, in 1980 or before.

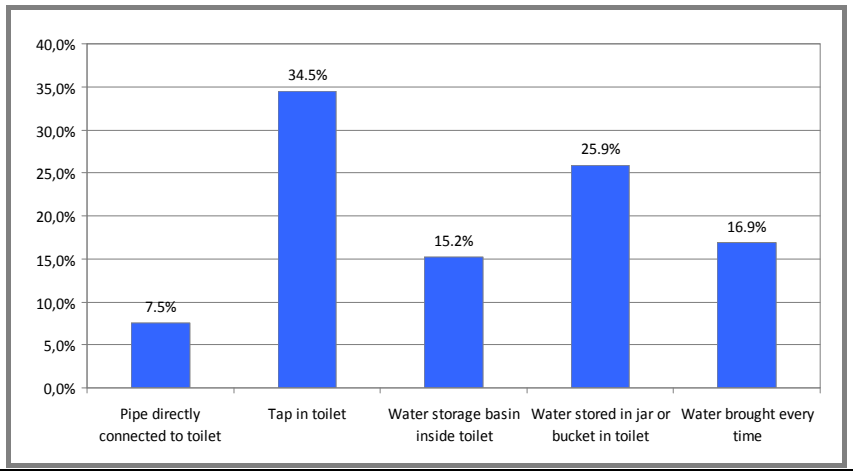
Taking privacy and other issues into consideration the survey enumerators were allowed to inspect 635 toilets (96%). All observed toilets were flush toilets: 12% were cistern flush toilets and 88% were pour-flush toilets where water for flushing needs to be poured manually. The walls of most toilets were made of bricks or blocks masonry (78%) or of sheeting (15%). The roofs of most toilets were made of various types of roof sheeting (90%).

On the basis of observations, the enumerators considered 67% of the toilets to be constructed in a durable manner, 25% were considered to be not durable, and the remaining 8% were considered questionable. Detached toilets were relatively more often observed as not durable (39% not durable; 14% questionable), than toilets inside the house (14% not durable; 3% questionable). Toilets perceived to be more durable often had walls constructed of masonry (95%), and the majority had roofs of roofing sheeting (92%). More inside toilets (81%) than detached toilets (42%) were evaluated as durable.

Water availability in toilet

With regards to availability of water for flushing, almost 8% of the toilets had a direct connection between the water pipe and the toilet, which is lower than the 12% cistern flush toilets reported earlier, and 35% used water from a tap in the toilet to flush the toilet. Apparently, only 62% of the cistern flush toilets were working properly. For the remaining toilets other forms of water storage were observed. In 26% of the toilets water was stored in a jar or bucket, in 15% of the toilets water was stored in a storage basin that was built as part of the toilet, and in 17% of the toilets water had to be brought every time someone used it.

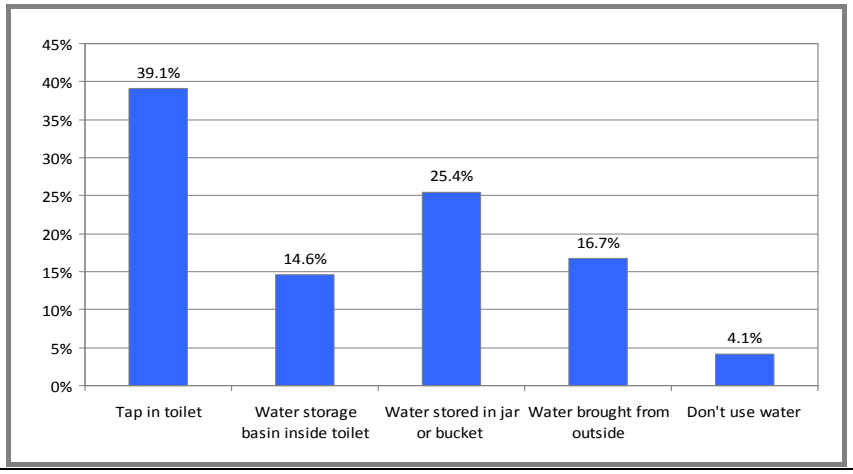
Figure 5.5: Water source for toilet flushing



The majority of the surveyed houses (96%) used water for anal cleaning; only 4% did not use water for anal cleaning. In 39% of the toilets water was available directly from a tap inside the toilet, in 40% of the toilets water was stored inside the toilet, and in 17% of the toilets water was brought from outside.

The water sources used for cleaning the toilet were very comparable to these findings. The 4% that did not use water for anal cleaning used water from a water basin or brought water from outside to clean their toilets.

Figure 5.5: Water source for anal cleaning



Hand washing facilities

Hygiene in terms of hand washing after toilet use is an important habit to reduce or contain disease incidences. For 32% of the toilets a specific place or facility for hand washing was observed inside the toilet, for 3% of the toilets a hand washing facility was observed immediately outside the toilet, but for 65% of the toilets no specific hand washing facility was found. In 85% of the cases where a facility for hand washing was observed, either inside or outside the toilet, soap was available for hand washing. This means that in only 29% of the toilets both a place and soap for washing hands after toilet use were observed.

Table 5.3: Soap and facility for hand washing

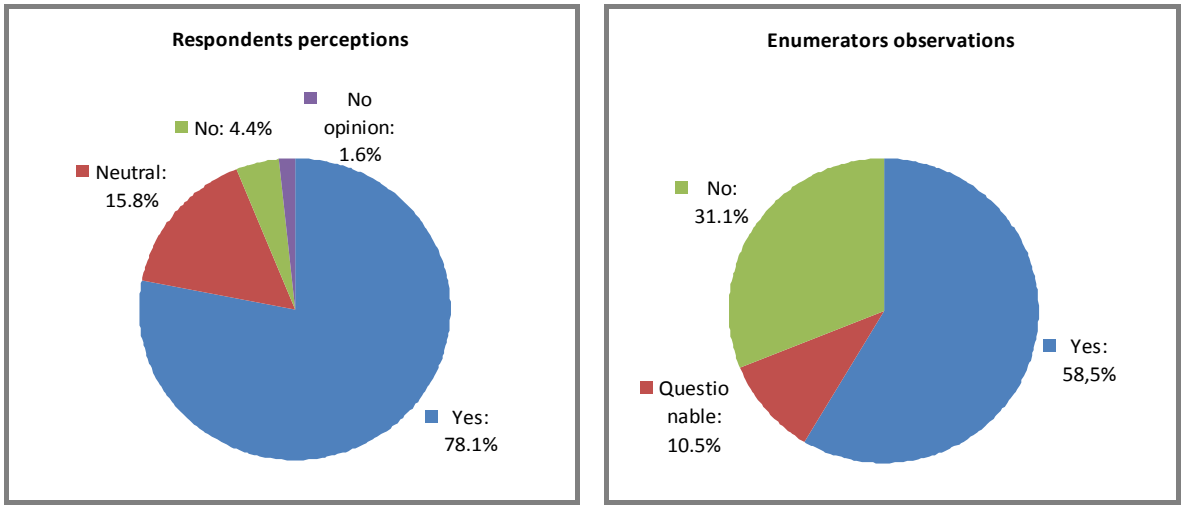
Specific place or facility for washing hands (N=635)	Soap/detergent for washing hands					
	Yes		No		Total	
Inside toilet	175	*27.7%*	30	*4.8%*	205	*32.5%*
Immediately outside toilet	11	*1.7%*	5	*0.8%*	16	*2.5%*
Elsewhere	1	*0.2%*	1	*0.2%*	2	*0.3%*
Not seen	142	*22.5%*	266	*42.2%*	408	*64.7%*
Total	**329**	***52.1%***	**302**	***47.9%***	**631**	***100.0%***

Toilets and showers are regularly combined in the same room, and even though there is no specific place for hand washing, there is often soap available. It can however not be confirmed that the available soap is actually used for hand washing after toilet use. In almost 40% of the toilets without specific hand washing facility (65% of the total toilets), soap was seen in or in the vicinity of the toilet. Still, this means that in 42% of the observed toilets there was neither a place nor soap for washing hands.

Toilet hygiene and cleanliness

Both respondents and enumerators gave their opinion on whether it was easy to keep the sanitary facilities clean. The respondents were asked a general question for their total sanitary facilities, while the enumerators evaluated for each toilet separately how easy it was to clean. 78% of the respondents thought that it is easy to keep their toilets clean, and 5% thought it to be difficult. Reasons given by respondents why they thought it is difficult to keep their toilets clean are that the toilet is too old, there is no good drainage, or that there are too many children that use the toilet. According to the enumerators, 59% of the toilets were easy to clean, 31% of the toilets were evaluated as difficult to clean, based on the construction quality, materials used and their overall appearance, while they had doubts about the remaining 10%. Toilets observed as non-durable were more often seen as difficult to clean (62%) as toilets with a durable superstructure (20%).

Figure 5.6: Ease of cleaning toilets



Both respondents and enumerators were also asked to rate each toilet for its cleanliness. According to the respondents, 48% of the toilets were considered to be clean, 9% were considered to be dirty, and 44% of the toilets were considered to be "neutral" (neither clean nor dirty). The enumerators considered 40% of the toilets to be clean, 19% were considered to be dirty, and 41% were considered to be "neutral". While there is an overall agreement on the state of cleanliness for 65% of the toilets, there is more agreement on the clean toilets, than on the dirty toilets. Only 30% of the toilets that the enumerators considered as dirty were not clean according to the respondents, while 47% of the 'dirty toilets' were said to be "neutral". This might have been caused by the specific aspects of smell and flies that were taken into account by the enumerators, whereas the respondents may have referred more to the visual aspects of cleanliness. The respondents found that 22% of the toilets had a foul smell, 10% had flies, and in 5% of the toilets human or animals could get in contact with faeces due to poor construction. A total of 25% of the toilets were affected by one of these three aspects.

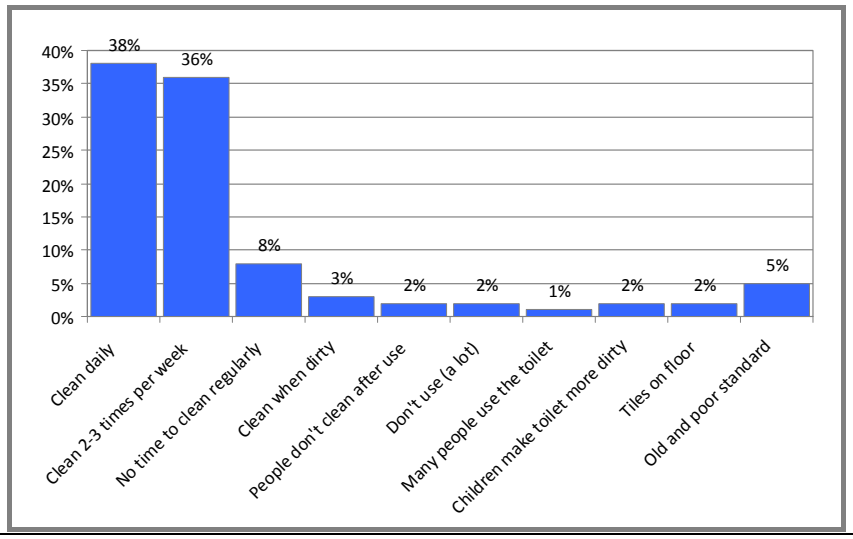
Table 5.4: Cleanliness of toilets

Respondent's rate of cleanliness (N=635)	Enumerators' Observation of cleanliness							
	Clean		Neutral		Not clean		Totals	
	#	%	#	%	#	%	#	%
Clean	201	***79.8%***	71	*27.6%*	27	*22.7%*	**299**	*47.6%*
Neutral	46	*18.3%*	172	***66.9%***	56	*47.1%*	**274**	*43.6%*
Not clean	5	*2.0%*	14	*5.4%*	36	***30.3%***	**55**	*8.8%*
Totals	**252**	*100.0%*	**257**	*100.0%*	**119**	*100.0%*	**628**	*100.0%*
In %	*40.1%*		*40.9%*		*18.9%*			

Reasons cited by the respondents why they thought their toilet was clean or not can be categorised into three groups: those related to cleaning, to the people using the toilet, and to the design and materials of the toilet. Most important for cleanliness was found to be that the toilet is cleaned daily (38%). Other reasons are that the toilet is used by adults only who keep it clean, and that the floor is tiled (or of concrete) thus easy to clean. Reasons to judge the toilet's cleanliness as neutral or dirty were that there is no time to clean regularly (8%), people do not clean after use (2%), the toilet is old, of poor standard, and difficult to clean because of the construction materials (5%). Interestingly, cleaning the toilet two to three times a week (36%) is for some respondents a reason to say their toilet is clean (14%), and for others it is

the reason that it is neutral or in a few cases even not clean. Similarly, for 10% of the households, daily cleaning is enough to judge their toilet as neutral.

Figure 5.7: Reasons for clean or dirty toilets

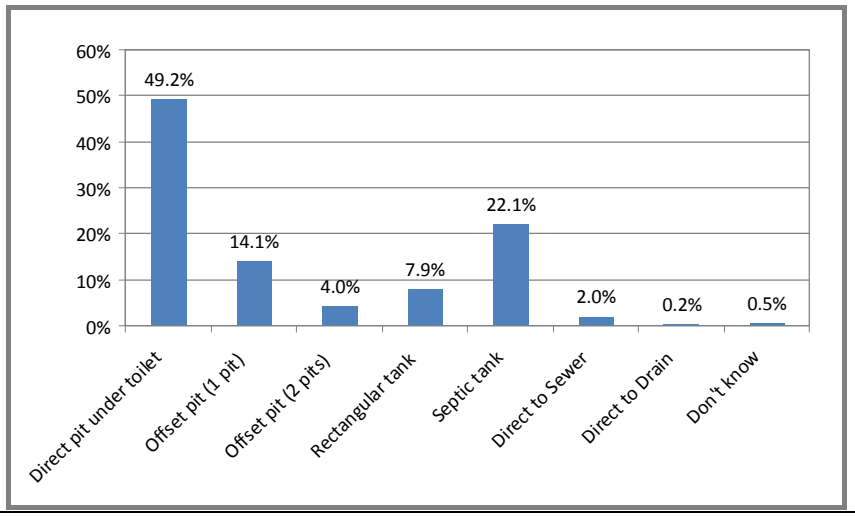


Septage storage

Most toilets and septage storages (tanks or pits) were built at the same time. There were a few toilets that were older than the septage storage or vice versa, the septage storage was older than the toilet. Apparently, in these cases either a new septage storage was built to existing toilets, or a new or additional toilet was built to an existing septage storage. The year of construction of the septage storages was established for 494 cases and similar to the toilets range from the end of the 19th century till the current year. About 20% of the septage storages were constructed in the last three years (2008-2010), and some 33% were constructed in the five years before that (2003-2007). This means that more than half of the septage storages were less than ten years old.

The type of septage storage or septage discharge was assessed by questioning the respondent and through ocular observations. The information of the respondent was crucial as the observations were restricted because for most part the structure is actually underground and therefore invisible. Evidently, not all respondents were fully aware of the underground structures and therefore the enumerators had to carefully probe into construction and operation issues to establish the type of septage storage.

Figure 5.8: Type of septage storage or discharge

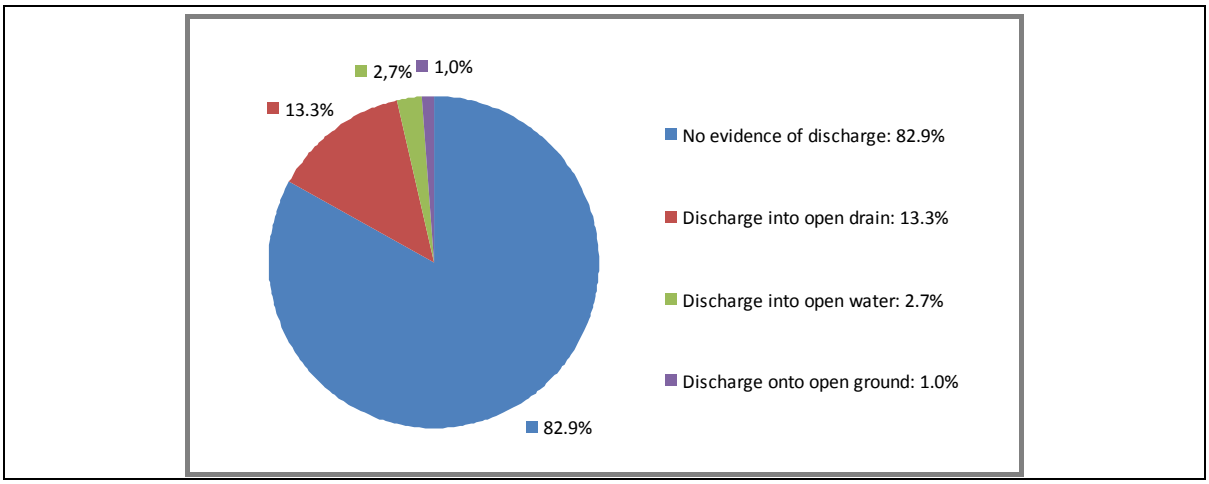


Most toilets discharged to some sort of on-site septage storage. A small number of houses in Ban Thongkhankham and Ban Hatsadi-Tai had a toilet that discharged directly to a small-bore sewer connected to a communal septic tank or interceptor tank. One house in Ban Souanmon was found to discharge directly to a covered storm water drain. Some 49% of the septage storages were found to be pits placed directly under the toilet, and 22% were reported to be septic tanks. The other septage storages were either rectangular tanks without a sealed bottom (8%), or round offset pits (18%) (4% single pits and 4% double pits). One house in Ban Souanmon was found to discharge directly to a covered drain, and of four toilets the type of septage storage could not be determined, because they were completely underground and respondents were not able to provide the necessary information.

Almost all older septage storages constructed before 1995, were either direct pits or single offset pits. Also off the newer septage storages, 45% were direct pits. About a quarter of the septage storages constructed after 1995 were septic tanks. This is a remarkably low figure considering the fact that the local building regulations followed by the district and VUDAA authorities requires every household to construct septic tanks. This supports earlier findings in Section 4.1 that there is no system in place to enforce actual compliance with official building regulations.

Enumerators were asked to observe the septage storages closely for evidence of effluent (untreated or semi-treated wastewater) discharge. Considering that most of the septage storage pits and tanks are underground and therefore for the most part invisible, this was not an easy task. Even so they observed that 17% of the septage storages showed evidence of discharging effluent into the open. Some 13% of the septage storages showed evidence of discharging effluent into open drains (68) – of these 44% were septic tanks (30), 25% were direct pits (17), and the remaining 31% were some form of offset pits (21). Almost 3% of the septage storages discharged effluent on open water bodies (41), and a further 1% of the septage storages discharged effluent onto open ground (5). Considering the fact that the official standard is for septic tanks to discharge into open drains, it is expected that in reality a much higher percentage of septage storages discharge effluent into the open.

Figure 5.8: Evidence of discharge of effluent from septage storage pits or tanks



Pit emptying issues

According to the respondents, some 37% of the septage storages had filled up at some stage. This urged most of them to have it emptied in one way or another. In one case a new storage was built, because the owner found that the pit filled up too quickly. The fact that 63% of the septage storages have never filled up confirms earlier findings that most of them can be considered as anything else than septic tank, and that they are probably some sort of soak or seepage pit where wastewater can infiltrate in the surrounding soil.

Relatively, more single pits, made of standard concrete rings, have filled up (56%) as these pits tend to have a smaller content. There was little difference between the proportion of direct pits and septic tanks that had filled up, but that may be partly explained by the fact that the direct pits are older on average.

Looking from a time perspective, it takes about 5 to 15 years for the average septage storage to fill up. Of the storages built in the last three years only 6% had filled up. Of the storages built in the five years before that (2003-2007), thirty per cent had filled up and of those built before 1995 at least three quarters.

For those cases where septage storages had filled up, the respondents realised that their pit was full because their toilet got blocked (85%) or didn't flush properly (2%). Others noticed that the storage was over flowing (5%), or that a bad smell emerged (4%). Only a very few households mentioned that they check regularly whether the pit or tank is full (3%). These findings are very comparable to that of respondents that did not yet experience a pit or tank filling up. Again 85% of respondents expected the toilet to get blocked, but some 5% were not sure how they would find out. Nobody mentioned that they checked the contents of the pit or tank regularly, even though regular checking of the tank's contents is important for the proper functioning of a septic tank.

Table 5.5: Knowledge about septage storage emptying

Respondent's answers (N=587; missing=7)	Did know		Will know	
	#	%	#	%
Toilet got / gets blocked	186	*85.3%*	312	*84.6%*
Pit or tank was overflowing / will overflowing	10	*4.6%*	20	*5.4%*
Bad smell	8	*3.7%*	13	*3.5%*
We check it regularly	6	*2.8%*	0	
We empty it regularly	2	*0.9%*	3	*0.8%*
Toilet doesn't flush well	4	*1.8%*	1	*0.3%*
Worms coming from the toilet	1	*0.5%*	0	
Don't know	1	*0.5%*	20	*5.4%*
Totals	**218**	***100.0%***	**369**	***100%***

All 218 pits that had filled up were emptied. Three respondents did not know the details of emptying, and in some other cases information was incomplete. 58% of the information collected concerned pit emptying that occurred in the last year, 30% occurred in the last three years, and only 12% occurred before 2007. The distribution of when septage storages were emptied, appears to indicate that part of them are emptied regularly (even yearly) and others only occasionally.

Almost all pits are emptied by vacuum tankers (99%), mostly by private service providers. The survey found that 15 different companies had been used, four of whom were most often mentioned. Some 5% of the respondents did not know which company had been hired. Only three septage storage pits or tanks had been emptied manually: two by the household itself and one by an individual hired specifically for that job.

Desludging or emptying costs differ on the basis of the size of the pit or tank. Average emptying costs were calculated based on the information of those houses that had their pit or tank emptied within the last five years. Costs were corrected by using the official consumer price indexes to account for changes in prices over the course of the past five years. Based on the information of 170 septage storages, the average cost of pit emptying by vacuum tanker comes at LAK 210,000 (US$ 26) at 2010 prices, with a minimum of LAK 100,000 (US$ 12) and a maximum of LAK 450,000 (US$ 56). The costs as reported by the respondents were slightly lower than the prices cited by the private companies (Section 4.2), where the average price was reportedly LAK 256,000 (US$ 31), with a minimum of LAK 150,000 (US$ 18) and maximum of LAK 800,000 (US$ 98).

Almost all septage storages were in reach of a vacuum tanker within about 25 to 30 meters of vehicle access (96%). Some 78% of the septage storages had some type of opening for emptying. Yet, many of these openings were found to be too small for proper inspection or checking of the contents. Interestingly, in 15% of all the pits that had actually been emptied no opening was detected. Relatively more single offset pits did have an opening (85%), whereas 40% of the direct pits did not have an opening. In about a quarter of the septic tanks no opening was found for emptying and/or checking.

Flooding and raising of toilets

All houses with sanitary facilities were asked how prone their premises were to seasonal flooding, to assess the potential risk of environmental pollution (e.g. groundwater contamination) as well as potential problems with storage operations during the rainy season. Almost one third of the houses (32%) had experienced flooding during the past ten years, with 25% of the houses reporting annual flooding. Anecdotally, the main cause for flooding is poor drainage during heavy and prolonged rain.

In terms of toilets this means that 31% of the toilets were at risk (207), of which 54% where detached toilets (111). Relatively more detached toilets (40%) were at risk of flooding than inside toilets (24%). A total of 33 toilets (6% of the surveyed houses) had flooded at least once. Of these toilets 53% was raised higher to prevent flooding, but apparently not high enough. More than a third of these toilets are inside the house. It was observed that the ground floor in some houses is actually lower than the surrounding yard, which could have contributed to the number of reported problems.

Table 5.6: Flooding of yards and toilets

Does your yard flood periodically? (N=520)	Has your toilet ever flooded?						Totals	
	Yes		No		Don't know			
	#	%	#	%	#	%	#	%
Every year	23	*17.8%*	106	*81.4%*	0	*0.0%*	129	*24.9%*
Once every 2-3 years	2	*9.1%*	20	*92.9%*	0	*0.0%*	22	*4.2%*
Once every 4-10 years	1	*7.7%*	12	*94.1%*	0	*0.0%*	13	*2.5%*
No	7	*2.0%*	342	*98.0%*	0	*0.0%*	349	*67.4%*
Don't know	0	*0.0%*	3	*60.0%*	2	*40.0%*	5	*1.0%*
Totals	**33**	***6.4%***	**483**	***93.2%***	**2**	***0.4%***	**518**	***100.0%***

The survey did not find a full match between 'flood prone villages' and the percentage of flood prone premises in the respective village. Although this can not be explained fully, this might have been caused by the choice of survey locations within these villages based on other criteria like population density or low-income areas.

Table 5.7: Flooding of yards versus raised toilets

Location of toilet	Total number of toilets		Toilets with yards flooding		Toilets raised (in flooding yards)	
	#	%	#	% of total	#	% of flooding
Inside the house	374	56.3%	89	23.8%	45	50.6%
Part of house; entrance outside	10	1.5%	7	70.0%	5	71.4%
Detached	280	42.2%	111	39.6%	80	72.1%
Totals	**664**	**100.0%**	**207**	**31.2%**	**130**	**62.8%**

It was presumed that the raising of toilets was more relevant for detached toilets, therefore, the question if the toilet was raised was to be observed only for detached toilets in houses that experienced regular flooding. However, the question was also asked for part of the other toilets. For a total for 306 toilets (46%) the observation was made. Of the 111 detached toilets with risk of flooding, 72% was raised to prevent water from flowing into the toilet. Of the toilets inside the house and at risk of flooding, 51% was found to be raised. Of the total toilets with information on this aspect, 70% was raised. One third of the total number of toilets was raised (35%), which indicates that it is common practice to raise toilets, almost regardless of flooding problems.

Construction costs

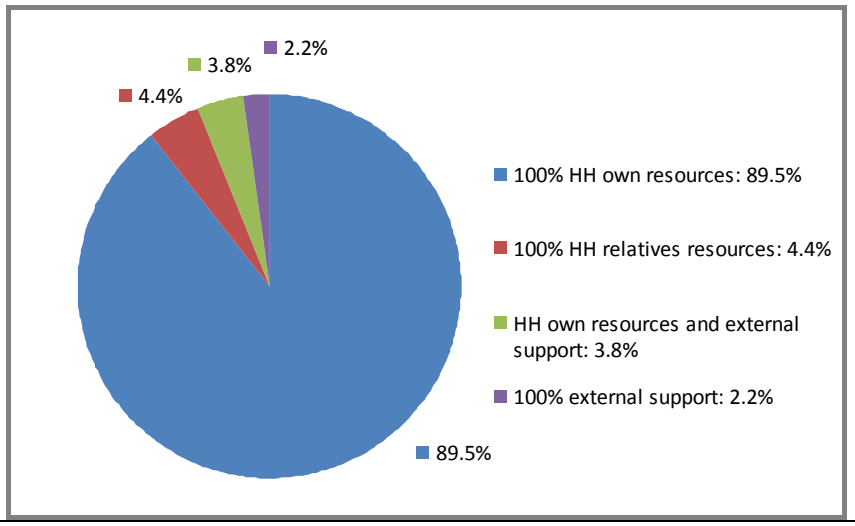
The survey aimed to get an understanding of the costs households incurred for installing sanitary facilities. There are various issues to be considered when evaluating construction costs of the facilities, not in the last place the memory or knowledge of the respondents. Sanitary facilities are often built as part of a house and therefore it is difficult to segregate costs for the facilities. A total of 61% of the respondent did not know or could not answer how much money was spent on the facilities. Information was available for a total of 206 houses, with varying numbers of toilets and septage storages. Average construction costs for total sanitary facilities and for a single toilet and septage storage were calculated using the same consumer price index corrections as used for calculating the pit empting costs. To further limit viability issues, also with regards to the 1998-2000 devaluations of the LAK, only data for sanitary facilities built after 2000 were taken into account.

The average construction costs spent on the combined total of all the sanitary facilities constructed after the year 2000, were found to be almost LAK 3.6 million (US$ 435), with a minimum of LAK 100,000 (US$ 12) and a maximum of almost LAK 32 million (US$ 3,900). Median costs were found to be LAK 1.8 million (US$ 220), which indicates that the distribution of the findings was skewed towards the lower amounts, with most households spending less than the average. The expenditures for the total facilities give an impression of the spending capacities of households for this kind of private services.

The survey was also interested in the costs of single sanitary facilities (single toilet with single septage storage) as this is the minimum level of services needed for a single household. The average costs for a single sanitary facility came to LAK 3 million (US$ 367). Median costs were found to be almost LAK 1.36 million (US$ 166). This is still a rather large investment considering the context of middle- and in particularly low-income households in the Lao PDR.

In almost 90% of the houses, the households used their own (financial) resources to invest in sanitary facilities. In the remaining 10%, the households received, to a smaller or larger extent, external support.

Figure 5.9: Sources for financing sanitary facilities

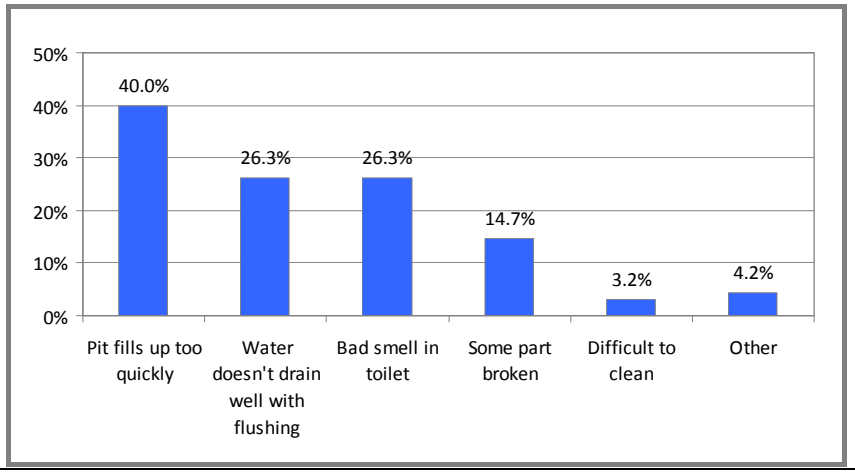


In most cases (62%) this support came from other family members or relatives. Project or government support played a relatively negligible roll with only six households indicating this kind of support. One household indicated that it had used a loan. The remaining 13 households said they had received support from other sources. The fact that so many households (with or without support from their families) had used their own resources, and apparently without taking a loan, indicates that people are willing and able to make this kind of investment.

Operation and maintenance issues

An inventory of the problems that people experience with their sanitary facilities was carried out. Most respondents (81%) indicated that they had no problems with their toilets. Only 18% of the respondents (95) mentioned one or more problems. In 40% of these cases the septage storage filled up too quickly, requiring frequent empting. This problem was sometimes related to high ground water levels, especially in the rainy season. This can be explained by the construction of septage storages other than watertight septic tanks. In the dry season these pits work well with the wastewater dispersing into the soil, however, in the rainy season groundwater tables rise significantly and as a consequence pits fill up with groundwater. In 26% of the cases the problem related to flushing. This also is likely to be caused by high groundwater tables where the water is pushed back up from the pit. About 26% of the respondents complained about bad smells in their toilets, and 15% mentioned that some part of the toilet required repair.

Figure 5.11: Problems with sanitary facilities



Problems were more common among houses with single and double offset pits and direct pits (respectively 33% and 24% of the cited problems), than among septic tanks (14%). The problem that the septage storage filled up too quickly was most common for all types of septage storage. Direct pits and single offset pits had

more often problems related to bad smell, and as expected problems with flushing due to high ground water tables were more frequently experienced by houses with direct pits.

How were these problems solved? For five households the best solution was to build a new toilet, with an average expenditure of LAK 1.7 million (US$ 207). This addressed problems as diverse as difficult to clean, some part broken, difficulties with flushing and a pit that was filling too quickly. In general, solutions were less rigorous. In 15% of the 109 reported cases the problem was not solved. Of the septage storages that filled up to quickly, 82% were emptied at an average cost of LAK 210,000 (US$ 26).

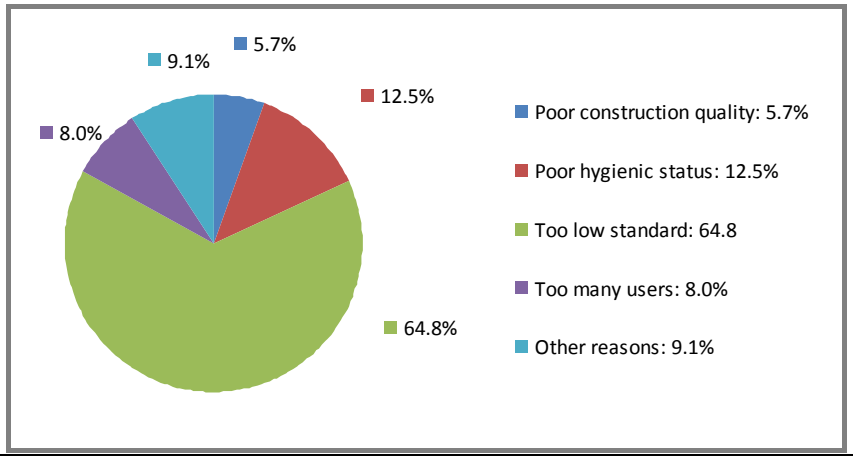
Solutions mentioned for bad smell were regular cleaning (21%), putting lime or charcoal in the septage storage (17%), emptying the septage storage (13%), improving the septage storage (12%), or making a drainage (4%). Costs for these interventions vary from nil for cleaning to a hefty LAK 3 million (US$ 366) for improving the pit and raising the toilet. A third of the cases were not solved or no action was taken. The problem of flushing was most often solved by making or improving drainage to the septage storage, the surrounding yard and/or the toilet room (28%) at an average cost of LAK 500,000 (US$ 61). Emptying the septage storage was a solution in 24% of cases, and 16% choose not to do anything. Most toilets that required some kind of repair or maintenance were indeed repaired (86%). Costs varied from LAK 40,000 (US$ 5) to 500,000 (US$ 61).

The average cost to solve a problem (based on 62 cases) was LAK 320,000 (US$ 39), with a minimum of LAK 5,000 (US$ 0.61) and a maximum of LAK 3.5 million (US$ 427). The average costs drop to about LAK 170,000 (US$ 21) If the costs for building a new toilet are omitted from this calculation.

Satisfaction with facilities

When asked, 60% of the respondents said that they were “happy” with their sanitary facilities, 23% said that they were okay (“neutral”), and 17% said that they were “not happy”. Reasons why respondents were not happy with their facilities fell roughly in five categories. The largest of which was that the toilet was of a “too low standard” (65%), which included “too old” (7%) and “too small” (8%). Others found their facilities of poor hygienic status, including bad smells (12%), have to share their facilities with too many others (8%), poor quality of construction (6%), and the remaining 9% cited other reasons for their unhappiness, including the septage storage filling too quickly and the fact that the toilet was still under construction.

Figure 5.12: Reasons for not being happy with current sanitary facilities



When looking back at the different aspects covered in this survey, it appears that several of these contribute to the overall happiness. Relatively more households with a toilet evaluated as durable were happy with their facilities than those evaluated as non-durable. The location of the toilet also made a difference, with relatively more households with a toilet inside the house being happy than those with a detached toilet. Also relatively more households with cistern flush toilets expressed being happy with their facilities than those having a pour-flush toilet. Households with poorly constructed toilets, particularly those with a risk of getting in contact with faeces, were less happy with their facilities. More households with

toilets that were found to be easy to clean by the enumerators were happy with their facilities, as were respondents that found their toilets clean and hygienic.

When respondents were asked about their preferred type of toilet, there is a clear preference for cistern flush toilets. None of the correspondents with cistern flush toilets preferred a pour-flush toilet, while 40% of the respondents with pour-flush toilets said that they would rather have a cistern flush toilet. Yet, more than half of these respondents had earlier indicated that they were happy with their current facilities. Out of a total of 61% of the respondents that are happy with their current facilities, 8% would like to upgrade their pour-flush toilets to cistern flush toilets, and 1% would rather have an Ecosan[40] toilet.

5.1.3. Survey Conclusions and Discussion

Overall access to sanitation is very high, with 95% of the houses surveyed having one or more private toilets, and only 5% of the houses not having a private toilet. Only two houses admitted to defecate in the open (0.4%), and the others were either using public toilets or toilets of their neighbours. In total 69 out of 2,869 people did not use their own facilities, including the 51 infants and small children too young to do so on their own

More than half of the toilets (57%) were constructed during the past ten years. In almost 90% of the houses, the households contributed towards, if not paid the total sum for installing these systems. In the remaining 10%, the households received, to a smaller or larger extent, external support. Considering that the median costs were found to be LAK 1.8 million (US$ 220), households are making considerable investments and it shows that people are willing to make this kind of investment.

The majority of households use toilets that rely on water for flushing (cistern flush or pour-flush toilets). Most latrines are connected to some sort of onsite septage storage pit or tank for containment of excreta. Only a small percentage of the toilets were connected via a small-bore sewer to a communal septic tank or interceptor tank. Only one toilet was found to be directly connected to a storm water drain. Basically three types of household sanitation facilities were observed:

1) Flush toilets located directly above a pit (49%)

This is the most common type of onsite sanitation system. They are the cheapest and are therefore used by the poorest households who use prefabricated concrete pipe sections or oil drums with perforated bases to contain excreta in a pit directly located underneath the toilet. The construction of the latrine itself as well as the superstructure is generally poor.

2) Flush toilets connected to one or more offset pits or tanks (26%)

This is the second most common type of onsite sanitation system because of its ease of construction and low cost. Most of these toilets are constructed by using prefabricated concrete pipe sections of 0.75 metre diameter. Sometimes basic rectangular tanks are constructed instead as the volume of single pits are considered to be too small. No special construction skills are required. They are installed by the households and the floor of the toilet is often raised above the ground level to prevent the entry of storm water.

Generally, no soakaway system is constructed and the pit fills up rapidly, requiring regular empting. No so-called alternating offset pits were observed. Where two offset pits exist, the second pit is often constructed at a later stage to increase the storing capacity and thus reduce the frequency of pit emptying.

3) Flush toilets connected to septic tanks (22%)

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[40] Ecological sanitation (ecosan) is a new paradigm in sanitation and recognises human excreta and household wastewater as resources that can be recovered, treated where necessary and safely reused. In ecological sanitation urine and faeces are separated at source and are not mixed with water. Hence this sanitation solution avoids the contamination of large volumes of water with pathogens. Ecosan systems enable the recovery of nutrients contained in excreta and wastewater, and their reuse in agriculture. In this way, they contribute to improved soil fertility and food security, whilst minimising the consumption and pollution of water resources. They also have the potential to produce renewable energy from biogas systems. Sources: http://www.ecosan.nl and http://www.gtz.de/en/themen/8524.htm

This is the third most common type of onsite sanitation system. Septic tanks consist of a sealed tank into which excreta and wastewater is flushed from a conventional cistern flush toilet or a pour-flush toilet. The tank acts as a settlement unit in which solids settle out by gravity and the solids undergo a process of anaerobic decomposition, which results in the production of water, gases, sludge and a layer of floating scum. Some septic tanks are connected to a soak pit to dispose of effluent, but many are expected to discharge effluent directly on the surrounding surface or to storm water drains.

Only about a quarter of the septage storages constructed after 1995 were septic tanks. This is a remarkably low figure considering the fact that the local building regulations require the installation of septic tanks. The VIUDP post-project BME[41] study revealed that in 2001, only 14% of the households surveyed had flush toilets connected to septic tanks.

Roughly two-thirds of the toilets were considered to be constructed in a durable manner. Toilets inside the house were relatively more often observed to be durable, than detached toilets. In general, toilets with walls constructed of masonry, and roofs made of roofing sheeting were considered durable. Some 60% were happy with their sanitary facilities, whereas 17% were not happy. Relatively more households with a toilet evaluated as durable were happy with their facilities than those with non-durable structures.

Although it was not feasible to carry out individual inspections of septic tanks, which is the only reliable way to evaluate the operation of septic tanks, the survey highlighted some serious concerns. Septic tanks are to be inspected regularly and desludging of septic tanks is recommended once every 2 or 3 years, but roughly half of the septic tanks had never been emptied. Others are cleaned more regularly at considerable expense to the owner. In many cases, poor maintenance or a lack of timely emptying leads to irreversible clogging of the up-flow anaerobic filter, especially during the wet season when rising ground waters inhibit the infiltration capacity of the soil, leading to failure of the septic tanks. Only a very small portion of the households inspect the contents of septic tanks regularly, whereas a vast majority of the households wait till it fills up or when toilet gets blocked or does not flush properly. Regular inspection and desludging activities are also hampered by a lack of proper manhole covers. Although three-quarters of the septage storages have some type of opening for emptying, many of these openings are too small for proper inspection or checking of the contents.

Toilets constructed in flood-prone areas or areas with high groundwater tables do not operate effectively and are expected to discharge sewage into stormwater drains or onto low-lying areas. The main problem associated with the septage storages, especially in the low-lying areas, is that they fill up with groundwater during the wet season. As groundwater is only 0.5 m from the surface in low-lying areas in Vientiane (GHK, 2001). Almost one third of the houses had experienced flooding during the past ten years, with a quarter of the houses being affected by annual flooding. This is higher than the 16% reported by ADB (2002)42. To prevent water from flowing into the toilet, slightly more than one third of all toilets were raised. Of the 207 toilets located in premises that flood regularly, 63% are raised well above ground level. Almost all the problems that were cited by the households, related directly or indirectly to high water tables.

The capacity of soil to absorb liquids with a high organic content such as human wastes varies according to its physical properties. Low permeability soils absorb lower volumes of effluent than more porous soils per unit area of soil. As water use increases infiltration rates increase and many soils, particularly those with a high clay and silt content, will block. The low permeability of the soil further deteriorates over time as fine particulars filter through and get deposited in the soil. Low permeable soil is a problem for onsite sanitation systems that dispose subsurface effluent and, eventually as surrounding soils cease to absorb the effluent, causing the function failure to the systems. As a consequence, polluted effluent starts to overflow from the septage storage and pollutes surface waters.

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41 A Benefit Monitoring and Evaluation (BME) study, covering 250 households in 32 urban villages, was carried out during the project completion report preparation for the Vientiane Integrated Urban Development Project (VIUDP). (ADB, 2002)

42 The VIUDP BME study reported that in 2001, the number of flood affected households decreased to 16% with an average depth of about 26 cm, from 21% reported in 1996.

With regards to the physical properties of the soils in Vientiane, GHK (2001) quotes from two sources of information. The "Improvement of Sanitation Works – Feasibility Study" of 1988 revealed that in the higher locations, the results showed presence of a more sandy soil and a lower groundwater level in some parts. In the lower locations, the tests showed high percentage of silt clay soils, with low soil permeability and low percolation rates, and a higher groundwater level. The "JICA Feasibility Study on Improvement of the Vientiane Drainage System" of 1990 revealed that in general the surface layer is clay loam up to a depth of 1 metre, below this a gravel clay loam up to a depth of 7 metres, and below this a sandy gravel and silt layer.

Despite the wide application of sanitation systems by the residents of Vientiane, sanitation and environmental problems continue to occur due to poor design, poor construction and a lack of maintenance. Onsite sanitation systems are a potential source for surface water and groundwater contamination in the immediate vicinity of households. This may in particular constitute a health hazard in areas with high population densities, high groundwater tables, and where the permeability of soil is low. The design of a majority of the existing onsite sanitation systems does not address the physical constraints relating to topographical and soil conditions.

ADB (2002) reported that groundwater quality had been deteriorating between June 1998 and December 2001, "probably because more people now live in Vientiane and contaminate the groundwater through faulty human waste disposal systems". With regards to surface water quality, JICA (2010) reported that judging from the coliform number observed at main stream or tributaries of Hong Ke and Hong Xeng, the stream is dominated by domestic and commercial wastewater. In November, at the downstream end and tributaries of Hong Ke or Hong Xeng, total/faecal coliform numbers were detected in the order of 10 million MPN/100 ml or more. Only one out of 15 water quality monitoring points met the surface water quality standards (less than 5,000 MPN/100 ml of total coliform and less than 1,000 MPN/100 ml of faecal coliform). In general, BOD levels were not so high, ranging from about 10 mg/l to less than 30 mg/l, although BOD levels were higher in November and December than in June. This can be explained by the fact that during the dry season the volume of water available in surface water bodies to dilute domestic (and commercial) wastewater is significantly less than during the wet season.

Sanitation facilities do not automatically lead to improvements in health. The effect of sanitation improvements on health will be limited unless they are accompanied by efforts to improve hygiene practices. The fact that only 40% to 48% of the toilets were clean, depending on whether this was judged by the enumerators or the respondents, does not bode well. Good hygiene also requires water and soap in or in the vicinity of the toilet so that people can wash their hands after defecating. However, half of the households did not have soap available for washing hands, and even more were without a specific facility for washing hands. In 42% of the toilets there was neither a place nor soap for washing hands.

5.2. Results of the Dormitories Survey

A survey of multiple occupancy accommodation, focusing on dormitories, was conducted in a selected number of locations in Vientiane Capital. The survey of sanitation facilities at dormitories was conducted during the month of August 2010. A total of 10 dormitories were visited and interviewed to assess the following:

- the perceived adequacy of the sanitary facilities provided;
- arrangements in place for cleaning and maintenance of the facilities; and
- any problems with functionality.

The results of the survey will be discussed in the following sections.

5.2.1. Methodology

Sampling methodology

No sophisticated or scientific sampling methodology was used for this small-scale survey. The survey was organised in such a way that a number of different types of multiple occupancy accommodation would be

included. Basically only one selection criteria was applied, namely: ownership. The intention was to identify and select dormitories that would give us as much as possible a representative sample of dormitories under different ownerships. As a consequence the following dormitories were considered and wherever approached:

1. Dormitories owned by Government institutions such as universities and hospitals;
2. Dormitories owned by special Government agencies such as the armed forces; and
3. Dormitories owned by private individuals and/or private companies.

Given the fact that little is know about the number and locations of dormitories in Vientiane, dormitories were identified through a number of different means. First of all, during the household survey a number of potential locations had been identified. Secondly, in discussions with VUDAA staff a number of locations had been suggested, and finally, the household survey enumerators, having graduated from University only recently, had some idea about possible locations.

No specific sample size had been mentioned in the Terms of Reference. As this survey is only an additional and minor part of the rapid assessment, a total sample size of 10 dormitories was determined. Furthermore, it was decided to select locations in the same four urban districts covered by the household survey.

Data collection, data entry and analysis

The survey was executed in more or less the same way as the household survey. It consisted therefore of semi-structured interviews and observations. A survey questionnaire was developed on the basis of the requirements specified in the Terms of Reference. Dormitories were included in the survey and its sanitary facilities inspected only after obtaining permission by the owner or its representative. Pictures were taken of all toilets and septage storages for cross verification between the findings and visual evidence. One enumerator team, composed of one experienced male and one female enumerator, was trained. The survey was conducted in a period of two weeks.

One survey supervisor was responsible for organising and managing the survey. This person trained, guided, coached and supported the enumerators. The survey supervisor was in daily contact with the team to ensure that appropriate locations were selected and that any issues with the approach and questionnaire could be resolved immediately.

Given the limited size of the survey, data entry and analysis of the collected data was performed with the help of Microsoft Excel software. Data cleaning and data analysis was performed by the author of this report. Data are presented, wherever appropriate, in graphs and charts. Qualitative information from open questions has been categorised and summarised in the report.

5.2.2. Findings

The main findings of the dormitory survey have been summarised in Appendixes 14.1 to 14.4. The findings in these appendixes have been presented for each individual dormitory.

General information

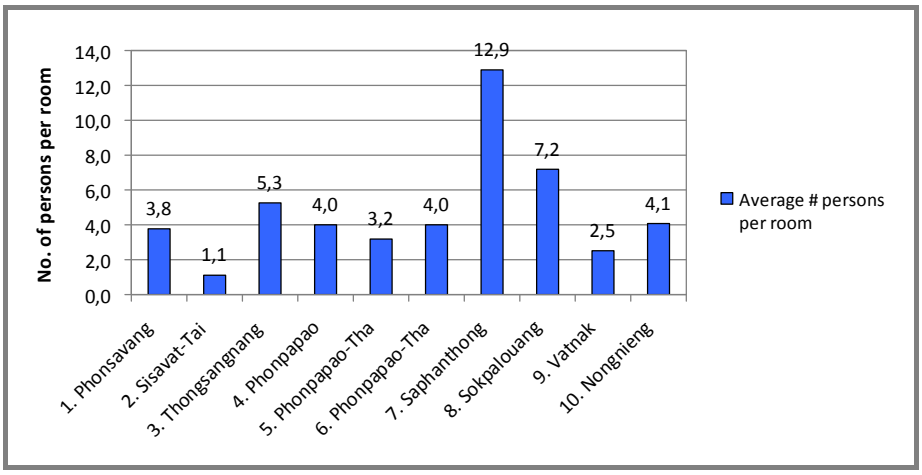
The survey covered ten dormitories with different ownership and different type of occupants. During the actual selection of possible survey locations it was discovered that quite a number of owners were not interested to participate in the survey. In the case of army and police dormitories, security concerns were often given as a reason. The reasons given by private individual dormitory owners or private companies were not always clear. The enumerators thought that the state of the sanitary facilities might have something to do with it.

The breakdown of ownership for the ten dormitories can be summarised as follows: 1) Government owned: 5; 2) state-owned: and 3) privately owned: 2. The Government owned dormitories were occupied by teachers, students and hospital employees. The state-owned dormitories were occupied by army and police

recruits and by employees of a state-owned electricity company. The privately owned dormitories were occupied by factory workers. The smallest dormitory consisted of one building with two floors, and the largest dormitory consisted of five separate buildings with each three floors. Two dormitories were constructed during the French colonial period, and five dormitories were constructed between 1979 and 1995. The age of one of the dormitories could not be established.

For each dormitory one building was selected for the actual survey. A total number of 1,277 persons are staying in the 10 dormitory buildings included in the survey. The average number of rooms per dormitory building was 27, with a minimum of 9 and a maximum of 80 rooms. On average 4.8 persons were staying in one room, with a minimum number of 1.1 and a maximum of 12.9 persons per room. Four dormitories were occupied by families. The remaining six dormitories were occupied by friends, peers and/or colleagues, of which three were female only dormitories.

Figure 5.13: Average number of persons per dormitory room



Toilets

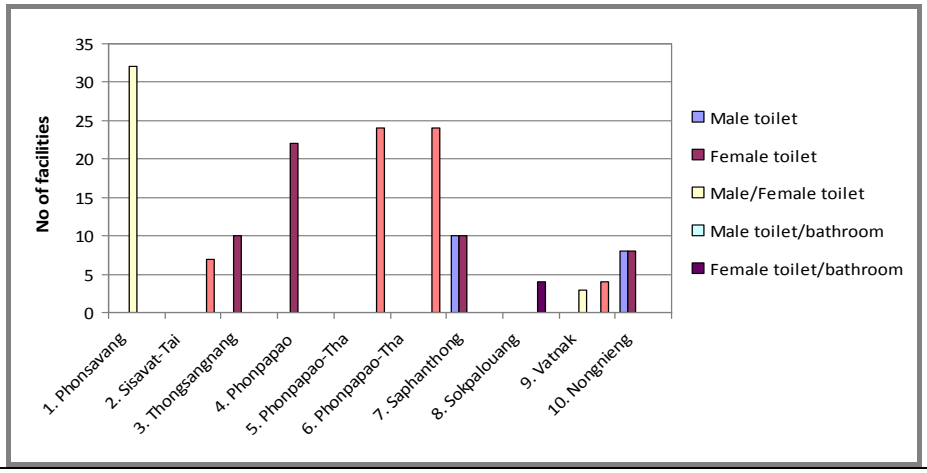
Six dormitories had toilets that were to be shared by the occupants, three dormitories had individual toilets for each room, and one dormitory had a mix of shared and individual toilets. At the latter dormitory, the first floor had individual toilets and the second floor had shared toilets. Two dormitories had cistern flush toilets, and the remaining eight dormitories had pour-flush toilets. There was one dormitory with three urinals for use by male occupants, but these had all broken down.

103 out of a total of 166 toilets were single toilets (62%), and the remaining 63 toilets were combined toilets and bathrooms (38%).

Table 5.8: Type and number of toilet facilities per dormitory

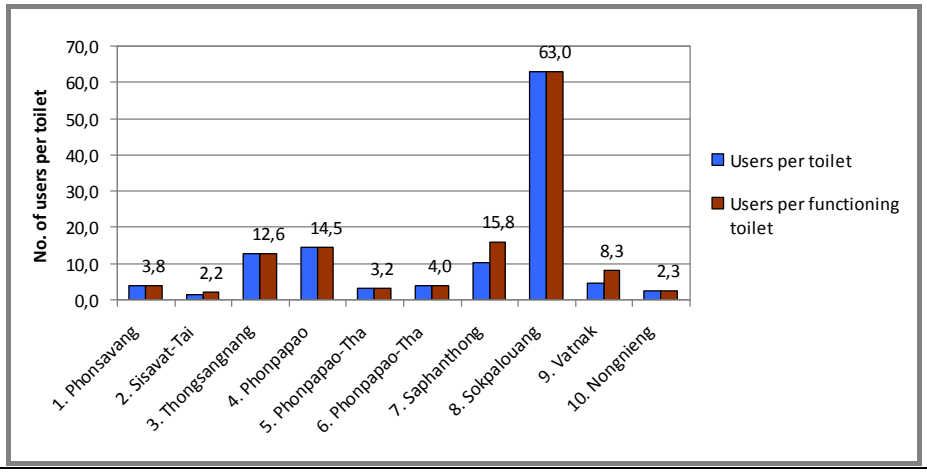
Dormitories	Toilets			Combined toilets and bathrooms			Totals
	Male	Female	Male / Female	Male	Female	Male / Female	
1. Phonsavang			32				**32**
2. Sisavat-Tai						7	**7**
3. Thongsangnang		10					**10**
4. Phonpapao		22					**22**
5. Phonpapao-Tha						24	**24**
6. Phonpapao-Tha						24	**24**
7. Saphanthong	10	10					**20**
8. Sokpalouang					4		**4**
9. Vatnak			3			4	**7**
10. Nongnieng	8	8					**16**
Totals	**18**	**50**	**35**	**0**	**4**	**59**	**166**
In percentages	*11%*	*30%*	*21%*	*0%*	*2%*	*36%*	*100%*
Grand totals	**103**			**63**			**166**
In percentages	*62%*			*38%*			*100%*

Figure 5.14: Type and number of toilet facilities per dormitory



Out of the total of 166 toilets, 12 toilets were found to be out of use. Using the 154 functioning toilets, the utilisation density was calculated. The average number of users per toilet facility ranges from a low of 2.2 persons at the Lao Youth Union dormitory to a high of 63 persons at the Polytechnic College students dormitory. The calculated median number – or middle observation – was found to be 6.1 users per toilet.

Figure 5.15 Average number of users per toilet



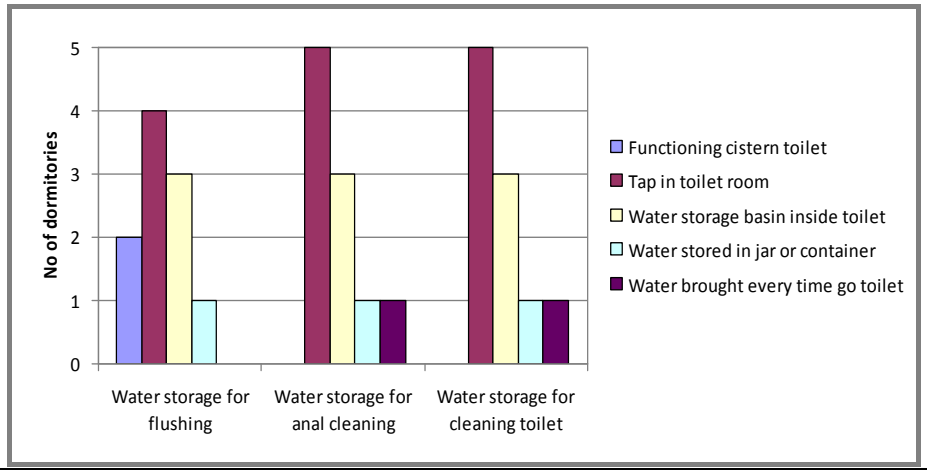
Water availability in toilet

With regards to water availability for flushing the toilet, two dormitories had functioning cistern flush toilets where toilets had a direct connection between the water pipe and the toilet, four dormitories had toilets where water from a tap located in the toilet was used for flushing, and the other four dormitories had either storage basins (3) or water jars or buckets (1) placed in the toilets which were used for flushing.

In all dormitories water was available for anal cleaning. In five dormitories water was available from a tap located in the toilet, four dormitories had water stored in either storage basins (3) or water jars or buckets (1), and the toilets in one dormitory (ironically one of the dormitories with cistern flush toilets) did not have any source of water in the toilets. Users were expected to bring water from outside every time they used the toilet.

Not surprisingly, the water sources used for cleaning the toilets was exactly the same as the water source used for anal cleaning.

Figure 5.16: Water availability in toilets



Washing hands

During the toilet observations, in three dormitories a specific place or facility for washing hands was seen inside the toilets, and in one dormitory a specific place or facility was seen immediately outside the toilets.

This means that in six of the ten dormitories no specific place or facility for hand washing was found. Soap was observed in or in the vicinity of toilets in just two dormitories. These are the two teachers' dormitories that had individual toilets for each family room. Summarising, only two dormitories had toilets with both a place and soap for washing hands after toilet use.

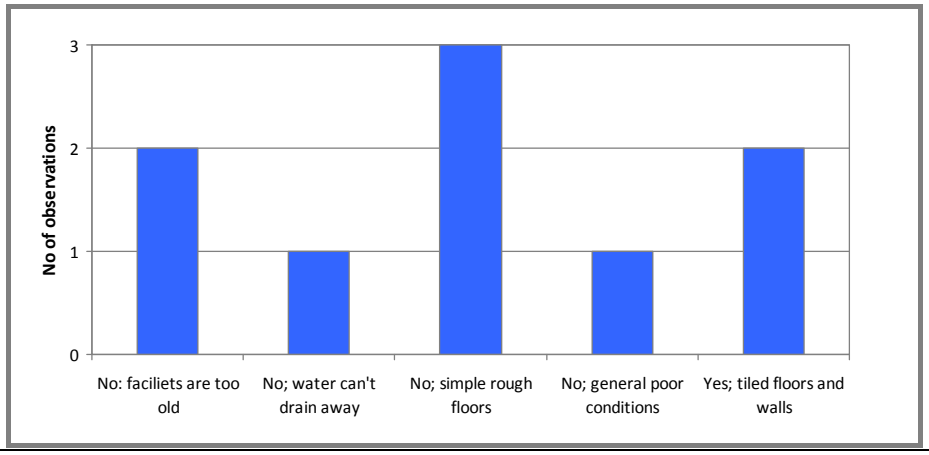
Hygiene and cleanliness

An attempt was made to get an understanding of the cleaning arrangements put in place in the different dormitories. In two of the ten dormitories the owners were responsible for making sure that the toilets were cleaned regularly with the actual cleaning work being carried out by paid housekeepers/cleaners. In the other eight dormitories the occupants were responsible for keeping the toilets clean. In three of these dormitories no specific cleaning rules had been set or cleaning arrangements been made. Users were expected to clean the toilet after use! In the remaining five dormitories some kind of cleaning arrangements had been adopted where the users took turn to clean the toilets. In none of the ten dormitories were residents paying any fees for toilet cleaning and maintenance.

The enumerators were asked to give their opinion on whether it was easy to keep the toilets clean. The enumerators concluded that in two dormitories the toilets were easy to clean, in seven dormitories the toilets were not easy to clean, and in one dormitory it was defined as "questionable". Reasons are shown in the following chart.

Similarly to the household survey, both respondents and enumerators were asked to rate each toilet for its cleanliness. The respondents in one dormitory thought that their toilets were clean, respondents in two dormitories thought that their toilets were not clean, and the respondents in the remaining seven dormitories judged their toilets as "neutral" – neither clean nor dirty. The enumerators judged slightly different, with none of the dormitories as having clean toilets, the toilets in three dormitories were found to be "not clean", and the toilets in the remaining seven dormitories were found to be "neutral". The respondents and the enumerators agreed on the cleanliness rating in six out of the ten dormitories.

Figure 5.17: Reasons why enumerators judged toilets to be easy to clean or not

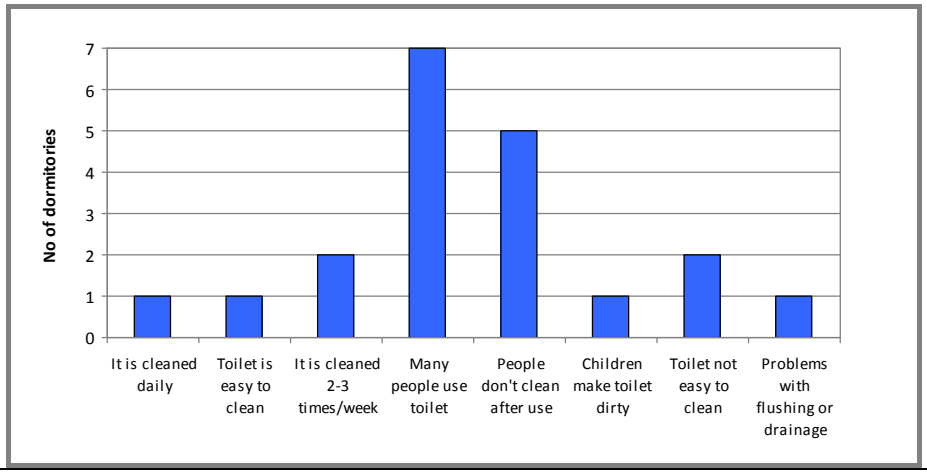


Reasons cited by the respondents why they thought their toilet was clean or not can be categorised into two broad groups: those related to cleaning, and to the people using the toilet. Only in one dormitory

respondents answered that they cleaned the toilets daily, and the respondents in two other dormitories answered that their toilets were cleaned 2 to 3 times per week. The respondents in one dormitory answered that their toilets were easy to clean, whereas the respondents in two dormitories answered that their toilets were not easy to clean. Respondents in seven dormitories mentioned that their toilets were used by too many people, and respondents in five dormitories mentioned that the toilets were not cleaned after use. Surprisingly the two teachers' dormitories with individual toilets were judged as either "neutral" or not clean by the enumerators, whereas the respondents thought they were okay (neutral).

The respondents of the dormitory, who judged their toilets as clean, thought that was because their toilets were easy to clean. The respondents of the two dormitories, who judged their toilets as not clean, thought that was because there were too many people using the toilet, with one dormitory having 12.6 users and the other having 63 users on average. Interestingly, the dormitories with on average only 2.2 and 2.3 users per toilets, and who judged their toilets to be "neutral", thought that their were too many users per toilet.

Figure 5.18: Reasons why respondents judged their toilets to be clean or not



In eight of the ten dormitories, the enumerators observed green moisture, caused by wet conditions, on the floors and walls in a majority of the toilets. The enumerators also observed that the toilets in five dormitories were having problems with bad smells, and in one of those dormitories flies were found in the toilets. Three of the five dormitories who had toilets with bad smells, were judged as not clean by them.

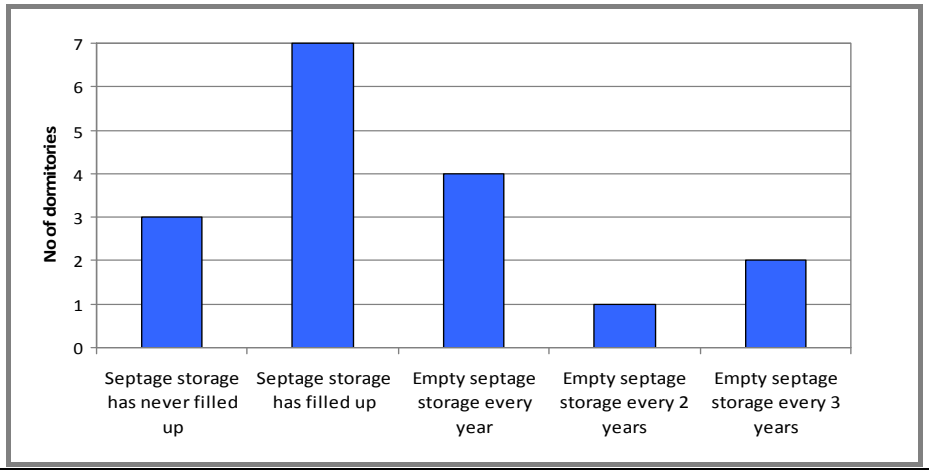
Septage storage

Most toilets and septage storages were built at the same time as the dormitory building. For six dormitories the toilets and septage storages were built in the same year as the dormitory, for three dormitories this information was missing, and for the remaining dormitory the toilets and septage storages appear to have been built later than the original dormitory.

Eight of the dormitories had some sort of septic tanks, and two had offset pits that were used to store the septage. One dormitory had had to build three alternative toilets with direct pits outside after a number of the originally constructed toilets with septic tanks ceased to function effectively.

Three of the eight dormitories had septic tanks (constructed in 1980) that had never filled up. The seven other dormitories had septage storages that had filled up regularly. Four of them were emptied annually, one was emptied once every two years, and the two were emptied once every three years. Five of the seven had been emptied during the past year. All the septage storages that had filled up had been emptied by a sludge removing vacuum truck.

Figure 5.18: Emptying of septage storages



Operation and maintenance

An inventory was made of the type of problems users had experienced with the sanitary facilities. Users in eight out of the ten dormitories had experiences one or more problems in the past. Users in two dormitories had not experienced any problems or were not aware of any. Users in six dormitories were complaining about regularly blocked pipes. In two of these six cases it was said that the blocking of pipes was caused by sanitary napkins used by the female users and thereafter disposed in the toilets. The problem of blocking pipes was resolved in one dormitory by replacing the pipes every three months, in the other five dormitories the problem was resolved by manually unblocking the pipes. In four dormitories, the users complained that the septage storages filled up too quickly. In three dormitories this problem was resolved through regular emptying, and in one dormitory this was resolved by installing a new sewer pipe. The residents of the Lao Youth Union complained that the toilets on the second floor of the dormitory building often did not have enough water. As there was little they could do about this problem, they opted for using the toilets on the first floor.

5.2.3. Conclusions and discussions

Although the exact numbers of dormitories in Vientiane is not known, it must be mentioned that the sample consisted of a relatively small sample. Hence, utmost caution will be taken in the following paragraphs not to generalise the findings of this survey.

The dormitories are relatively old. Two of them were – one for the Lao Youth Union and one for the EDL employees – constructed during the French colonial period and the most recent one built for the Hospital 103 nursing school constructed during 1995. This means that the average age of the ten dormitories is over 30 years old! The age, combined with generally inadequate maintenance, is likely to have a bearing on the conditions of the sanitary facilities. Even so the number of non-functioning toilets was relatively low (7%).

In general, the cleaning arrangements put in place appeared to be inadequate. Where this was the owners' responsibility in two dormitories and the residents were responsible in the other eight dormitories. No effective cleaning arrangements or rules had been put in place other than that in five dormitories residents were "taking turns" to clean the toilets. The toilets in the dormitory used by factory workers, where the owner was responsible for cleaning arrangements, was judged the cleanest. The toilets in the Sokpalouang students' dormitory, where again the owner was responsible for cleaning arrangements, was judged as the most unclean. This was however the dormitory with the highest number of users per toilet. Although one may expect otherwise, the dormitories with individual toilets per family room did not do much better than the dormitories with shared toilets. Likewise the dormitories with only female residents did not do much better – or maybe even worse – than the dormitories with toilets that were used by both sexes.

Another factor for the overall conditions of the sanitary facilities concerns the actual number of users per toilet. In four out of the ten dormitories the average number of users was in excess of 10 users per toilet, with an unbelievable 63 users per toilet at the Sokpalouang students' dormitory.

Table 5.9: Summary of toilet facilities per dormitory

#	Dormitory	% of functioning toilets	Average # of users per toilet	Rating of easiness to clean by enumerators	Rating of cleanliness		Handwashing facilities	
					By respondents	By enumerators	Handwashing place	Availability of soap
1	Phonsavang	100%	3,8	Questionable	Neutral	Neutral	No	No
2	Sisavat-Tai	71%	2,2	Not easy	Neutral	Neutral	Yes	No
3	Thongsangnang	100%	12,6	Not easy	Not clean	Neutral	No	No
4	Phonpapao	100%	14,5	Easy	Clean	Neutral	Yes	No
5	Phonpapao-Tha	100%	3,2	Not easy	Neutral	Neutral	Yes	Yes
6	Phonpapao-Tha	100%	4,0	Not easy	Neutral	Not clean	Yes	Yes
7	Saphanthong	65%	15,8	Easy	Neutral	Neutral	No	No
8	Sokpalouang	100%	63,0	Not easy	Not clean	Not clean	No	No
9	Vatnak	57%	8,3	Not easy	Neutral	Not clean	No	No
10	Nongnieng	100%	2,3	Not easy	Neutral	Neutral	No	No

Four of the ten dormitories scored quite poorly, with either the respondent or the enumerators judging the toilets as "not clean". Three of these four dormitories also did not have any specific place/facility or any soap available for the washing hands after toilet use. Handwashing facilities and soap in or nearby toilet facilities were observed in only two of the ten dormitories.

Considering the fact that we were not allowed to visit a number of other dormitories – likely because the owners judged their toilet facilities below par – could mean that we have not even seen the worst possible toilet facilities in Vientiane. In the course of this rapid assessment we have not been able to ascertain whether any government agency is tasked with the responsibility to regularly check health (e.g. sanitary and hygiene) conditions at dormitories or other multiple occupancy accommodation. However, given the conditions observed in the ten dormitories that were included in this survey, it might not be a bad idea if some institution takes up this responsibility.

6. Ground Water Quality

Two additional surveys were undertaken as part of the overall rapid assessment, (i) a survey of ground water quality to assess the risk of contamination from sanitation facilities, and (ii) a sampled survey of available construction materials retailers and materials costs used in constructing sanitation facilities.

6.1.1. Ground Water Quality

A total of 66 water samples were collected from 33 locations (see appendix 16 for locations and water quality analysis results) inside the rapid assessment study area. In discussions with VUDAA and district authorities sampling sites were generally located in villages corresponding to the villages where household interviews were undertaken. A number of the sample survey villages had no reported ground water sources in use or available so a number of alternative locations were also used. Many of the sampling sites were located in temples as these often had wells constructed in the past.

Arrangements were made with two institutions to undertake the ground water samples collection and analysis, namely:

1. The National Centre for Environmental Health and Water Supply (Nam Saat) of the Ministry of Health collected samples to be tested for compliance with the National Drinking Water Quality Standards (as per the MoH Decision # 1371/MoH dated 04/10/2005.
2. Chinaimo Water Treatment Plant Laboratory, Nakhoneluang, "Nam Papa Vientiane" collected samples to be compared against the "Wastewater Discharge Standards from the Urban Area (5.5) Table 5.5.1 Wastewater Discharge Standards; as per the Agreement on the Natural Environmental Standards Vientiane Capital 2010, following Instruction #2734/PMO/WREA dated December 7 2009)[43]

The sets of samples were compared against two different water standards (see appendix 17) one related to public health the Drinking Water Quality Standards. While the second related to the waste water discharges in urban areas.

The drinking water standard lists a number of priority parameters, 12 of these 13 priority parameters were tested for. The parameter for residual chorine was not tested for as this refers to treated water in urban piped water systems

For the environmental water quality standards, the waste water discharge parameters were used. This has numerous parameters of which 7 were tested for (see appendix 17) as others parameter related to the discharge of specific substances, unlikely to be found in domestic waste water. The wastewater standards also use a sliding scale of permitted waste water releases dependent on the size and used of releasing sources (buildings). In general all samples corresponded with requirement for category D of waste water standards. The Nam Papa laboratory was also asked to test the samples for the presence for thermo-tolerant coliform to try and allow for some comparison between the two sets of samples.

6.1.2. Key Findings-re Drinking Water Quality Standards

In terms of compliance with the National Drinking Water Standards and of greatest interest to the rapid assessment was the risk of and or evidence of ground water contamination by thermo-tolerant coliform (faecal). The national standard use a coliform index[44] for thermo-tolerant coliform and is set at 0 colony forming units (CFUs) per 100 millilitres of water. From the reported analysis of the samples (Appendix 16)

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[43] Nam Papa Vientiane was used as the pollution control section of WREA were unable to organise water quality testing and recommended the use of Nam Papa instead

[44] A **coliform index** is a rating of the purity of water, based on a count of faecal bacteria. Coliform bacteria are microorganisms that primarily originate in the intestines of warm-blooded animals. By testing for coliforms, especially the well known E.Coli, which is a thermo tolerant coliform, one can determine if the water has probably been exposed to fecal contamination; that is, whether it has

☛ **31 out of the 33 tested samples (94%) reported the presence of thermo-tolerant coliform, with levels of contamination ranking from low to intermediate risks** *(based on the World Health Organisation's (WHO) (1997) Guidelines for drinking-water quality (2nd Edition)- Volume 3- Surveillance and control of community supplies)*

Levels of contamination ranged from 0, 6% (2 samples) to 82 CFUs; with 42 % (14) of the samples posing a low risk while 52% (17 samples) posed an intermediate risk based on the WHO categories. (see tables below)

CFU Count per 100ml	Code & colour	# of Samples	% of Samples	Remarks
0	A (blue)	2	6%	In conformity with WHO guidelines
1–10	B (green)	14	42%	Low risk
10–100	C (yellow)	17	52%	Intermediate risk
100–1000	D (orange)	0	0%	High risk
>1,000	E (red)	0	0%	Very high risk
		33		

Table 6.2 WHO's Categorisation of Risk for thermo-tolerant Coliform

Count per 100ml	Category and colour code	Remarks
0	A (blue)	In conformity with WHO guidelines
1–10	B (green)	Low risk
10–100	C (yellow)	Intermediate risk
100–1000	D (orange)	High risk
>1000	E (red)	Very high risk

Table 5.2 Example of classification and colour-code scheme for thermotolerant (faecal) coliforms or E. coli in water supplies, WHO (1997) Guidelines for drinking-water quality (2nd Edition)- Volume 3- Surveillance and control of community supplies

6.1.3. Other Findings

Tested samples also failed a number of the other drinking water parameters,

- with 20 samples (61% either being below the pH parameter (where pH is a measure of the acidity of a solution) and being acidic in nature.

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come in contact with human or animal faeces. It is important to know this because many disease-causing organisms are transferred from human and animal faeces to water, from where they can be ingested by people and infect them. Water that has been contaminated by faeces usually contains pathogenic bacteria, which can cause diseases. Some types of coliforms cause disease, but the coliform index is primarily used to judge if other types of pathogenic bacteria are likely to be present in the water.

- Over a fifth of the groundwater samples 21%/7 samples exceed the permitted turbidity levels and were cloudy in nature in nature

	pH	Cond	Turbi	Test and Odour	Fe	Mn	NO_3	NO_2	As	F	T-Hard	erant Coliform
	6.5-8.5	<1000 uS/cm	<10 NTU	Accept	<1 Mg/l	<0.5 Mg/l	50 Mg/l	<3 Mg/l	0.05 Mg/l	1.5 Mg/l	<300 Mg/l	0/100 ml
Sample Exceeding paramenter	20	0	7	0	6	0	0	0	0	0	0	31
	61%	0%	21%	0%	18%	0%	0%	0%	0%	0%	0%	94%

- While just under a fifth of the samples (18%/6 samples) exceeded the permitted iron level.

6.2. Key Findings-re Environmental Water Quality Standards

The second set of samples, analysed by Vientiane's Nam Papa laboratory were compared against the wastewater environmental standards. Some samples breached at least two of the parameters namely for pH (45%/15 samples) and total suspended solids (3%/ 1 sample)

	pH	Sulfide (S^2)	COD_{Mn}	BOD_5	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Settle able Solids (SS)
Parameters	6-9.5	4	350	60	50	1500	0.5
33	15	0	0	0	1	0	0

It was observed that Nam Papa laboratory apparently used a different scale for BOD_5[45] the official parameter is 60 miligrams of oxygen per litre (mg/l) consumed during a five day incubation test (for category D of waste water discharge standards). While the analysis report from Nam Papa stated that the "Lao standard was 5 mg/l"? of which 10 samples exceed this level.

As mentioned above, the second set of samples were also tested for the presence of thermo-tolerant coliform. 82% (27 samples) were reported to show the presence thermo-tolerant coliform. 18% of Samples (6) indicated no presence of coliform. 27% (9 samples) posed a low risk with between 1-10 CFU present and Over half of the samples 55% (18) may pose an intermediate risk based on an analysis of the results when compared against WHO risk assessment matrix.

CFU Count per 100ml	Code & colour	# of Samples	Remarks
0	A (blue)	6	In conformity with WHO guidelines
1–10	B (green)	9	Low risk
10–100	C (yellow)	18	Intermediate risk
100–1000	D (orange)	0	High risk
>1,000	E (red)	0	Very high risk
		33	

It should be noted that the reported analysis by Nam Papa for the presence of coliform may be under estimated, as the CFU count were halted after reaching 23 cluster forming units (CFU). The analysis report just states ">23"/100mls, so result could be higher.

[45] **Biochemical oxygen demand** or **BOD** is a chemical procedure for determining the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period. It is not a precise quantitative test, although it is widely used as an indication of the organic quality of water. It is most commonly expressed in milligrams of oxygen consumed per litre of sample during 5 days of incubation at 20 °C and is often used as a robust surrogate of the degree of organic pollution of water.

6.2.1. Conclusions and Discussions

The majority of samples (between 28-31 samples) collected and tested indicated the presence of thermo-tolerant coliform contamination. These were above the approved national standard of 0 CFUs/100ml of water, with most samples posing an intermediate risk to health if used for water consumption.

The presence of coliform bacteria which primarily originate in the intestines of warm-blooded animals, enables one to determine if the water has probably been exposed to faecal contamination. In that it has come in contact with human or animal faeces. Luckily none of the sampling points were reportedly in used for drinking water consumption purposes now, as respondents at locations reported using bottle water for drinking and piped water for most other uses.

6.3. Construction Materials Survey

A sampled survey was undertaken of 16 locally based construction materials suppliers distributed across the four districts making up the VUDAA and the rapid assessment study area, with four enterprise/ businesses being surveyed in each district.

Data on the cost and stocking of a range of material (35 items) commonly used in construction of sanitation facilities was reported on (see appendix 18 for maximum median and minimum prices reported and stocking count).

In terms of sanitary pans 13 out of 16 enterprises reported stocking pour flush ceramic pan usually manufactured in Vietnam, The median reported cost was 50,000kip (US$ 6.2) per unit with a reported maximum price of 60,000 Kip (US$7.5). Cistern flush toilets were also available with 10 out of the 16 enterprises stocking them, These were either manufactured in Vietnam (4 retailers) or Thailand (10 retailers) with prices ranging from 442.000-728,000 (US$55-90.5) for a cistern and toilet set. Median prices were 446,000 Kip (US$55.5) for a Vietnamese manufactured model to 562,000 Kip (US$69.9) for a Thailand sourced model.

No cost effective sanitary pans or toilets (such as plastic, fibreglass or concrete) were reported as being available, when these were asked about.

In terms of simple sub-surface sanitary components, pre-cast concrete rings are available though often they are not stocked by many of the retailers, in fact only 1 of the 16 retailers had precast rings in stock. The businesses reported they usually just order rings from concrete fabricator located outside of the study area often on the periphery of the city. Rings were reported as being available in a range of sizes with reported diameter ranging from 80 cm-150 cm with a standard height of 50 cm. Prices ranged from 65,000Kip (US$8.1) for a 80cm diameter ring to 85,000 Kip (US$10.6) for a 120 ∅ ring, 150 ∅ rings are available but no price was quoted.

In terms of constructing septic tanks; brick and block and concrete are usually used again the city retailers often did not stock these; but could order them from fabricators outside of the study areas only 2 of the retailers had brick available; 7 had concrete block while all 15 sold cements . The price for a brick was 300 Kip (US$0.04); while concrete blocks were 1400 Kip (US$0.20), cement for concrete was readily available with prices ranging from 35,000 Kip to 41,000Kip (US$4.4-$5.1) reportedly for 50kg bags, while a cubic metre of 1:2 aggregate was reported at 120,000Kip (US$14.9).

Data on other materials was also collected mainly relevant to superstructure construction including PVC pipes; roofing materials; reinforcement bars; precast concrete columns! often used in superstructure construction (and which sadly lead to the inflated construction costs).

7. Conclusions and Recommendations

7.1. Conclusions

In the urban areas of Vientiane, the existing onsite sanitation systems are, if not already to a certain degree, expected to compromise public health as well as the overall quality of the environment in the near future. Despite high sanitation coverage as a consequence of the wide application of onsite sanitation systems by Vientiane's citizens, health and environmental problems exist due to poor design, poor construction combined with a lack of maintenance. Onsite sanitation systems are a potential source for surface water and groundwater contamination.

In the absence of centralised sewerage systems, the choice for basic onsite sanitation systems is understandable, particularly considering that all the investments are to be incurred by the individual households, sometimes at considerable costs. However, this rapid assessment acknowledges that these systems are inadequate and do not function well in specific parts of Vientiane. Particularly in areas that are prone to seasonal flooding, areas with high groundwater tables, areas with high population densities, and areas where the permeability of soil is low.

It is obvious that the design of a majority of the existing onsite sanitation systems does not address the physical constraints relating to topographical and soil conditions. Untreated wastewater discharges either via storm water drainage systems into natural watercourses (including wetlands and marshes) in and around the city, or filtrates into the subsurface where it mixes with groundwater, resulting in heavy pollution and pathogenic contamination.

The underlying causes that have led to the present situation can be summarised as follows:

- ☒ Vientiane is growing rapidly and often in an unplanned manner, which has resulted in high population densities in the city centre and other commercial areas. During the next ten years, the population of Vientiane is expected to grow by almost 40% and whereas the population density in the city centre is expected to stay more or less the same, the population density in the surrounding areas is expected to increase by almost 50%.
- ☒ The drainage situation in Vientiane City has improved a lot since the late nineties, but drainage conditions are expected to worsen in future as sediment is accumulated in the drainage channels and thereby decreasing the flood flow area. Flooding in the urban area of Vientiane is not deep but frequent flooding is the cause for inefficiencies in onsite septic tanks and soak pits.
- ☒ The impact of past projects has been somewhat limited because only relatively small investments were made to improve sanitation conditions. Also little sustainability was built into project designs resulting in discontinued use of for example the sewer line and wastewater stabilisation ponds.
- ☒ Although environmental legislation has evolved quickly in the Lao PDR, the current legal framework is said to be often rather general in nature with limited specific reference to sanitation or wastewater issues. Inconsistencies have surfaced in different legislation as a result of different ministries leading the development of sectoral legislation. Principal inconsistencies include conflicting provisions, unclear or sometimes overlapping institutional mandates, lack of implementing regulations at the devolved level, and ineffective monitoring and control mechanisms to ensure compliance with environmental legislation.
- ☒ Sanitation has been neglected! One could easily get the impression that nobody is really in charge for urban (and rural) sanitation. As no single government agency has responsibility, there is no leadership on such important issues as policy, legislation, responsibilities and budget allocations. As a consequence policy and legal developments for sanitation has lagged, and has been overshadowed by, water supply.
- ☒ Government's ability to implement plans and achieve sanitation coverage targets depends almost entirely on project or programme financing by development partners because the government's

budget allocations for sanitation are woefully inadequate. It is evident that the development needs of the country exceed the funding capacity of the Government.

- ☒ The existing building regulation (No. 7681, dated 29 June 2005) has a number of shortcomings with regards to the standards set for onsite sanitation systems and there is no system in place to enforce actual compliance with official regulations and standards. The one-size-fits-all septic tank standard is not very helpful in increasing sustainable access to improved sanitation. Although septic tanks and other types of onsite sanitation might not function effectively in certain urban areas of Vientiane, cheaper alternatives that meet improved sanitation criteria might function very well in the sub-urban areas.
- ☒ Very little is known about the removal and disposal of sludge from on-site sanitation facilities. In the absence of public services, private service providers have emerged, but at present this business is completely unregulated. As a consequence some 1,100 to 1,500 m^3 of untreated or at best semi-treated septage is collected and hauled across the city each month unregulated and uncontrolled. There is also evidence of indiscriminate and illegal dumping of septage in the vicinity of Vientiane. Pure self-regulation by the private sector does not work without adequate oversight by the authorities.

7.2. Recommendations

Sanitation coverage in Vientiane City Lao PDR has made great progress in the past decade. This increase in coverage has been realised only because of the willingness of Vientiane's citizens to make investments to improve their health and living conditions. But because of the fact that sanitation has basically been neglected, much remains to be done.

Considering the magnitude and complexity of the existing problems, it will not be possible to make recommendations that will address all the key challenges. However, the study team has come up with a limited number of recommendations, to government and development partners, in order to safeguard public health and wherever possible improve overall environmental and living conditions in Vientiane City.

The priority areas to be addressed in the immediate and short-term are: 1) improvement of existing sanitation facilities; 2) installation of improved sanitation facilities at new locations; 3) development of an integrated system for septage collection, transportation, treatment, and disposal; and 4) execution of a public awareness campaign.

i. Encourage, and where necessary support, households to improve and maintain their existing onsite sanitation systems. In areas where this is technically appropriate, improvements should focus on ensuring the effective drainage of effluent by installing onsite seepage or leaching pits. These simple improvements will allow excreta and effluent to be stored separately, and this is expected to increase the infiltration rate of effluent in the soil. Support could be provided in the form of appropriate technical designs and advice.

ii. Provide more flexible standards and designs for onsite sanitation systems and ensure that they are developed by experts that understand the urban sanitation business. The choice of sanitation system should first and foremost depend upon the physical factors relating to topographical and physical constraints and density of housing. Not just on the willingness of Vientiane's residents to invest in improved sanitation. The rapid assessment has shown that it is not effective to propose a universally acceptable and affordable technical solution. Instead a number of technical options at varying cost are required to respond to the topography and physical constraints as well as to the different socio-economic status of Vientiane's citizens.

A similar approach to the VUISP sanitation strategy developed by GHK International LTD in 2001 (GHK, 2001) should be considered, where three different options were offered on the basis of their technical feasibility of the local physical conditions and affordability of the residents:

1) A low-cost option consisting of a single chamber septic tank connected to a seepage pit or to small-bore sewerage system. The tank and seepage pits can be constructed of prefabricated

concrete rings. UN-HABITAT developed a similar low-cost design for its small-town water supply and sanitation programme.

2) A medium cost option consisting of a two-chamber septic tank connected to a seepage pit or to small-bore sewerage system.
3) A high cost option consisting of a three-chamber septic tank with anaerobic filter for discharge of semi-treated effluent directly into the storm water drainage system or into a receiving watercourse.

iii. Provide technical options that can be improved or upgraded over time. Particularly for low-income households it is important that they invest in sanitation facilities that can either be upgraded or linked up to form a network in future.

iv. Start investing in community based systems for areas where onsite sanitation facilities can not function effectively. This is particularly relevant in poorly drained areas which are subject to flooding and poor soil permeability. The BORDA-LIRE piloted community based sanitation programme approach, which involves the installation of Decentralised Wastewater Treatment Systems (DEWATS), should be further tested on a much larger scale and also independently and objectively assessed for it cost effectiveness and user friendliness to ensure that actually can be community operated and managed. Additionally, the feasibility of constructing small-bore sewers in the central areas that link communal septic tanks or interceptor tanks to the existing EU sewer should be explored. Sustainability should be build into any programme by developing appropriate management and maintenance systems, and an adequate tariff structure that is based on the basic principle that the polluter pays.

v. Ensure that technical improvements are supported by adequate capacity building initiatives for implementing agencies. The focus should be on the development of appropriate technical responses to the prevailing physical constraints by enhancing the institutional capacity of VUDAA, Provincial Department of Public Works and Transport and District Offices of Public Works and Transport that are dealing with issues related to building regulations on a daily basis.

vi. Establish and enforce a clear legal and regulatory framework to administer and manage the safe collection, transportation, disposal and treatment or reuse of onsite sanitation septage. There is an urgent need to establish an appropriate legal and regulatory framework and also to create a regulatory regime that will ensure effective enforcement. The available evidence suggests that purely voluntary self-regulation by the private service providers has failed unless complemented by an appropriate "carrot and stick" policy.

vii. Make the necessary improvements to the septage waste disposal site at KM32 to serve as a magnet for private operators. This should be part of the "**carrot** and stick" policy. Minimal improvements should consist of a better approach road to the wastewater stabilisation pond and the provision of a designated place with reliable water supply for cleaning of vacuum trucks. Improvements at the disposal site will make it necessary, but also easier, to increase the current uneconomical fees.

viii. Investigate whether alternative or additional septage disposal and treatment plants need to be constructed. As the haulage of relatively small septage sludge volumes is considered inefficient and uneconomic –resulting in illegal dumping – haulage distances should be minimised by considering a system of decentralised waste management sites.

ix. Increase public awareness through effective environmental health and hygiene promotion campaigns. Improved sanitation facilities do not automatically lead to improvements in health. Therefore, investments in physical components should be complimented by campaigns to promote improved sanitation and hygiene behaviour (e.g. the washing of hands at critical times), health awareness, and awareness of the benefits of improved environmental health and waste management. The Provincial Department of Health and the District Offices of Health should take the lead by integrating these awareness raising campaigns in their ongoing "Model Healthy Villages" programme. Simultaneously, the verification and certification of "Model Health Villages", and in particular where this concerns access to 'hygienic' latrines, should be based on the WHO/UNICEF JMP definitions.

x. Because of the reported high prevalence of thermo-tolerant coliform contaminated ground water sources. Further and more regular investigation of the contamination risk is needed especially if households (even the 9% reported) are using ground water for their main sources.

The implementation of the above recommendations will be much more effective if the following two conditions are met:

1. Sanitation is no longer neglected by Government agencies and development partners. To be able to address the current and future sanitation and wastewater management needs of urban (and rural) areas, broad commitments are required including policies, capacities, resource allocations and innovative action. There is an urgent need for an effective legislative and institutional framework which is adequate for the prevailing national context, that can address the current and future development needs, and that the concerned institutions and agencies have the requisite resources to carry out or support the tasks required.

2. Consider developing a National Sanitation Policy to better guide the development of new or the revision of existing laws and regulations. This will also assist in the advancement of sanitation and hygiene service provision across the country. It is generally one of the roles of Government to provide sector leadership, and one of the methods of expressing this is through National Policy statements which can be accepted by sector actors and supporters and has been adopted by the Government as a whole. Such a statement should cover the Government's intentions and vision for the sanitation (sub-) sector, overall objectives, principles and advocated methods, clarifications of contested issues (e.g. demarcation of agency responsibilities; the use subsidies and fees), and methods of conducting monitoring and evaluation.

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Appendices

Appendix 1.1: Population of Vientiane Capital

		District totals (urban + rural)			Totals of Urban villages				
	District	**No of villages**	**No of households**	**No of people**	**No of villages**	**Urban villages as % of total**	**No of households**	**No of people**	**Urban population as % of total**
01	Chanthabuly	37	11.778	62.496	37	100%	11.778	62.496	*100%*
02	Sikhottabong	61	19.313	103.702	36	59%	9.869	54.492	*53%*
03	Xaysetha	52	17.830	93.362	39	75%	14.975	79.471	*85%*
04	Sisattanak	40	10.853	72.227	40	100%	10.853	72.227	*100%*
05	Naxaythong	56	11.472	59.316	13	23%	3.118	16.045	*27%*
06	Xaythany	104	26.511	150.479	30	29%	13.650	76.012	*51%*
07	Hatxayfong	60	16.801	80.568	41	68%	12.943	62.683	*78%*
08	Sangthong	37	5.777	27.589	1	3%	365	1.848	*7%*
09	Pak Ngum	53	8.129	45.143	4	8%	982	5.659	*13%*
	Totals	**500**	**128.464**	**694.882**	**241**	**48%**	**78.533**	**430.933**	***62%***

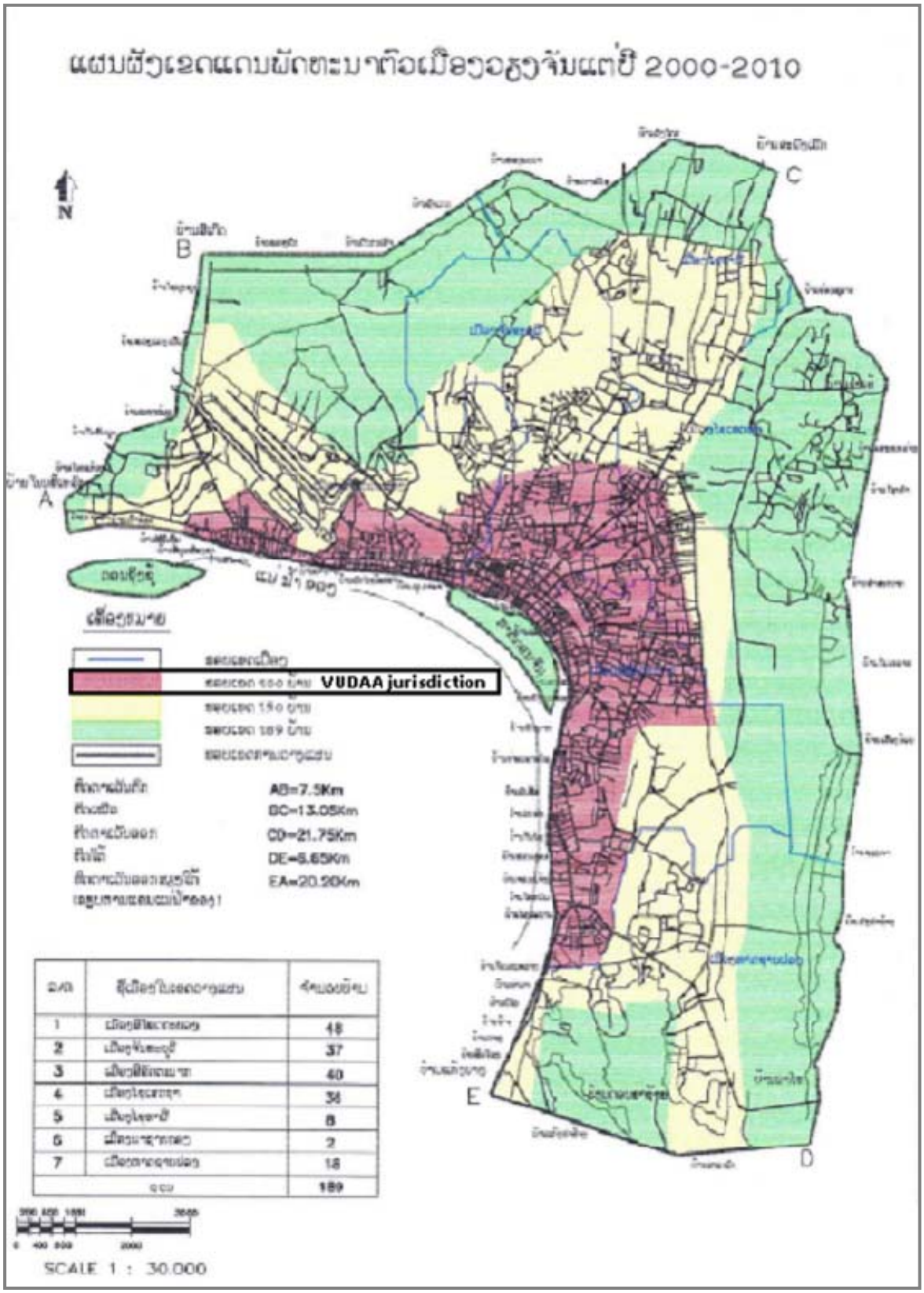
Source: Department of Planning and Investment (2008 data)

Appendix 1.2: Population of Vientiane Municipality

		District totals (urban + rural)			Totals of 100 VUDAA villages				
	District	**No of villages**	**No of households**	**No of people**	**No of villages**	**VUDAA villages as % of total**	**No of households**	**No of people**	**VUDAA population as % of total**
1	Chanthabuly	37	11.778	62.496	24	65%	5.317	29.022	46%
2	Sikhottabong	61	19.313	103.702	23	38%	4.950	27.832	27%
3	Xaysetha	52	17.830	93.362	17	33%	6.235	34.472	37%
4	Sisattanak	40	10.853	72.227	36	90%	8.905	60.652	84%
	Totals	**190**	**59.774**	**331.787**	**100**	**53%**	**25.407**	**151.978**	**46%**

Source: Department of Planning and Investment (2008 data)

Appendix 2: Map of Vientiane Municipality



Appendix 3: Overview of past projects

This appendix gives an overview of past projects that were implemented to improve infrastructure development, drainage and wastewater management in and around Vientiane.

Rehabilitation of Sihom area, UNCDF/UNDP, 1991-1997

The Vientiane Master Plan identified priority areas suffering from environmental problems related to poor drainage, household sanitation, and access to services such as waste management. The priorities of the project were:

- to improve living conditions of the population of the Sihom area through its rehabilitation and upgrading;
- to improve sanitation and storm water drainage along the Hong Pasak between the Mekong and the junction with the Hong Xeng stream; and
- to strengthen institutional and technical capacity of the Ministry of Communication, Post, Transport and Construction (MCTPFC, now MPWT) and the Institute for Technical Studies (ITSUP) to plan and implement projects to upgrade urban areas and to manage human settlements, using community participation for effective monitoring and operation.

One of the biggest successes of the project was the establishment of two village credit schemes: one revolving fund to improve housing; and one self-managed savings and credit scheme to improve small business and upgrade livelihoods. These schemes were managed by the national counterparts and by a United Nations Volunteer/SNV financed community development specialist.

The project improved the urban environment in the project area by improving the drainage network. Physical works have been completed as planned but with significant delays. The quality of the work was evaluated as reasonable, particularly considering the inexperience of the contractor and other local circumstances. Drainage, roads, water supply, electricity, solid waste management and the primary school were all provided. A recommended small bore sewerage system was excluded from the project due to technical problems as well as the expectation that the Asian Development Bank would take up the sewerage component.

Despite some serious project-specific management problems and delays, the project has successfully achieved its main objectives concerning institutional capacity building and the supply of infrastructure. The project was less successful in creating an institution within urban Vientiane that takes an overall leading role in urban management. In part, due to the change of the government executing agency but it must also be attributed to a serious underestimation of the requirements to achieve lasting institutional change. Furthermore, the sustainability of some project achievements, however, are at risk because necessary mechanisms for infrastructure maintenance and cost recovery have not been put into place, specifically: 1) operational and financial responsibility for the maintenance of the facilities created is not clearly defined; and 2) cost recovery aspects have not been dealt with as planned as the government has not applied or attempted to apply any form of betterment tax as the basis of cost recovery. (UNCHS, 1999)

Project costs	All amounts in US$
UNCDF	2,959,104
UNDP	2,200,025
Government of Lao PDR	310,500
Total project costs	5,496,629
Total expenditures at evaluation (Dec 1997)	4,964,703

Source: http://www.uncdf.org/english/local_development/uploads/evaluations/LAO-89-C01_Final.html

Wastewater Management of That Luang Marshes, EU, 1993

The That Luang Wastewater Management project was designed to improve wastewater treatment and drainage out of the central Vientiane area by constructing a trunk sewer main to intercept sewage from Hong Thong drain and to pump dry weather flows of wastewater to the waste stabilisation ponds at That Luang marsh.

The project built a system of stabilisation ponds at That Luang Marsh designed to serve an estimated population of 44,590 for 2005 with a per capita BOD of 45g/capita/day assuming 50% of the pollutant load would reach the treatment plant. A 2.8 kilometre trunk sewer main, including three pumping stations, was also constructed, intercepting sewage from Hong Thong drain to be pumped to the stabilisation ponds.

Since the completion of the EU project, the stabilisation ponds built as part of the project have gone unused for wastewater treatment. Although they were used as aquaculture (fish) ponds for some period they are now said to be completely out of use[46].

Vientiane Integrated Urban Development Project, ADB, 1996-2000

The overall objective of the Vientiane Integrated Urban Development Project was to improve access to basic services and infrastructure, thus providing benefits of urban environmental health to the population of Vientiane. The project supported the formation of the Vientiane Urban Development and Management Committee (VUDMC) to institutionalise urban planning and strengthen the development of the control system. The project consisted of the following components:

- Part A: Environment improvements (drainage, solid waste management and sanitation)
- Part B: Road infrastructure upgrading
- Part C: Social action program
- Part D: Implementation assistance and institutional strengthening

Overall, the project was rated successful in the project completion report. A number of primary and associated secondary drainage channels were improved with a total length of 23.6 kilometres. A socioeconomic beneficiary household survey of 250 households indicated that flooding (at least once a year) decreased from 21% in 1996 to 16% in 2001. Although the on-plot sanitation systems and improvement of neighbourhood roads were cancelled, the project's primary objective to improve the physical well-being and health of the population of Vientiane has been achieved.

An amount of 1.81 million US$ was earmarked for sanitation, however only 0.09 million US$, equal to some 5%, was actually spent as the onsite sanitation component was cancelled.

	Appraisal estimate in US$ million			Actual expenditure in US$ million			
	Foreign	Local	Total	Foreign	Local	Total	In %
Sanitation component	082	0.99	1.81	0.06	0.03	0.09	5%

About 2,250 septic tanks and 750 soak pits could not be built or upgraded as originally envisaged, because the targeted areas were low-lying and found technically inappropriate for installation, and most of the targeted low-income households were not interested in taking out a micro credit loan. Piped sewer needs to be installed in these low-lying areas. A wastewater stabilisation pond was constructed upstream of the European Union (EU) funded facultative wastewater treatment pond. The size of the wastewater stabilisation pond was reduced as the quantity of effluent sewage and sludge to be collected from pit latrines and septic tanks could be treated in the facultative wastewater treatment pond. The facilities, however, did not satisfactorily reduce organic contents without facultation, maturation, and sedimentation and it was therefore recommended to improve the ponds. Ten vacuum desludging trucks were also cancelled as private companies started providing efficient desludging services. As a result of the cancelation of these work items, an amount of $550,000 was reallocated to other civil works.

Project costs[47]	All amounts in US$
ADB (loan)	17.15 million
JICA	4.87 million
Government of Lao PDR	5.65 million
Total project costs	27.67 million

The overall performance of the Government and MCTPC was rated satisfactory as the Government fulfilled its responsibilities during project implementation. Although various training and on-the-job training developed the capacity for urban planning and management of managerial, but not of operation and maintenance (O&M) personnel, VUDAA's institutional capacity was rated as still weak by the end of the project. The report recommended that VUDAA will continue its public campaign to encourage urban residents to improve sanitation facilities and the environment. Residents should be further educated and appropriate design for low-lying areas devised to improve existing soak-pits and septic tanks.

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46 Personnel communication with Mr Phetnakhone Phasavat, Engineer of the Department of Public Works and Transport Vientiane Capital, during a visit to the stabilisation ponds on 28 July 2010.

47 Source: ADB (2002)

Vientiane Urban Infrastructure and Services Project, ADB, 2002-2007

The overall objectives of the project were to improve the quality of life of the urban residents, especially the poor and the disadvantaged; and to enhance urban productivity and economic growth in the Vientiane urban area. To this end, the project's specific objectives were: 1) to support decentralisation and urban governance reforms and the process toward an autonomous, well-functioning, and self-sufficient urban local government capable of planning, managing, and financing urban development and providing services in a sustainable manner; and 2) to target investment in infrastructure and services to maximise the utility of existing infrastructure by completing missing links and, through service efficiency improvements and focusing on secondary and tertiary-level infrastructure, allowing a greater share of the population, especially the poor, to benefit from environmental improvements.

The project area covered the four urban districts of Saysetha, Sisathanak, Chanthabouly, and Sikhottabong, including 50 villages. The project consisted of the following components:

- Part A: Citywide infrastructure and environmental improvements to provide critical missing links in the primary and secondary road and drainage networks, along with improvements in solid waste and traffic management
- Part B: Village area improvements (VAI)
- Part C: Capacity building and project implementation support

The ADB considers the project relevant, effective, efficient, and sustainable. Overall, it was a success. The project had a major impact on the road and drainage network of the city. The project built and upgraded 82.8 km of roads, or 29% of Vientiane's 279 km total. The lengthening of primary and secondary storm drainage channels, the replacement of inefficient open drains, and the construction of underground drainage have drastically reduced the areas of the city where major flooding occurs. At completion, 16.1 km of new drains (6.6 km of primary and 9.5 km of secondary channels) had been built, 10% more than the appraisal target.

The village area improvements (VAI) component, which covered 50 urban villages, comprised the upgrading of surface drainage, tertiary access roads, and primary waste collection. A total of 38.5 km of road and drainage works were completed between June 2004 and December 2006, with corresponding environmental, community health, and solid waste collection improvements at a cost of US$ 4.81 million. In particular, improved drainage in the 50 urban villages under the VAI program is expected to lead to improved community health. Community contributions, particularly for the VAI, exceeded project expectations and reflected the overall support by beneficiary communities.

Project costs	All amounts in US$
ADB (loan)	28.86 million
Agence Française de Développement	5.35 million
Government of Lao PDR	9.46 million
Total project costs	43.67 million

Source: ADB (2008)

Although the project met difficulties in facilitating the urban policy and institutional reform agenda, the issues pertained to design, not implementation. The assumptions that VUDAA would have the necessary mandate and the Government the capacity to undertake the reforms were unfounded.

Improvement of Urban Environment in Vientiane, Danida, 2001-2005

The project aimed to continue support to the municipal planning with the development of linkages between green and brown environmental issues and increased village involvement in environmental planning, implementation and monitoring. The objectives of the project were: 1) national, municipal, district and village authorities work with other stakeholders towards sustainable planning and management of the green and brown environment; and 2) replicable demonstration projects in environmental planning and management linking green and brown environmental issues.
The project was designed to pay particular attention to the issue of sustainability through stakeholder involvement and ownership, institutional capacity building, public awareness raising, community participation, good governance, gender-specific poverty reduction and training.

To reach the project objectives, the project focused on the following activities:

- Assist villagers to reduce the wastewater around their house and neighbourhood;
- Contribute to environmentally sustainable management aspects of the Nongchan wetland and livelihoods for the people living surrounding of the wetland;
- Reduce nutrient load on the That Luang Marsh and eventually on the Mekong River; and
- Provide a demonstration project for domestic wastewater handling in low income areas.

Appropriate sanitation infrastructure was constructed in demonstration areas focusing on the core downtown area. A sanitation network was designed that consisted of household connections, small bore sewers, secondary sewers and communal septic tanks in a number of urban villages including Thongkankham Tai/Nua, Dongpalan Tha and Nongchan. The project also carried out repair and maintenance work on the three pumping stations of the original EU financed sewer line and thereby re-established the use of the stabilisation ponds at That Luang Marsh. Furthermore, the project improved the Nongchan wetland in the centre of town and by doing so it demonstrated the value of a functioning wetland ecosystem to the city.

During visits to Thongkankham village, the pumping station near the Nongchan wetland and the EU financed stabilisation ponds and in discussions with Government officials[48], it became clear that the infrastructure facilities constructed with the assistance of DANIDA are not maintained adequately. The communal septic tanks have not been inspected since project completion and two of the three pumping stations that were rehabilitated during the project are not functioning. As a consequence the stabilisation ponds are not in use at present.

Wastewater Treatment through Effective Wetland Restoration of That Luang Marsh, WWF, 2007-2010

The project built on a past economic valuation (Gerrard, 2004) of That Luang Marsh conducted jointly by WWF and IUCN. Financed by the EU ASIA PRO Eco II programme, the overall objective of the project was to improve urban wastewater treatment, enhance wetland management, increase institutional capacity through participatory decision making, and refine regulations and planning policies within and surrounding That Luang Marsh leading to enhanced environmental conditions and the delivery of sustainable livelihoods. Specifically:

1. Government agencies at community, district and municipal levels work with all stakeholders to achieve improved urban planning surrounding That Luang Marsh, thus avoiding detrimental impacts on the functioning of the important wetland ecosystem.
2. Design a constructed wetland treatment system to treat current and potential wastewater inputs to That Luang Marsh and the development of best practice guidelines for domestic and industrial wastewater treatment.
3. Effective management of all wetland ecosystem services and resources of That Luang Marsh.

A sustainable urban plan for the area surrounding the marsh and an adaptive management plan for the wetland area were to be developed promoting: high environmental standards in urban planning; innovative solutions and best practice guidance for effective treatment of domestic and industrial wastewater through wetland treatment systems; and the management of wetland resources and services to sustain stakeholder livelihoods and alleviate poverty. Five wastewater treatment wetlands were constructed and pilot wastewater treatment facilities were constructed at the None Khor Neua primary school and in None Khor Neua village in Xaysetha district.

The project focused on using a low cost, low energy sustainable solution to improve water quality for Vientiane City using wetland treatment system technology instead of conventional wastewater solutions. It involved training local stakeholders in wetland treatment system design, operation and maintenance and wetland management; designing and constructed six wetland treatment systems to treat both domestic and industrial pollution; and producing plans for large scale wetlands that will treat the majority of the city's wastewater. Demonstration wetlands were built to demonstrate wetland treatment technology. These included a linear wetland treatment system for Beer Lao, one of the largest industries in Vientiane and part owned by Carlsberg, and one designed for None Khor Primary school, in which the children are actively involved in managing the system by helping clear vegetation whilst teachers help monitor the system. The project used designs which benefit the wildlife and provide income for the people of Vientiane who rely directly on the marsh for livelihoods. http://www.ciwem.org/competition-and-awards/world-of-difference.aspx

Public Works and Transport Institute executed projects

During the past years there have also been a number of smaller initiatives to improve sanitary conditions in a few selected urban villages in Vientiane. The following projects were implemented by the Public Works and Transport Institute (PTI) to pilot new urban sanitation related approaches or technologies:

- The SIDA-AIT supported regional SEA-UEMA project ”Decentralised sanitation system and integrated solid waste management for environmental improvement” which implemented project activities in:
  - Integrated environmental management of a typical low income community in Nongdouang-Thong, Sikhottabong district focusing on construction of storm water drainage and three public toilets
  - Strengthening and supporting solid waste collection in Phonkheng village, Xaysetha district
  - Decentralised sanitation for a cluster of households in Thongkhankham-Nua village, Chanthabuly district focusing on construction of communal septic tanks

48 Personnel communication with Mr Chittavong. Technician of the Office of Public Works and Transport Chantabouly District, on 19 July 2010, and with Mr Phetnakhone Phasavat, Engineer Department of Public Works and Transport Vientiane Capital, on 28 July 2010.

- The SANDEC EAWAG supported project “Participatory Improvement of Urban Environmental Sanitation Services” by following the Household-Centred Environmental Sanitation (HCES) approach in Hatsadi-Tai village, Chanthabuly district focusing on construction of public drains and three communal septic tanks, as well as improving solid waste management.

Appendix 4: Legal and Policy Framework for Urban Sanitation

This appendix gives an overview of the most important laws and regulations with relevance to urban sanitation.

Document	Description and relevance to Urban Sanitation
Water and Water Resources Law (No. 02/96/NA of 11/10/1996)	The Law provides principles, regulations and measures governing the management, exploitation, development and use of water and water resources with the aim to protect and sustain water resources of sufficient quantity and quality sot satisfy the national needs and to protect the natural environment. The Law makes no reference to sanitation except in relation to the control of wastewater discharge into water sources. • Article 29: Individuals and organisations are required to protect water and water resources from drying up or becoming spoilt or polluted. • Article 42: The discharge of water or dumping of waste into a water source is prohibited if such discharge or dumping will lower the quality of the water source.
Regulation on Monitoring and Control of Wastewater Discharge (No. 1122/STENO of 1998)	On 29 May 1998 the Science Technology and Environment Organisation issued the Regulation on the Monitoring and Control of Waste water Discharge to control and monitor wastewater which is discharged from buildings, commercial areas and agricultural production, which may have an impact on the environment, in particularly on the quality of water, and the public health. The Decision describes various quality parameters for wastewater discharge. It also defines categories of buildings according to the stipulated wastewater production. Lastly it defines necessary treatment standards for discharge into the natural environment and testing methods. The owner of the facility is responsible to make sure that appropriate treatment is applied prior to discharge. Failure to apply this can result in punishments. These regulations appear to have been superseded now by the recently issued WREA Agreement of the National Environmental Standards 2010 (No. 2734/PMO.WREA of 2009).
Environmental Protection Law 1999 (No. 02-99/NA of 03/04/1999)	The Environmental Protection Law of 1999, supported by its Implementing Decree of 2002 (No 102/PM), is the principal legal instrument covering environmental matters in the Lao PDR. The Law specifies necessary principles, rules and measures for managing, monitoring, restoring and protecting the environment in order to protect the public, natural resources and biodiversity, and to ensure the sustainable socioeconomic development of the nation. The basic principles of environmental protection are stated in Article 5: 1) Environmental protection shall be the priority consideration, and environmental remediation and restoration are considered to be less preferable, but also important activities; 2) The national socio-economic development plan shall include a programme to protect the environment and natural resources; 3) All persons and organisations residing in the Lao PDR shall have an obligation to protect the environment; 4) Whoever causes damage to the environment is liable under the laws for such damage; 5) Natural resources, raw materials and energy shall be used in an economical manner, which minimises pollution and waste and [supports] sustainable development. The Law is rather general in nature and the only reference to wastewater is made in Article 23, which states: "It is forbidden to discharge wastewater, or water that exceeds the prescribed standards into canals, natural bodies of water or other places without proper treatment." Articles 36 to 40 defines the rights and duties of Environmental Management and

Document	Description and relevance to Urban Sanitation
	Monitoring Agencies at different levels , however it is not known whether these agencies exist and if so whether they function efficiently and effectively:
Prime Minister's Decision on Management and Development of the Water Supply Sector (No. 37/PM of 30/09/1999)	The objective of the Decision is to define the policy of the GOL on management and development of the water supply sector and to inform all actors of the strategies, targets and operational frameworks for the effective and sustainable financing, development and management of water supply and wastewater management systems in urban and rural areas. The Decision places the following responsibilities for development and management of wastewater: • Article 2.1: MCTPC is responsible for facilitation and coordination of the development process for wastewater management systems in urban and rural areas, as well as for the promotion and mobilisation of all available resources toward achieving the set goals and objectives. • Article 2.2: MPH is responsible for the facilitation, coordination and direction of all urban and rural environmental hygiene activities. Nam Saat is responsible for the management of technical aspects in promoting urban and rural environmental hygiene. • Article 2.5: Nam Papas are responsible for management and operation of all wastewater management systems and development of raw water in urban and rural areas. Communities are responsible for protection of waste water systems and environmental hygiene. • Article 6.1: All beneficiary communities participate in the development of wastewater management systems from the beginning until the period of operation and maintenance.
Hygiene, Prevention and Health Promotion Law (No 01/NA of 10/04/2001)	The Law was developed to set up principles, rules and measures related to the practices of hygiene, prevention and health promotion activities to bring good health as well as better quality of life and long life expectancy to the people. The Law states the following: • Article 10: Families are responsible for creating conditions to ensure access latrines fulfilling hygienic standards. • Article 11: People in the community should take care of wastewater and preserve water sources. • Article 16: Schools should ensure access to hygienic latrines. • Article 40: MPH, together with Provincial and District Health Offices, is responsible for management and supervision of hygiene prevention and health promotion. The Law does not address how hygiene, prevention and health promotion activities are to be conducted, nor does it provide detail linkages with other concerned sectors and agencies.
Prime Minister's Decree to Implement the Law on Water and Water Resources (No. 204/PM of 09/10/2001)	The objective of the Decree is to implement the Law on Water and Water Resources and to establish the responsibilities of different ministries, agencies and local authorities for the management, exploitation, development and use of water and water resources. The Decree mentions the following regarding management of wastewater: • Article 22: MCTPC and MPH shall develop regulations defining prohibited activities in order to ensure water quality and quantity for both urban and rural populations. • Article 23: STEA is responsible for the management and control of wastewater discharge. MCTPC is responsible for setting water quality standards of water and treatment methods for wastewater from urban areas that is discharged into water. MPH is responsible for setting water quality standards for drinking water and wastewater, including methods of treatment of wastewater. MAF and MIH have similar responsibilities related to their sectors. Local authorities are responsible for implementing controls for water quality, discharge of

Document	Description and relevance to Urban Sanitation
	wastewater and dumping of waste. • Article 28: Individuals and organisations shall treat wastewater before it is discharged to a water source that meets standards determined by the ministry concerned with the purpose of their project.
Prime Minister's Decree (No. 102/PM of 2002)	MPWT has an overall responsibility to issue technical regulation related to urban wastewater handling and treatment (in collaboration with WREA).
Ministerial Decision on Management of Wastewater Drainage in Towns and Municipalities (First draft 2008; updated in June 2010)	The objective of the draft Decision is to regulate and standardise the activities on wastewater management to ensure water treatment conforms to proper environmental standards to protect the country's environment. The draft concerns management, control of wastewater discharge and drainage from buildings, commercial areas and industry in towns and municipalities. The draft decision defines two ways of treatment: 1) onsite wastewater treatment at the site by the owner of the facility; and 2) centralised wastewater treatment. The discharge shall be controlled prior to approval by an authorised agency and the draft decision defines wastewater discharge management agencies. The draft has been put aside tentatively, but it will be revised with the purpose of issuing it as Ministerial regulation in accordance with the Decree on implementation of EPL.
Urban Wastewater Strategy and Investment Plan 2008-2020 (Final draft October 2008)	The National Urban Wastewater Strategy and Investment Plan is developed to support increased access to sustainable wastewater facilities and services in urban areas by 1) ensuring environmental protection and mitigate impacts from wastewater on the environment; 2) to ensure health protection and appropriate wastewater services to the urban population; 3) to guide the future urban investments and development of wastewater services; and 4) to ensure financial sustainability in the wastewater sector. The strategy includes institutional and legal reforms, capacity building and awareness raising, application of appropriate and affordable technologies, and wastewater infrastructure investment. Cost estimations are included in the 2008-2020 Investment Plan. Household septic tanks and decentralised treatment is foreseen for Vientiane Capital City for the period up to 2020. Investments in Vientiane Capital City alone are estimated at US$ 20.4 million for the period up to 2020.

Water Supply Law (2009)	The Law sets out the principles, rules, and measures about the management, construction and installation of water supply systems, where water supply is defined as water that has been processed through water production plants through various technical procedures and processes, without contaminants and different types of disease-causing microbial bacteria.
	The Law basically deals only with piped and treated water; sanitation is subsumed into "water supply activities" and not dealt with separately. The Law mentions the following regarding sanitation and wastewater issues:
	• Article 3: provides the definitions of terms used in the Law:
	  • **Sanitation services** means the construction of latrines, septic tanks and on-site household sewage disposal systems and installation of all associated components, excluding sewage drainage systems or storage or removal from sites that go to treatment places through other methods;
	  • **Wastewater services** means the retainment, removal, disposal or treatment of human faeces, household wastewater and water discharged when used for commercial purposes; and
	  • **Basic level of sanitation** means the minimum standard necessary for sanitation services which have been defined for appropriate safety, hygiene and storage, removal, disposal or treatment of faeces, wastewater and sewage from various types of households.
	• Article 37: Water supply service users shall ensure that household sanitation won't contaminate or pollute water sources.

Document	Description and relevance to Urban Sanitation
	• Article 43: MPWT is responsible to research policies and develop strategies on water supply and sewerage services, to develop detailed sectoral plans, programs and projects, and to monitor and supervise the implementation of policies, strategies, investment plans and the development or expansion of water supply and sewerage systems.
Agreement of the National Environmental Standards 2010 (No. 2734/PMO.WREA of 2009	This Agreement defines the National Environmental Standards as the basis for environmental monitoring and pollution control on water, soil, air and noise. The standards as laid down in the Agreement apply to any relevant person, enterprise and organisation in order to protect the environment and to control pollution in Lao PDR. Chapter II provides an overview of the National Environmental Standards. The Agreement is basically a compilation of existing environmental standards issued by the relevant Ministries in the past[49]. Urban sanitation related relevant standards are: • Drinking water quality standards (4.1.1) • Groundwater quality standards (4.1.3) • Surface water quality standards (4.1.4) • Wastewater discharge standards (5.5.1) • Wastewater treatment standards (5.5.3) Chapter III provides an overview of the organisations responsible for implementation and monitoring of the National Environmental Standards grouped into central level and provincial level organisations. Most of the rights and duties remain within the domain of WREA. The role of other agencies (sectors) is somewhat ambivalent and is provided in Article 8.5 as follows: "Other sectors at central (and provincial) level have duty of responsible to monitor and review the technical standards related to its responsibility in order to ensure the implementation of the National Environmental Standards." Chapter IV provides two articles dealing with Rewards and Sanctions. Article 12 on Sanctions is too general and rather indecisive: "Individuals, consumers, producers and other related organisations violating the provision of this Agreement will be warned, be fined or subject to criminal punishment, depending on the severity of the violation".

[49] Personal communication with Vanhxay Phiomanyvone and Sengkeo Tasaketh of the Department of Environment, Water Resources and Environment Administration on 01 July 2010.

Appendix 5: Institutional framework for urban sanitation

This appendix gives an overview of ministries and institutions that are operating in the urban sanitation/wastewater sector.

Water Resources and Environment Administration (WREA)
The Water Resources and Environment Administration (WREA) of the Prime Ministers Office (PMO) was established in 2007 (Decree No 149/PM of 10 May 2007 concerning the organisation and activities of the administration) together with the National Authority of Science and Technology (NAST) to replace what was previously called the Science, Technology and Environment Agency (STEA). The Prime Minister's Decree (No 149/PM of 10 May 2007) does not refer to the original mandate for STEA in Article 36 of the EPL, nor to the Law on Water and Water Resources. Therefore it is not clear what authority is vested with WREA in relation to these laws and whether WREA has the authority to monitor and enforce penalties on violation of the laws. This is one of the reasons why the EPL is presently being revised to reflect the new administrative set up.

WREA is responsible for the formulation of policies, laws, strategies, plans, decrees, and other standards regarding water resources, environment, meteorology and hydrology activities. WREA is also expected to lead and advice on implementation of legislation and to manage, monitor, collect and disseminate data and information on water resources, environment, meteorology and hydrology nationwide. Detailed duties and jurisdiction of WREA are provided on its website (http://www.wrea.gov.la).

The Department of Environment (DOE) is responsible for the formulation of relevant legislation and national environmental standards including ambient water quality standards and effluent standards for domestic wastewater. The Department is also responsible for providing overall environmental guidance and approving environmental assessment reports. At present the Department is revising the Environmental Protection Law (1999).

WREA has a small laboratory facility - the Environmental Quality Monitoring and Hazardous Chemical Center - under the Water Resources and Environment Research Institute (WREI). WREI is responsible for monitoring and inspecting compliance with the national environmental standards such as: water, soil, air, radiation, noise, etc. The analysis equipment and human resources of the laboratory are very limited at present. The Water Quality Monitoring Unit has only 3 staff members. (JICA, 2010)

Water Resources and Environmental Office (WREO) s are Provincial counterparts of the WREA.
At the provincial level, WREA executes its authority and functions through the Water Resources and Environmental Offices. The offices were established in 2008 as the successor of STEO and are responsible for monitoring of environmental issues, including wastewater discharge, and for raising the awareness of the general public on environmental issues. They report directly to the Provincial Governors. WREO of Vientiane Capital consists of three units namely Administration Unit, Water Resources Unit, and Environment Unit. Due to a lack of equipment and financial resources WREO has not been able to fulfil their responsibilities with respect to environmental monitoring[50]. At present WREO is primarily focusing on awareness raising and public education in target villages with some sort of environmental problem.

Ministry of Public Works and Transport (MPWT)
Decision 37/PM of 30 September 1999 on Management and Development of the Water Supply Sector places responsibilities for development and management of wastewater systems in urban and rural areas with the Ministry of Public Works and Transport (then the Ministry of Communication Transport Post and Construction). On the other hand, the new Decree on the Operation and Functioning of MPWT (No 373/PM; 22 October 2007) does not specify MPWT's role in wastewater. It is, however, clear from other legislation, hereunder the Decree No 204/PM of 9 October 2001 on implementation of the Water Resources Law, and Decree No 102/PM of 2002 that MPWT has an overall responsibility to issue technical regulation related to urban wastewater handling and treatment (in collaboration with WREA).

The Rural and Urban Development Division (UDD) of the Department of Housing and Urban Planning (DHUP) of MPWT is responsible for basic urban infrastructure, hereunder drainage, sewerage (wastewater) and solid waste in accordance with the Ministerial Decision No 1726 of 26 May 2000 and later DHUP decisions. The Department assists the Minister of MPWT to study, develop, plan and manage matters related to urban water supply and wastewater. It does so by drafting sector policies, regulations, standards, technical specifications and performance indicators. At present the Department is working on finalising the following pieces of legislation: 1) Urban Wastewater Strategy and Investment

[50] Personnel communication with Mrs. Khamfong Phoumvongxay, Director Water Resources and Environmental Office Vientiane Capital, on 22 July 2010.

Plan 2008-2020 (Drafted in 2008); and the Decision on regulation of wastewater discharge in towns and municipalities (Drafted in 2008).

Public Works and Transport Institute (PTI) of MPWT
The Public Works and Transport Institute, together with WSP the initiator of the Rapid Assessment, is the main technical agency for urban planning in the Lao PDR. It offers services in the fields of urban planning, studies and evaluations on urban planning as well as trainings on environmental management.

At present the PTI supported by JICA is involved in two studies that are expected to provide valuable input for Vientiane's future plans: 1) Study on improvement of water environment in Vientiane City; and 2) Project for Urban Development Master Plan Study in Vientiane Capital.

Provincial Department of Public Works and Transport (DPWT)
At the provincial level, MPWT executes its authority and functions in the urban water supply and sanitation sectors through the Director of the Department of Public Works and Transport and the Office of Public Works and Transport at district level. DPWT is responsible for planning, developing, and managing urban and rural infrastructure and services in each province on behalf of and under the overall supervision of the Provincial Governor. It reports to the provincial government and funds for salaries and operations flow through the provincial budget. DPWT coordinates closely on technical matters with the national level MPWT. The DPWT provides the technical standard for urban sanitation including designs of septic tanks, and approves building permits for new houses and their proposed toilets.

District Office of Public Works and Transport (OPWT)
The Office of Public Works and Transport develops and manages urban and rural infrastructure and services in the districts. It reports directly to the District Governor and indirectly to the DPWT. OPWT is responsible for checking construction of new building works such as houses (and their toilets) to ensure they are in accordance with the approved building plans, however field checking of toilets constructed rarely occurs due to limited resources and capacity of OPWT[51].

Provincial Nam Papas
The Prime Minister's Decision on Management and Development of the Water Supply Sector (No 37/PM of 30/09/1999) places the responsibility for operation of urban wastewater systems on the respective Provincial Nam Papas (state-owned urban service provider). Provincial Nam Papas are responsible for planning, developing, and managing water supply and wastewater management systems in designated urban areas within each province. The provincial Nam Papas are supervised by DWPT. A regulatory regime and strategy for urban water supply has been developed and is being implemented in the country. On urban wastewater management, however, little has been done till date.

Urban Development and Administration Authorities (UDAA)
In some larger towns (i.e. Vientiane, Luang Prabang, Kaysone Phomvihan (Savannakhet), Thakek and Pakse, and in 12 district/small towns Urban Development and Administration Authorities are established under the Local Administration Law. UDAA plan, implement, manage and control urban development and services within specified administrative boundaries (e.g. construct, improve, and maintain urban infrastructure, including sanitation and protection of the environment). UDAA operate under the supervision of the DPWT and report to the Provincial Governor.

The 1998 Policy Statement on Urban Development outlines the Government's objectives and strategies to improve management of urban environments and services under a decentralised system of municipal government administrations. In line with this strategy, the Vientiane Urban Development and Management Committee (VUDMC) was established in April 1995. A decentralised form of urban governance laid down under the policy statement led to the consolidation of VUDMC in February 1999 as the Vientiane Urban Development Administration Authority (VUDAA), which would be developed as an independent municipal organisation dedicated to managing Vientiane's urban infrastructure and services. The government's commitment to decentralisation led to the issuance of a number of Prime Minister's decrees, instructions, and decisions to develop VUDAA and the four principal secondary towns. Most significant in the decentralisation process were decrees 77/PM in 1997 and 14/PM in 1999, and their implementing instruction 141/PM in May 2000. (ADB, 2002)

The urban area under the jurisdiction of VUDAA is divided into 100 urban villages belonging to four districts, namely: Chanthabuly, Sikhottabong, Xaysetha and Sisattanak. Under the overall supervision by the Governor of Vientiane City, VUDAA offers various services similarly to what is described under UDAA above.

[51] Personnel communication with Technicians of the Offices of Public Works and Transport in Chantabouly and Sisattanak districts on 16 July 2010 and 19 July respectively.

Ministry of Health (MOH)

In accordance with the Prime Minister's Decision on Management and Development of the Water Supply Sector (37/PM of 1999), the Ministry of Health is responsible for facilitation, coordination and direction of all rural water supply, and urban and rural environmental hygiene activities. The Decision has not yet been implemented with proper regulations that clarifies responsibilities and gives the institutional mandate to execute and monitor sanitation/wastewater improvements in urban areas. The Law on Hygiene, Disease Prevention and Health Promotion was promulgated in April 2001. MOH, provincial and municipal health departments, and the district health offices are the agencies in charge of implementing and supervising the law. Although there are few specifics about sanitation, the law is a good starting point for developing advocacy for improved sanitation services.

Within the Ministry of Health, the Department of Hygiene and Prevention's Environmental Health Division is responsible for developing the national strategy, policies and regulations in the field of Environmental Health with particular emphasis on water supply and sanitation. MoH has issued regulation on quality standards for drinking water and household water supply (No 1371/MoH of 4 October 2005), a decision on public area hygiene regulation (No 1705/MoH of 20 July 2004), and is presently working on regulation of wastewater discharge from hospitals.
MoH is also responsible for disseminating hygiene and environmental health information to villagers throughout the country. The Division cooperates with MoH departments at provincial and district levels and with Nam Saat Central.

Provincial Public Heath Department (PPHD)

The Provincial Public Health Departments are responsible for the implementation of a number of public health related prevention and control programmes, including health education activities. District Health Offices are found in all districts. They report directly to the District Governor and indirectly to the PPHD. Provincial Public Health Departments and District Health Offices are amongst others responsible for implementing the Model Healthy Village approach.

The Government intends to develop model healthy villages nationwide in order to aim to ensure poverty alleviation. The recent cholera outbreaks in the southern provinces of Sekong and Attapeu raised the concern that the majority of Lao PDR people living in rural areas use unclean drinking water and eat uncooked food, while some do not have toilets, making it difficult to limit outbreaks such as cholera. Therefore the Government has been urging all provinces to develop model healthy villages in order to prevent outbreaks such as cholera, malaria, avian influenza as well as asking development partners to assist this initiative. Model health villages are established to have a direct impact on the health and living conditions of the target villages, and villagers are expected to benefit from improved health, savings in health care costs, and ultimately income benefits from expanded access to clean water and sanitation services.

Model Healthy Village Approach

A model healthy village was defined in the Government's 2007 national health conference as a village that maintains the basic conditions needed to lead a healthy life, including the following eight primary health care elements: (i) adequate health information; (ii) clean environmental practices with basic hygiene principles such as using latrines, having safe water, and eating well-cooked food; (iii) safe motherhood; (iv) Expanded Programme on Immunization; (v) nutrition; (vi) common disease control; (vii) awareness and information of available treatments in health facilities; and (viii) availability of essential drugs or drug kits.

A model healthy village has a well-functioning VHC and VHVs, and involves all villagers in community activities related to clean and healthy living. Currently, various approaches and methods for healthy village development exist in Lao PDR, but a harmonised and more community-centred approach is needed to focus on increasing access to basic infrastructure (such as water supply and sanitation), improving village ownership and capacity by creating village-level sustainable structures and mechanisms, and improving district-level human resources to support village development.

Source: ADB (July 2009)

According to the Executive Summary of the Seventh Five-Year Health Sector Development Plan (2011-2015) (MOH, August 2010) the Government's targets for the coming period are as follows:

- By year 2015: at least 65% of all remote villages, 70% of all semi-remote villages, and 75-85% of other villages, are model healthy villages; and
- By year 2020: 100% of all villages are model healthy villages.

The following table shows the criteria used in Sisattanak district for certifying model healthy families.

Model Healthy Family Criteria			
Item	**Description**	**Point**	**Remarks**
1	Save drinking water, healthy food, stay clean and dress clean	2	• >8 points will receive RED sticker • 5–7 points will receive GREEN sticker • <5 points will receive dark BLUE sticker • RED sticker means Very Good • GREEN sticker means Good • DARK BLUE means Dirty or needs improvements
2	Access to a hygienic toilet	2	
3	Proper disposal of solid waste	1	
4	All family members have been vaccinated	1	
5	No mosquito larva breeding grounds	1	
6	Access to save water supply	1	
7	Proper discharge of grey and black water (no flooding)	1	
8	No animal raising under the house or regular cleaning of the animal shed	0.5	
9	Front and back of house are clean	0.5	
	Maximum points	10	

National Centre for Environmental Health and Water Supply (Nam Saat)

Within MOH, the National Centre for Environmental Health and Water Supply (better known as Nam Saat) is expected to facilitate, advice, promote and develop rural water supply and sanitation, and urban and rural environmental hygiene through community-based approaches. Nam Saat is responsible for: 1) providing technical support, coordination and services in rural water supply and urban and rural sanitation based on the sectoral polices enacted by the Minister of Health; 2) control the quality of drinking water in rural areas; and 3) planning and design of rural water supply and sanitation systems. Nam Saat Central is based in Vientiane and falls under the responsibility of the Department of Hygiene and Prevention.

Each province has a provincial Nam Saat under the Provincial Department of Health, and this structure is replicated at district level. The subordinate role of Nam Saat within the MoH is consistent at each level of government. District Nam Saat staff are the main implementers of water supply and sanitation programs. A severe constraint on operations, however, is that the district Nam Saat staff budget typically covers salaries and very little else. They rely almost exclusively on externally financed programs or government programs in other sectors (usually supported by development partners) to fund fieldwork and village visits. Involvement of Nam Saat in urban sanitation is limited.

Appendix 6: Estimated sources and uses of sanitation and hygiene financing in Lao PDR for 2008/09

Sources			
Sources of funding	**LAK Million**	**US$ Million**	**In %**
Government	6,277	0.73	*14.7%*
Development Partners	17,798	2.08	*41.6%*
Households	18,735	2.18	*43.8%*
Private Sector	*Unknown*	*Unknown*	
Totals	**42,811**	**5.00**	***100.0%***

Uses			
Expenditure	**LAK Million**	**US$ Million**	**In %**
Software	13,219	1.54	*30.9%*
▪ *Recurrent Govt. Budget*	*6,277*	*0.73*	*14.7%*
▪ *Other*	*6,941*	*0.81*	*16.2%*
Hardware	29,593	3.46	*69.1%*
Totals	**42,811**	**5.00**	***100.0%***

Source: WSP (April 2010)

Appendix 7: Proposed wastewater investments for Vientiane Capital City

Urban Wastewater Strategy and Investment Plan (Draft October 2008)

Facilities	Investment costs in US$					
	Period 2008-2020				Beyond 2020	
	2008-10	2011-15	2016-20	Sub-totals	2020-	Totals
Centralised sewerage system				**0**	54.900.000	**54.900.000**
Decentralised systems			3.900.000	**3.900.000**		**3.900.000**
Onsite wet systems	6.960.000	3.160.000		**10.120.000**		**10.120.000**
Onsite dry systems				**0**		**0**
Treatment systems	2.552.000	3.828.000		**6.380.000**		**6.380.000**
Totals	**9.512.000**	**6.988.000**	**3.900.000**	**20.400.000**	**54.900.000**	**75.300.000**

Source: COWI (October 2008)

Unit costs used by COWI

Facilities	Options	US$ per capita
Onsite facilities	Lined pit latrines / VIP latrines	20
	Pour-flush latrines	40
	Pour-flush latrines with septic tanks	110
Offsite facilities	Decentralised treatment (piping and septic tanks)	155
	Centralised treatment (piping and stabilisation ponds)	215
Treatment	Natural clean treatment such as biological ponds, lagoons	25

The Study on Improvement of Water Environment in Vientiane City – Interim Report

Alternatives	Investment costs in US$					Total annual O&M costs
	Communal septic tanks (DEWATS)[52]	Sewerage treatment plant and interceptor	In-stream treatment facilities	Totals	Average per capita costs	
Alternative 1		27.300.000		**27.300.000**	192	410,000
Alternative 2	32.200.000			**32.200.000**	332	70,000
Alternative 3	32.200.000		8.300.000	**40.500.000**	316	230,000

Source: JICA (March 2010)

[52] DEWATS or Decentralised Wastewater Treatment System is a typical system for domestic households. It consists of a primary treatment system of a settling and sedimentation tank, a secondary treatment system of an up-flow type baffled reactor which digests wastewater anaerobically, a tertiary treatment in subsurface horizontal flow through sand filters with reed beds, and finally a polishing pond for oxygenation and UV disinfection from the sun's rays.

Appendix 8: JMP definitions for types of drinking-water sources and sanitation

The WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) has defined a list of drinking-water and sanitation categories that can be considered improved or unimproved. The JMP definitions can be found on: http://www.wssinfo.org/definitions/infrastructure.html

An **improved drinking water source** is defined as a drinking water source or delivery point that, by nature of its construction and design, is likely to protect the water source from outside contamination, in particular from faecal matter. The JMP uses the following classifications to differentiate improved from unimproved drinking water sources. Details can be obtained from the above website.

Improved drinking water source	Unimproved drinking water source
☑ Piped water into dwelling, plot or yard	☒ Unprotected dug well
☑ Public tap or standpipe	☒ Unprotected spring
☑ Tubewell or borehole	☒ Cart with small tank/drum
☑ Protected dug well	☒ Tanker truck
☑ Protected spring	☒ Surface water (river, dam, lake, pond, stream, canal, irrigation channel)
☑ Rainwater collection	☒ Bottled water[53]

An **improved sanitation facility** is defined as one that hygienically separates human excreta from human contact. The JMP uses the following classifications to differentiate improved from unimproved sanitation facilities. However, sanitation facilities are not considered improved when shared with other households, or open for public use.

Improved sanitation facilities	Unimproved sanitation facilities
☑ Flush or pour-flush to: ▪ piped sewer system ▪ septic tank ▪ pit latrine	☒ Flush or pour-flush to elsewhere
☑ Ventilated improved pit latrine	☒ Pit latrine without slab or open pit
☑ Pit latrine with slab	☒ Bucket
☑ Composting toilet	☒ Hanging toilet or hanging latrine
	☒ No facilities or bush or field (open defecation)

Sanitation categories
"Improved" sanitation:

- Flush toilet uses a cistern or holding tank for flushing water, and a water seal (which is a U-shaped pipe below the seat or squatting pan) that prevents the passage of flies and odours. A pour flush toilet uses a water seal, but unlike a flush toilet, a pour flush toilet uses water poured by hand for flushing (no cistern is used).
- Piped sewer system is a system of sewer pipes, also called sewerage, that is designed to collect human excreta (faeces and urine) and wastewater and remove them from the household environment. Sewerage systems consist of facilities for collection, pumping, treating and disposing of human excreta and wastewater.
- Septic tank is an excreta collection device consisting of a water-tight settling tank, which is normally located underground, away from the house or toilet. The treated effluent of a septic tank usually seeps into the ground through a leaching pit. It can also be discharged into a sewerage system.
- Flush/pour flush to pit latrine refers to a system that flushes excreta to a hole in the ground or leaching pit (protected, covered).
- Ventilated improved pit latrine (VIP) is a dry pit latrine ventilated by a pipe that extends above the latrine roof. The open end of the vent pipe is covered with gauze mesh or fly-proof netting and the inside of the superstructure is kept dark.
- Pit latrine with slab is a dry pit latrine that uses a hole in the ground to collect the excreta and a squatting slab or platform that is firmly supported on all sides, easy to clean and raised above the surrounding ground level to prevent surface water from entering the pit. The platform has a squatting hole, or is fitted with a seat.

[53] Bottled water is considered to be improved when the household uses water from an improved source for cooking and personal hygiene.

- Composting toilet is a dry toilet into which carbon-rich material (vegetable wastes, straw, grass, sawdust, ash) are added to the excreta and special conditions maintained to produce inoffensive compost. A composting latrine may or may not have a urine separation device.
- Special case: a response of "flush/pour flush to unknown place/not sure/DK where" is taken to indicate that the household sanitation facility is improved, as respondents might not know if their toilet is connected to a sewer or septic tank.

"Unimproved" sanitation:

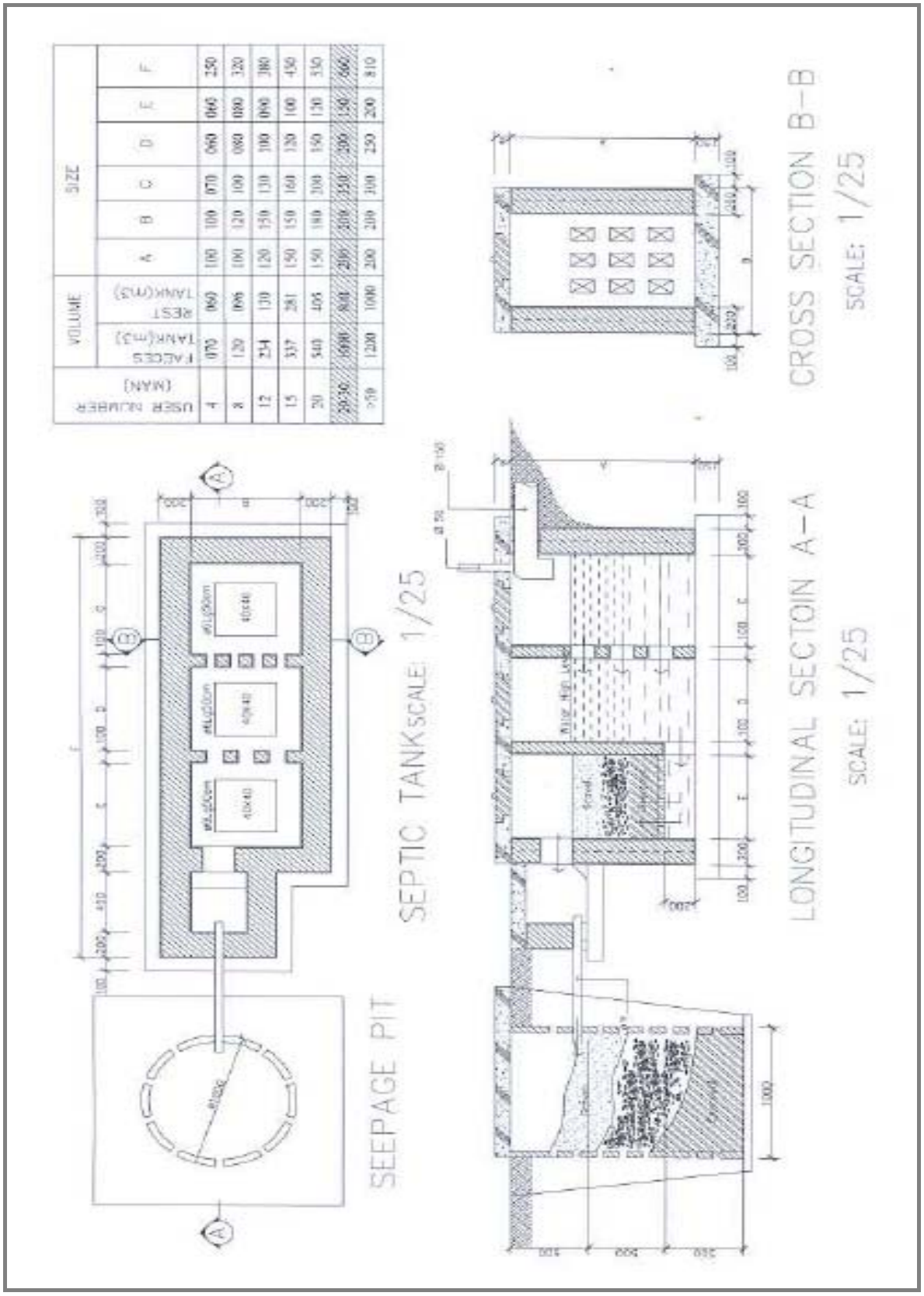
- Flush/pour flush to elsewhere refers to excreta being deposited in or nearby the household environment (not into a pit, septic tank, or sewer). Excreta may be flushed to the street, yard/plot, open sewer, a ditch, a drainage way or other location.
- Pit latrine without slab uses a hole in the ground for excreta collection and does not have a squatting slab, platform or seat. An open pit is a rudimentary hole.
- Bucket refers to the use of a bucket or other container for the retention of faeces (and sometimes urine and anal cleaning material), which are periodically removed for treatment, disposal, or use as fertilizer.
- Hanging toilet or hanging latrine is a toilet built over the sea, a river, or other body of water, into which excreta drops directly.
- No facilities or bush or field includes defecation in the bush or field or ditch; excreta deposited on the ground and covered with a layer of earth (cat method); excreta wrapped and thrown into garbage; and defecation into surface water (drainage channel, beach, river, stream or sea).

Appendix 9: Process of obtaining a building permit

Step	Procedure	Agency	Details
1	Purchase the application forms to a building permit	District Office	To apply for a building permit, application forms are to be purchased from the District Office.
2	Request and obtain residence certificate	Village Chief	The applicant must obtain a residence certificate certifying the applicant's permanent address.
3	Request and obtain map describing the location of the construction site, and map describing the technical characteristics of the ground	District Land Management Authority	The applicant must obtain a map (on a scale from 1:5,000 to 1:20,000) delineating the location of the construction site. In addition, the applicant must obtain a map (on a scale from 1:5,000 to 1:20,000) delineating the technical characteristics of the plot: surrounding streets and inner ways, existing buildings, walls, electricity poles, and the like.
4	Submit building permit application	District Office of Public Works and Transport	Submit the application for a building permit, along with a copy of the land title and documents described above (four copies each).
5	Receive pre-approval inspection	District Office of Public Works and Transport (OPWT)	OPWT inspects the property. If the inspectors approve the application, the District Chief signs the approval. For buildings larger than 200 m^2, the District Chief sends a letter to VUDAA's Building and Urban Planning Division for final approval. OPWT notifies the applicant that the letter has been forwarded to VUDAA.
6	Receive pre-approval inspection	VUDAA	The inspectors verify that the construction plan complies with building regulations.
7	Obtain building permit	VUDAA	After the plan is approved, VUDAA's Building and Urban Planning Division contacts the applicant to pick up the building permit. If the applicant is not contacted within 30 days, the plan is deemed approved.
8	Receive construction inspections	Committee for Management of Construction (CMC)	The CMC may inspect the construction site several times before, during, and after construction. The committee may conduct any of the following inspections: pre-construction; excavation work; foundations work; concrete work; steel work for slabs; frame; damp-proof course; drainage; timber scaffolding; electrical; plumbing (water); environmental; sanitary (sewage); surroundings of the building; structure; final inspection.
9	Request and receive final inspection	Committee for Management of Construction	After construction is finished, the building owner must request in writing for the CMC to inspect the construction according to the issued building permit.
10	Obtain certificate of completion of building works	VUDAA	If the building complies with construction regulations, the Housing and Urban Planning Division officially issues a correct construction certificate (a correct construction certificate means a certificate issued by the CMC to certify that the construction complies with the regulation).

Source: http://www.doingbusiness.org/

Appendix 10: Standard septic tank design



Appendix 11: Explanation on septic tanks

Septic tanks	Description
Definition	A **septic tank** is a watertight chamber made of bricks/blocks, concrete, fibreglass, PVC or plastic, for the storage and treatment of black water and grey water. Settling and anaerobic processes reduce solids and organics, but the treatment is only moderate.
Where to use	Septic tanks are small scale sewage treatment systems common in areas with no connection to main sewage pipes. Septic tank systems are a type of On-Site Sewage (OSS) facility where sewage is treated at its location (on-site), rather than transporting the sewage to a sewer system or larger treatment system.
Quick explanation	There is nothing really complex about how a septic tank works. In a nutshell, untreated wastewater flows into the septic tank, where the solids separate from the liquids. Heavy particles, such as human and kitchen wastes, sink to and settle at the bottom of the tank as sludge. Scum (oil and fat) will float to the top of the tank to form a scum layer. With time, the solids that settle at the bottom are degraded anaerobically. Self forming anaerobic bacteria in the tank help the system "digest" these solids or sludge. The remaining liquids flow out of the tank and are dispersed throughout the soil by leaching through a land drainage system or drain field. Baffles built into the tank hold back the floating scum from moving past the outlet of the tank.
Explanation	A septic tank generally consists of a tank (or sometimes more than one tank) of between 4000 - 7500 litres in size connected to an inlet wastewater pipe at one end and a septic drain field at the other. A septic tank should typically have at least two chambers (each of which is equipped with a manhole cover) which are separated by means of a dividing wall (baffle) which has openings located about midway between the floor and roof of the tank. Wastewater enters the first chamber of the tank, allowing solids to settle and scum to float. The settled solids are anaerobically digested reducing the volume of solids. The liquid component flows through the dividing wall into the second chamber where further settlement takes place with the excess liquid (effluent) then draining in a relatively clear condition from the outlet into the leach field, also referred to as a drain field, or seepage field, depending upon locality. The dividing wall prevents scum and solids from escaping with the effluent. The remaining impurities are trapped and eliminated in the soil, with the excess water eliminated through percolation into the soil (eventually returning to the groundwater), through evaporation, and by uptake through the root system of plants and eventual transpiration. A piping network, often laid in a stone filled trench, distributes the wastewater throughout the field with multiple drainage holes in the network. The size of the leach field is proportional to the volume of wastewater and inversely proportional to the porosity of the drainage field. Alternatively, a soak pit can be used to disperse the effluent. A soak pit, also known as a soak away or leach pit, is a deep, covered cylindrical pit that is open on the sides and bottom. These pits can be constructed using honeycombed brickwork, or concrete manhole sections with perforations in the walls. Pre-settled effluent is discharged to the underground chamber from where it infiltrates into the surrounding soil. Waste that is not decomposed by the anaerobic digestion eventually has to be removed from the septic tank, or else the septic tank fills up and un-decomposed wastewater discharges directly to the drainage field. Not only is this bad for the environment, but if the sludge overflows the septic tank into the leach field, it may clog the leach field piping or decrease the soil porosity itself, requiring expensive repairs. A properly designed and normally operating septic system is odour free and, besides periodic inspection and pumping of the septic tank, should last for

	decades with no maintenance.
Operation and maintenance	Periodic preventive maintenance is required to remove the solids which settle and gradually fill the tank, reducing its efficiency. In most jurisdictions this maintenance is required by law, yet often not enforced. As the rate of accumulation is faster than the rate of decomposition, the accumulated sludge must be removed at some point. Regular septic tank pumping is the only way to prevent septic tank systems from clogging and to extend the life of the septic system. There appears to be some different views on the frequency of emptying septic tanks: ■ http://septictank.org states: "most septic tank system experts recommend that a typical tank should be pumped every three to five years." ■ http://en.wikipedia.org/wiki/Septic_tank states: "Contrary to what many believe, there is no "rule of thumb" for how often tanks should be emptied. How often the septic tank has to be emptied depends on the volume of the tank relative to the input of solids, the amount of indigestible solids and the ambient temperature (as anaerobic digestion occurs more efficiently at higher temperatures). The required frequency varies greatly depending on jurisdiction, usage, and system characteristics. Some health authorities require tanks to be emptied at prescribed intervals. Some systems require pumping every few years or sooner, while others may be able to go 10–20 years between pumping." ■ http://www.johnstonsmith.co.uk/fact4.html states: "It is generally recommended that septic tanks be pumped out annually, or the sludge and scum layers be measured at least every year so that solids don't wash out into the soil treatment system. Solids can clog the soil and limit its ability to properly treat the septic-tank effluent." ■ EAWAG (2008) states: "Generally, septic tanks should be emptied every 2 to 5 years, although they should be checked yearly to ensure proper functioning."
Treatment	Generally, the removal of 50% of solids, 30-40% of biochemical oxygen demand[54] (BOD) and a 1-log removal of E.Coli[55] can be expected in a well designed and well functioning septic tank. Efficiencies vary greatly depending on operation and maintenance and climatic conditions. Although septic tanks can be installed in every type of climate, the efficiency will increase in warmer climates.
Considerations	Time is needed for bacteria to digest the waste. The tank needs to be large enough that fresh influent can sit for a while before being displaced as effluent. Obviously a higher volume of water flushing through the tank will need a larger tank. Not all sites are suitable for septic tank systems. Of primary concern is the type and porosity of the soil at the site. Soils that are too coarse or too fine can limit the effectiveness of the treatment system. Also the depth of the seasonally high water table or bedrock can also cause problems.

[54] Microorganisms such as bacteria are responsible for decomposing organic waste. When organic matter such as dead plants, leaves, grass clippings, manure, sewage, or even food waste is present in water, the bacteria will begin the process of breaking down this waste. When this happens, much of the available dissolved oxygen is consumed by aerobic bacteria, robbing other aquatic organisms of the oxygen they need to live. **Biological Oxygen Demand (BOD)** is a measure of the oxygen used by microorganisms to decompose this waste. If there is a large quantity of organic waste in the water, there will also be a lot of bacteria present working to decompose this waste. In this case, the demand for oxygen will be high so the BOD level will be high. As the waste is consumed or dispersed through the water, BOD levels will begin to decline.

[55] ***E.Coli*** is the common abbreviation of Escherichia Coli. It is a type of bacteria that inhabits the intestinal tract of humans and other mammals. It is not necessarily harmful, but it is used to indicate the presence of other, more dangerous bacteria. Their ability to survive for brief periods outside the body makes them an ideal indicator organism to test environmental samples for faecal contamination.

	A septic tank is appropriate where there is a way of dispersing or transporting the effluent. Because the septic tank must be desludged regularly, a vacuum truck should be able to access the location. If septic tanks are used in densely populated areas, onsite filtration should not be used otherwise the ground will become oversaturated and excreta may rise up to the surface posing a serious health risk. Instead the septic tank should be connected to a sewer and the effluent transported to a subsequent treatment or disposal site.
Potential problems	• Excessive dumping of cooking oils and grease can cause the inlet drains to block. Oils and grease are often difficult to degrade and can cause odour problems and difficulties with the periodic emptying. • Flushing non-biodegradable items such as cigarette butts and hygiene products such as sanitary towels and cotton buds will rapidly fill or clog a septic tank. • Certain chemicals may damage the working of a septic tank, especially pesticides, herbicides, materials with high concentrations of bleach or caustic soda or any other inorganic materials such as paints or solvents. • Covering the drainage field with an impervious surface, such as a driveway or parking area, will seriously affect its efficiency. • Excessive water entering the system will overload it and cause it to fail. • Putting an excess load on the system (more people) then the system is designed for can result in materials moving through the system too quickly to be decomposed and contamination problems may result. • Septic tanks by themselves are ineffective at removing nitrogen compounds that can potentially cause algal blooms in receiving waters. This can be remedied by ensuring that the leach field is properly sited to prevent direct entry of effluent into bodies of water.

Sources: http://en.wikipedia.org/wiki/Septic_tank
http://septictank.org/
http://www.johnstonsmith.co.uk/fact4.html
EAWAG (2008) *Compendium of Sanitation Systems and Technologies*. Available at:
http://www.eawag.ch/organisation/abteilungen/sandec/publikationen/compendium_e/index_EN

Appendix 12: Outcome of interviews with septage removal providers

#	Name of service provider	# of vacuum trucks			Average # of trips / month		Cost of emptying services		Dumping sites					Problems encountered		
										Alternative dumping sites						
		Small truck	Big truck	Totals	Dry season	Rainy season	Min	Max	Km 32	Own site	Paddy fields	Ketsana plantation	Remarks	KM32 is too far	Access road too difficult	No water available
1	Somyot Company	1	1	2	2	3	150.000	800.000	✓		Sometimes		Fee of cost	✓	✓	✓
2	Sai	1		1	15	25	150.000	300.000	✓						✓	✓
3	Kop	1		1	6	10	150.000	280.000	✓						✓	
4	Kong	1		1	3	4	150.000	250.000	✓					✓		
5	La Pathammavong	2	2	4	3	20	150.000	500.000		✓	Sometimes		Free of cost			
6	Phoovieng	1		1	10	5	150.000	220.000				✓	Free of cost	✓		
7	Daoheuang	1		1		5	180.000	300.000	✓						✓	
8	Thongtoom	2	1	3	30	40	150.000	280.000	✓			✓	Free of cost	✓		
9	Lea															
10	Phan	1		1	14	20	150.000	300.000	✓						✓	✓
11	Sit	1	1	2	20	25	150.000	250.000	✓			✓	Free of cost			
12	Somyot Chaokao	2		2	28	30	150.000	300.000	✓		✓		Free of cost	✓	✓	
13	Xuang	1		1	25	30	200.000	280.000	✓			✓	Free of cost		✓	✓
14	Khamsuay	1	1	2	10	10	150.000	250.000	✓					✓		
15	Sansouk	1		1	6	6	150.000	250.000	✓					✓	✓	
16	Sengkao															
17	Xieng	1	1	2	20	20	150.000	800.000	✓		✓		For a cost	✓		
Totals	**15**	**18**	**7**	**25**	**192**	**253**			**13**	**1**	**4**	**4**		**8**	**8**	**4**
Average		**1,2**	**0,5**	**1,7**	**12,8**	**16,9**	**155.333**	**357.333**								
Minimum		**1**	**1**	**1**	**2**	**3**	**150.000**	**220.000**								
Maximum		**2**	**2**	**4**	**30**	**40**	**200.000**	**800.000**								

						Actual survey results							
						Actual sample size		Respondents			Houses		
District	Vill_ID	Village Name	Total # of HH	Total # of persons	Sample size # of HH	# of HH surveyed	Actual as % of sample	Male	Female	Average age	Average # of persons per house	% of families owning the house	
Sikhottabong	9	B. Akat	370	2.084	44	34	77%	32%	68%	44	5,6	91%	
Sikhottabong	53	B. Nongdouang-Nua	273	1.475	32	38	119%	26%	74%	45	6,3	92%	
Sikhottabong	55	B. Nongdouang-Thong	258	1.583	31	43	139%	26%	74%	44	6,8	95%	
Sikhottabong	5	B. Vattainoy-Thong	196	998	23	25	109%	48%	52%	53	6,4	84%	
Sikhottabong			**1.097**	**6.140**	**130**	**140**	**108%**	**31%**	**69%**	**44**	**6,0**	**91%**	
Chanthabuly	32	B. Hatsadi-Tai	175	888	17	16	94%	31%	69%	41	4,9	94%	
Chanthabuly	36	B. Mixai	137	565	13	17	131%	18%	82%	34	5,1	59%	
Chanthabuly	1	B. Nongping	410	1.990	40	20	50%	30%	70%	48	5,1	95%	
Chanthabuly	025-6	B. Thongkhankham	406	2.707	39	50	128%	44%	56%	44	5,4	98%	
Chanthabuly			**1.128**	**6.150**	**109**	**103**	**94%**	**35%**	**65%**	**45**	**5,5**	**90%**	
Sisattanak	016-7	B. Bungkhagnong	426	2.847	46	48	104%	38%	63%	47	6,2	92%	
Sisattanak	33	B. Dongsavat	518	3.004	56	70	125%	33%	67%	40	5,2	87%	
Sisattanak	14	B. Phonsavan-Nua	382	2.042	42	46	110%	26%	74%	49	5,2	91%	
Sisattanak	31	B. Souanmon	197	1.148	22	13	59%	46%	54%	41	5,4	92%	
Sisattanak			**1.523**	**9.041**	**166**	**177**	**107%**	**33%**	**67%**	**44**	**5,5**	**90%**	
Xaysetha	32	B. Khamsavat	588	2.872	37	41	111%	37%	63%	39	5,1	90%	
Xaysetha	4	B. Phonphanao	576	3.021	36	39	108%	26%	74%	35	4,7	69%	
Xaysetha	14	B. Thatlouang-Kang	428	2.266	27	26	96%	42%	58%	45	5,0	88%	
Xaysetha	8	B. Thatlouang-Nua	322	1.897	20	22	110%	41%	59%	44	5,5	91%	
Xaysetha			**1.914**	**10.056**	**120**	**128**	**107%**	**35%**	**65%**	**40**	**5,0**	**84%**	
Totals			**5.662**	**31.387**	**525**	**548**	**104%**	**34%**	**66%**	**43**	**5,5**	**89%**	
N =								548	548	548	548	548	
Missing data								0	0	3	0	0	

Appendix 13.2: Household survey results - Information on toilets

		Actual survey results												
Vill_ID	Village Name	# of HH surveyed	Sanitary facilities		No of toilets per house					Type of toilets		No of people using toilets		
			% of houses with ≥1 toilets	% of houses without a toilet	1 toilet	2 toilets	3 toilets	4 or more toilets	Average # of toilets per HH	% of cistern flush toilets	% of pour-flush toilets	Minimum # of persons per toilet	Maximum # of persons per toilet	Average # of persons per toilet
9	B. Akat	34	100%	0%	23	6	4	1	1,5	19%	84%	2	13	3,7
53	B. Nongdouang-Nua	38	100%	0%	29	8	1	0	1,3	9%	91%	2	22	5,0
55	B. Nongdouang-Thong	43	67%	33%	28	1	0	0	1,0	0%	100%	3	16	6,2
5	B. Vattainoy-Thong	25	100%	0%	23	1	0	1	1,2	0%	100%	2	10	4,2
			0%	**0%**	**103**	**16**	**5**	**2**	**1,3**	**8%**	**92%**	**2**	**20**	**4,7**
32	B. Hatsadi-Tai	16	94%	6%	13	2	0	0	1,1	13%	88%	2	15	5,5
36	B. Mixai	17	100%	0%	13	3	1	0	1,3	33%	75%	3	11	4,0
1	B. Nongping	20	100%	0%	18	2	0	0	1,1	24%	81%	2	9	4,6
025-6	B. Thongkhankham	50	92%	8%	41	4	1	0	1,1	9%	92%	2	15	4,8
			0%	**0%**	**85**	**11**	**2**	**0**	**1,2**	**16%**	**86%**	**2**	**15**	**4,7**
016-7	B. Bungkhagnong	48	98%	2%	28	15	3	1	1,6	28%	78%	1	12	4,0
33	B. Dongsavat	70	94%	6%	49	13	3	1	1,3	14%	88%	1	13	3,9
14	B. Phonsavan-Nua	46	98%	2%	35	6	4	0	1,3	30%	77%	1	13	4,1
31	B. Souanmon	13	100%	0%	9	3	1	0	1,4	6%	94%	3	12	3,9
			0%	**0%**	**121**	**37**	**11**	**2**	**1,4**	**21%**	**83%**	**1**	**13**	**4,0**
32	B. Khamsavat	41	95%	5%	35	4	0	0	1,1	8%	93%	1	11	4,3
4	B. Phonphanao	39	97%	3%	28	8	2	0	1,3	10%	91%	1	14	3,9
14	B. Thatlouang-Kang	26	100%	0%	20	4	2	0	1,3	6%	94%	2	12	3,8
8	B. Thatlouang-Nua	22	100%	0%	19	2	0	1	1,2	13%	88%	1	12	4,5
			0%	**0%**	**102**	**18**	**4**	**1**	**1,2**	**9%**	**92%**	**1**	**14**	**4,1**
		548	**95%**	**5%**	**411**	**82**	**22**	**9**	**1,3**	**14%**	**88%**	**1**	**22**	**4,3**
		548	548	548	520	520	520	520	520	635	635	520	520	520
		0	0	0	0	0	0	0	0	3	3	0	0	0

				Actual survey results														
				No of septage storages per house			Type of septage storages								Evidence of discharge			
District	Vill_ID	Village Name	# of HH surveyed	1 septage storage	2 septage storages	3 or more septage storages	Direct pit	Single offset pit	Double offset pit	Rectangular tank	Septic tank	Direct to sewer	Direct to drain	Don't know	No evidence of discharge	Discharge into open drains	Discharge into open drains	Discharge into open drains
Sikhottabong	9	B. Akat	34	29	3	2	34%	20%	10%	10%	27%	0%	0%	0%	97%	3%	0%	0%
Sikhottabong	53	B. Nongdouang-Nua	38	35	3	0	44%	32%	2%	10%	12%	0%	0%	0%	92%	6%	3%	0%
Sikhottabong	55	B. Nongdouang-Thong	43	28	1	0	50%	7%	3%	3%	33%	0%	0%	3%	60%	36%	4%	0%
Sikhottabong	5	B. Vattainoy-Thong	25	24	0	1	41%	26%	19%	4%	11%	0%	0%	0%	88%	8%	0%	4%
Sikhottabong				**116**	**7**	**3**	**42%**	**22%**	**8%**	**7%**	**21%**	**0%**	**0%**	**1%**	**86%**	**12%**	**2%**	**1%**
Chanthabuly	32	B. Hatsadi-Tai	16	14	1	0	56%	0%	0%	19%	6%	19%	0%	0%	67%	20%	13%	0%
Chanthabuly	36	B. Mixai	17	16	1	0	78%	17%	0%	0%	0%	0%	0%	6%	92%	0%	8%	0%
Chanthabuly	1	B. Nongping	20	18	2	0	41%	36%	9%	9%	5%	0%	0%	0%	83%	11%	0%	6%
Chanthabuly	025-6	B. Thongkhankham	50	46	0	0	65%	7%	0%	2%	7%	20%	0%	0%	95%	0%	5%	0%
Chanthabuly				**94**	**4**	**0**	**61%**	**14%**	**2%**	**6%**	**5%**	**12%**	**0%**	**1%**	**87%**	**6%**	**6%**	**1%**
Sisattanak	016-7	B. Bungkhagnong	48	31	16	0	43%	13%	6%	5%	33%	0%	0%	0%	80%	16%	4%	0%
Sisattanak	33	B. Dongsavat	70	54	9	3	54%	8%	1%	11%	25%	0%	0%	0%	96%	1%	0%	3%
Sisattanak	14	B. Phonsavan-Nua	46	37	6	2	51%	11%	5%	5%	27%	0%	0%	0%	65%	33%	0%	2%
Sisattanak	31	B. Souanmon	13	11	2	0	47%	13%	7%	13%	13%	0%	7%	0%	79%	21%	0%	0%
Sisattanak				**133**	**33**	**5**	**50%**	**11%**	**4%**	**8%**	**27%**	**0%**	**0%**	**0%**	**82%**	**16%**	**1%**	**2%**
Xaysetha	32	B. Khamsavat	41	38	1	0	43%	13%	3%	15%	23%	0%	0%	5%	92%	4%	4%	0%
Xaysetha	4	B. Phonphanao	39	33	5	0	35%	16%	0%	12%	37%	0%	0%	0%	68%	21%	11%	0%
Xaysetha	14	B. Thatlouang-Kang	26	24	1	1	59%	7%	3%	3%	28%	0%	0%	0%	80%	20%	0%	0%
Xaysetha	8	B. Thatlouang-Nua	22	19	3	0	60%	12%	0%	8%	20%	0%	0%	0%	79%	21%	0%	0%
Xaysetha				**114**	**10**	**1**	**47%**	**12%**	**1%**	**10%**	**28%**	**0%**	**0%**	**1%**	**79%**	**17%**	**4%**	**0%**
Totals			**548**	**457**	**54**	**17**	**49%**	**14%**	**4%**	**8%**	**22%**	**2%**	**0%**	**1%**	**83%**	**13%**	**3%**	**1%**
N =			548	520	520	520	594	594	594	594	594	594	594	594	594	594	594	594
Missing data			0	0	0	0	0	0	0	0	0	0	0	0	84	84	84	84

Appendix 13.4: Household survey results - Other information

					Actual survey results									
						Flooding	Construction costs			Septage emptying		Toilet characteristics		
Vill_ID	Village Name	Total # of HH	Total # of persons	Sample size # of HH	# of HH surveyed	% of houses with risk of flooding	Minimum costs	Maximum costs	Average costs	% of septage storages ever emptied	Average emptying costs	% of toilets durable	% of toilets with handwashing place	% of toilets with soap
9	B. Akat	370	2.084	44	34	47%				49%		71%	49%	65%
53	B. Nongdouang-Nua	273	1.475	32	38	37%				54%		73%	50%	58%
55	B. Nongdouang-Thong	258	1.583	31	43	44%				43%		37%	30%	33%
5	B. Vattainoy-Thong	196	998	23	25	44%				48%		59%	30%	59%
		1.097	**6.140**	**130**	**140**	**43%**	**190.000**	**28.590.000**	**4.160.000**	**49%**	**200.000**	63%	42%	56%
32	B. Hatsadi-Tai	175	888	17	16	25%				19%		88%	41%	59%
36	B. Mixai	137	565	13	17	12%				50%		62%	24%	57%
1	B. Nongping	410	1.990	40	20	10%				55%		62%	29%	33%
025-6	B. Thongkhankham	406	2.707	39	50	54%				22%		35%	22%	39%
		1.128	**6.150**	**109**	**103**	**34%**	**120.000**	**19.180.000**	**2.350.000**	**33%**	**210.000**	54%	26%	45%
016-7	B. Bungkhagnong	426	2.847	46	48	31%				44%		75%	41%	61%
33	B. Dongsavat	518	3.004	56	70	1%				8%		73%	32%	43%
14	B. Phonsavan-Nua	382	2.042	42	46	33%				42%		70%	37%	54%
31	B. Souanmon	197	1.148	22	13	23%				33%		83%	44%	67%
		1.523	**9.041**	**166**	**177**	**19%**	**100.000**	**31.890.000**	**3.280.000**	**29%**	**230.000**	74%	37%	53%
32	B. Khamsavat	588	2.872	37	41	22%				18%		60%	33%	36%
4	B. Phonphanao	576	3.021	36	39	41%				42%		80%	33%	59%
14	B. Thatlouang-Kang	428	2.266	27	26	35%				59%		65%	38%	50%
8	B. Thatlouang-Nua	322	1.897	20	22	9%				44%		77%	27%	73%
		1.914	**10.056**	**120**	**128**	**28%**	**300.000**	**7.700.000**	**2.200.000**	**39%**	**210.000**	70%	33%	53%
		5.662	**31.387**	**525**	**548**	**30%**	**100.000**	**31.890.000**	**3.010.000**	**37%**	**210.000**	**67%**	**35%**	**52%**
						548	123	123	123	594	170	635	635	635
						0				0		0	3	3

#	Village name	District	General information														
			Interviewee		Dormitory details				Building used for survey				Occupants	Building used for survey			
			Sex	Age	Ownership	When built	Dormitory building	# of buildings	# of floors	# of rooms	# of people	Average # persons/room	Type of occupants	Singles / Families	Sex		
1	Phonsavang	Chanthabuly	Female	42	Government	1980	Dormitory of Hospital 150 employees	2	4	32	120	3,8	GOL employees	Families	M/F/C		
2	Sisavat-Tai	Chanthabuly	Male	26	Goverment	<1960	Lao Youth Union dormitory	1	2	10	11	1,1	GOL employees	Families	M/F/C		
3	Thongsangnang	Chanthabuly	Male	35	Private invidual	1990	Dormitory of factory workers	2	2	24	126	5,3	Factory workers	Peers or friends	F		
4	Phonpapao	Sisattanak	Female	29	Company	Unknown	Dormitory of factory workers	2	2	80	320	4,0	Factory workers	Peers or friends	F		
5	Phonpapao-Tha	Sisattanak	Male	26	Government	1979	Teachers dormitory	2	3	24	76	3,2	Teachers	Families	M/F/C		
6	Phonpapao-Tha	Sisattanak	Male	30	Government	1986	Teacher's dormitory	2	3	24	96	4,0	Teachers	Families	M/F/C		
7	Saphanthong	Sisattanak	Male	33	Lao Armed Forces	1995	Dormitory Hospital 103 nursing school	1	2	16	206	12,9	Students	Peers or friends	M/F		
8	Sokpalouang	Sisattanak	Male	50	Government	1980	Students dormitory	5	3	35	252	7,2	Students	Peers or friends	F		
9	Vatnak	Sisattanak	Male	46	State owned enterprise	<1960	EDL employees dormitory	1	2	13	33	2,5	Other	Peers or friends	M/F/C		
10	Nongnieng	Xaysetha	Male	42	Lao Police Forces	1985	Dormitory Special Police Force school	3	1	9	37	4,1	Students	Peers or friends	M/F		
Totals and averages										**267**	**1.277**						
Average				**36**				**2,1**	**2,4**	**26,7**	**127,7**	**4,8**					
Minimum								**1**	**2**	**9**	**11**	**1,1**					
Maximum								**5**	**3**	**80**	**320**	**12,9**					

Appendix 14.2: Dormitory survey results - Information on toilets

#	Village name	District	Year of construction	Details on toilets: Type of toilet: Shared or individual family toilets: Shared toilets	Individual toilet per room	Both shared and individual toilets	Type of toilet system: Cistern flush toilet	Pour-flush toilet	Number of toilets: Urinal	Toilet	Combined toilet / bathroom	Totals (excl. urinals)	Totals not in use	Totals actually in use	Users per toilet: No of users	Average # of users / toilet	Are toilets in use
1	Phonsavang	Chanthabuly	1980	0	Yes	0	1		0	32	0	32	0	32	120	3,8	Yes
2	Sisavat-Tai	Chanthabuly	Unknown	0	0	Yes		1	0	0	7	7	2	5	11	2,2	Yes
3	Thongsangnang	Chanthabuly	1990	Yes	0	0		1	0	10	0	10	0	10	126	12,6	Yes
4	Phonpapao	Sisattanak	Unknown	Yes	0	0		1	0	22	0	22	0	22	320	14,5	Yes
5	Phonpapao-Tha	Sisattanak	1979	0	Yes	0		1	0	0	24	24	0	24	76	3,2	Yes
6	Phonpapao-Tha	Sisattanak	1986	0	Yes	0	1		0	0	24	24	0	24	96	4,0	Yes
7	Saphanthong	Sisattanak	1995	Yes	0	0		1	3	20	0	20	7	13	206	15,8	Yes
8	Sokpalouang	Sisattanak	1980	Yes	0	0		1	0	0	4	4	0	4	252	63,0	Yes
9	Vatnak	Sisattanak	Unknown	Yes	0	0		1	0	3	4	7	3	4	33	8,3	Yes
10	Nongnieng	Xaysetha	1985	Yes	0	0		1	0	16	0	16	0	16	37	2,3	Yes
Totals				**6**	**3**	**1**	**2**	**8**	**3**	**103**	**63**	**166**	**12**	**154**	**1.277**	**8,3**	**10**
Average												**17**		**15**	**128**	**13,0**	
Minimum									**0**	**0**	**0**	**4**	**0**	**4**	**11**	**2,2**	
Maximum									**3**	**32**	**24**	**32**	**7**	**32**	**320**	**63,0**	

Appendix 14.3: Dormitory survey results - Information on toilets #2

			Details on toilets														
#	Village name	District	Year of construction	Cleaning arrangements				Rating of easiness to clean by enumerators	Rating of cleanliness		Rating of hygienic status by enumerators			Handwashing place with soap		
				Who is responsible?	Who cleans?	How is this organised?	Are fees collected?		By occupants	By enumerators	Contact with faeces	Bad smell	Flies in toilet	Handwashing place		Toilets with soap
														Inside toilet	Outside	
1	Phonsavang	Chanthabuly	1980	Occupants	Occupants	No rules set	No	Questionable	Neutral	Neutral	No	No	No	0	0	0
2	Sisavat-Tai	Chanthabuly	Unknown	Occupants	Occupants	No rules set	No	Not easy	Neutral	Neutral	No	No	No	1	0	0
3	Thongsangnang	Chanthabuly	1990	Occupants	Occupants	Take turn	No	Not easy	Not clean	Neutral	No	No	No	0	0	0
4	Phonpapao	Sisattanak	Unknown	Owner	Housekeeper	Hire personnel	No	Easy	Clean	Neutral	No	Yes	No	0	1	0
5	Phonpapao-Tha	Sisattanak	1979	Occupants	Occupants	Take turn	No	Not easy	Neutral	Neutral	No	Yes	No	1	0	1
6	Phonpapao-Tha	Sisattanak	1986	Occupants	Occupants	Take turn	No	Not easy	Neutral	Not clean	No	Yes	No	1	0	1
7	Saphanthong	Sisattanak	1995	Occupants	Occupants	Take turn	No	Easy	Neutral	Neutral	No	No	No	0	0	0
8	Sokpalouang	Sisattanak	1980	Owner	Housekeeper	Hire personnel	No	Not easy	Not clean	Not clean	No	Yes	Yes	0	0	0
9	Vatnak	Sisattanak	Unknown	Occupants	Occupants	No rules set	No	Not easy	Neutral	Not clean	No	Yes	No	0	0	0
10	Nongnieng	Xaysetha	1985	Occupants	Occupants	Take turn	No	Not easy	Neutral	Neutral	No	No	No	0	0	0
Totals and averages											0	5	1	3	1	2

#	Village name	District	Year of construction	Details on septage storage										
				Tpe of septage storage			Pit/tank emptying issues							
				Direct pit under toilet	Offset pit or tank	Septic tank	Has pit/tank ever filled up		Frequency of emptying			What was done?		Last time emptyied
							Yes	Never	Every year	Every 2 years	Every 3 years	Built new pit or tank	Emptyied by vacuum truck	
1	Phonsavang	Chanthabuly	1980	0	0	1	0	1	0	0	0			
2	Sisavat-Tai	Chanthabuly	1979	0	1	0	1	0	0	0	1	Yes		
3	Thongsangnang	Chanthabuly	1990	0	1	0	1	0	0	1	0		Yes	Last year
4	Phonpapao	Sisattanak	Unknown	0	0	1	1	0	1	0	0		Yes	Last year
5	Phonpapao-Tha	Sisattanak	1980	0	0	1	0	1	0	0	0			
6	Phonpapao-Tha	Sisattanak	1980	0	0	1	0	1	0	0	0			
7	Saphanthong	Sisattanak	1995	0	0	1	1	0	1	0	0		Yes	Last year
8	Sokpalouang	Sisattanak	1980	0	0	1	1	0	1	0	0		Yes	Last year
9	Vatnak	Sisattanak	Don't know	1	0	1	1	0	1	0	0		Yes	Last year
10	Nongnieng	Xaysetha	1985	0	0	1	1	0	0	0	1		Yes	< 3 years
Totals and averages				1	2	8	7	3	4	1	2	1	6	

Appendix 15: Meeting list

Date	Organisation	Person met	Contact details
20May 2010	Water and Sanitation Program (WSP)	Mr Viengsamay VONGKHAMSAO Country Team Leader	021-416710 vvongkhamsao@worldbank.org
		Mr Jeremy Colin Consultant	jemcolin@tesco.net
27 May 2010	Water and Sanitation Program (WSP)	Mr Bounthavong SOURISAK Social Development Specialist	021-416710 bsourisak@worldbank.org
26 May 2010	Public Works and Transport Institute, Ministry of Public Works and Transport	Mrs Saykham THAMMANOSOUTH Director Cooperation and Training Division	021-412285 O20-5601171
		Mr Thenekham THONGBONH Director General	021-412285 020-55514533
26 May 2010	Department of Public Works and Transport, Vientiane Municipality	Mr. Keophilavanh APHAYLATH Director	020-55520422 aphaylath@yahoo.com
27 May 2010	World Wide Fund for Nature (WWF)	Mrs Pauline Gerrard	
2 June 2010	UN-HABITAT	Mr Buahom SENGKHAMYONG Chief Technical Advisor	bsengkhamyong@yahoo.com
2 June 2010	Northern and Central Region Water Supply and Sanitation Sector Project (NCRWSP)	Mr Phomma VEORAVANH Project Director	021-416519 ncrwssp@laotel.com
		Mr Graham Jackson Team Leader	020-2221002 gjackson@truemail.co.th
3 June 2010 6 June 2010	Vientiane Urban Development and Administration Authority (VUDAA)	Mr Khampiane INTHALUXA Deputy Director	021-244347-9 020-5502815
10 June	Household survey selection meeting at VUDAA	Mr. Veha of the Bridge and Road Section and representatives of the four municipal districts	
1 July 2010	Water Resources and Environment Administration (WREA)	Mr Vanhxay PHIOMANYVONE Technician Department of Environment	020-5413268 p-vxay@yahoo.com
		Mr Sengkeo TASAKETH Technician Pollution Control Division, Department of Environment	021-218712 020-2001722 tsengkeo@yahoo.com
13 July 2010	The Study on Improvement of Water Environment in Vientiane City	Ms Maniseng DOUANGNOULACK Deputy Director of Urban Engineering Division of the Public Works and Transport Institute	021-263177 020-2205018 mdouangnoulack@yahoo.com
		Mr Vongsack MIXAY Environment Engineer/Urban Planner, Urban Engineering Division of the Public Works and Transport Institute	021-412285/263177 vongsack@yahoo.com vongsack@gmail.com
		Mr Hitoshi SHIMOKOCHI Civil Engineer responsible for sanitation/water quality analysis / water quality improvement planning and member of the JICA Study Team	021-263177 020-7836401 shimokochi@ctii.co.jp
15 July 2010	Vientiane Urban	Mr Sisouk THORATHA	021-218872

Date	Organisation	Person met	Contact details
	Development and Administration Authority (VUDAA)	Chief Environment Unit	020-55505716 sisoukthoratha@yahoo.com
16 July 2010	Office of Public Works and Transport Sisattanak District	Mr Boula Technician	020-2221696
17 July 2010	Solid Waste Disposal Site at Km 32	Mr Bounta Head	020-
		Mr Banh Deputy Head	
17 July 2010	Dongxiendy Village, Nasaythong District	Mr Khonsy Village Chief	
19 July 2010	Office of Public Works and Transport Chantabouly District	Mr Chittavong Technician	020-55698665
20 July 2010	Vientiane Urban Development and Administration Authority (VUDAA)	Mr Amphavanh MANIVANH Head of Housing and Urban Planning Division	021-218872 020-5606947
20 July 2010	Water Resources and Environment Administration (WREA)	Mr Ketkeo SALICHANH Director of Policy and Law Division Department of Environment	021-218712-222-752 020-5507180 salichanh@hotmail.com salichanh@yahoo.com
21 July 2010	Water Supply and Environmental Health Section (Nam Saat) Department of Public Health Vientiane Capital	Mr Pany VONGPADITH Head	020-55917938
22 July 2010	Public Works and Transport Institute, Ministry of Public Works and Transport	Ms Saykham THAMMANOSOUTH Director of Planning and Cooperation Division	021-412285 020-5601170 saykamt@yahoo.com
		Mr. Phouthala SOUKSAKHONE Deputy Director of Planning and Cooperation Division	021-412285 020-2205116 phouthala@yahoo.com
22 July 2010	Water Resources and Environment Office Vientiane Capital	Ms Khamfong PHOUMVONGXAY Director	021-720413 020-55400430 wreo.vte@hotmail.com
23 July 2010	Department of Housing and Urban Planning, Ministry of Public Works and Transport	Mr Bounthong KEOHANAM Director Division of Urban Development	021-911322 020-5699286 Bunthong2002@yahoo.co.uk
23 July 2010	Follow up meeting at VUDAA	Mr Amphavanh MANIVANH Mr Veha	
23 July 2010	Progress meeting at WSP	Mr Viengsamay VONGKHAMSAO	
27 July 2010	Progress meeting at VUDAA	Mr Khampiane INTHALUXA	
28 July 2010	Department of Public Works and Transport Vientiane Capital	Mr Phetnakhone PHASAVAT Engineer	021-212631 020-2449070 phetnakhone@dpwt.laopdr.org

Appendix 16 Ground water survey results

Analysis Against the Drinking Water Quality Parameters

Result of water Quality analysis

Testing undertaken by the National Centre for Environmental Health and Water Supply

No	Sampling location (villages)	pH	Cond-uctivity	Turbidity	Test & Odour	Fe	Mn	NO_3	NO_2	As	F	Total Hard	Coli form
	Standard	6.5-8.5	<1000 uS/cm	<10 NTU	Accept	<1 Mg/l	<0.5 Mg/l	50 Mg/l	<3 Mg/l	0.05 Mg/l	1.5 Mg/l	<300 Mg/l	0/100 ml
1	Sokpaluang temple 1	5.7	65.8	0	Accept	0.14	0	3.8	0.007	0	0	20	2
2	Sokpaluang temple 2	5.72	93.5	16	Accept	1.05	0.031	1.5	0.005	0	0	20	6
3	Saladeng temple	6.63	393	39	Accept	2.35	0.025	4.3	0.011	0	0	100	42
4	That khao temple	8.4	538	6	Accept	0.05	0.106	2.4	0.004	0	0	180	18
5	Sangwery village	5.5	207	0	Accept	0.02	0.012	4	0.007	0	0.01	20	33
6	Dongsavath village 1	6.4	106.3	0	Accept	0.03	0.002	6.2	0.006	0	0.4	20	9
7	Dongsavath village 2	6.4	67.7	0	Accept	0.03	0.001	4.7	0.005	0	0.56	20	4
8	Nongping village 1	6.6	105	0	Accept	0.02	0.004	3.5	0.002	0	0.44	20	22
9	Nongping village 2	5.5	119.4	1	Accept	0.04	0.009	1.2	0.004	0	0.4	20	7
10	Haiysok village	8.88	575	0	Accept	0.1	0.042	1.6	0.005	0	0.36	120	15
11	Khamsavath village 1	5.53	62.3	3	Accept	0.04	0.011	1.9	0.01	0	0	20	18
12	Khamsavath village 2	5.64	18.3	1	Accept	2.44	0.007	1.2	0.044	0	0.52	20	0
13	phonpanaow village	6.6	192.6	8	Accept	0.2	0.003	1.9	0.027	0	0.58	20	8
14	Thatluang village 1	5.98	257	34	Accept	0.09	0.03	2.1	0.012	0.01	0.44	60	34
15	Thatluang village 2	6	295	0	Accept	2.18	0.061	5.5	0.32	0	0.08	60	9
16	SNV	5.85	166.4	1	Accept	0.32	0.018	8.2	0	0	0.13	60	1
17	Tainoy Temple	6.75	181	0	Accept	0.01	0.007	3.6	0.227	0	0.01	60	6
18	Oupmoung Temple	7	419	0	Accept	0.01	0.027	5.6	0.038	0	0.15	100	3
19	NongDouang village	6.39	132	0	Accept	0.01	0.03	6.1	0.006	0	0.16	60	1
20	NongDuang thong village	6.75	39.4	0	Accept	0.01	0.001	2.7	0.006	0	0.05	20	12
21	NongDuang neua village	6.6	533	3	Accept	1.62	0.097	9.8	0	0	0.17	140	35
22	Phonsavath Neua village	5.38	41.6	189	Accept	0.25	0.022	1.3	0.001	0	0.44	60	0
23	Dongnasok Temple	5.29	91	4	Accept	0.09	0.019	3.6	0.004	0	0	20	40
24	Nongbuathong NeuaTemple	5.4	97.4	7	Accept	0.15	0.024	2.5	0.005	0	0	60	63
25	Phonkham Temple	4.43	75.5	2	Accept	0.03	0.008	3.7	0.002	0	0.06	60	82
26	Nongbaothong tai Temple	4.92	26.5	16	Accept	0.29	0.023	1.4	0.004	0	0.6	60	14
27	Dongpalap Temple	4.9	182.4	1	Accept	0.02	0.016	5.1	0.006	0	0	60	21
28	Chommany Neua village	4.74	273	1	Accept	0.11	0.021	1.9	0.004	0	0.2	60	1
29	Amone village	5.24	84	12	Accept	0.76	0.036	0.9	0.008	0	0	60	33
30	Nonesavang village	5.6	91.4	0	Accept	0.11	0.015	4.1	0.005	0	0	60	7
31	Phonpapaow village	4.7	122	0	Accept	0.15	0.003	3.4	0.009	0	0	20	4
32	Phonpapaow Teample	5.97	353	14	Accept	3.3	0.079	3.4	0	0	0.14	100	72
33	Sapanthong village	6.58	413	0	Accept	0.02	0.023	3.1	0	0	0.02	60	35

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	pH	Cond	Turbi	Test and Odour	Fe	Mn	NO_3	NO_2	As	F	T-Hard	erant Coliform
	6.5-8.5	<1000 uS/cm	<10 NTU	Accept	<1 Mg/l	<0.5 Mg/l	50 Mg/l	<3 Mg/l	0.05 Mg/l	1.5 Mg/l	<300 Mg/l	0/100 ml
Sample Exceeding paramenter	20	0	7	0	6	0	0	0	0	0	0	31
	61%	0%	21%	0%	18%	0%	0%	0%	0%	0%	0%	94%

Count per 100ml	Code & colour	# of Samples	% of Samples	Remarks
0	A (blue)	2	6%	In conformity with WHO guidelines
1-10	B (green)	14	42%	Low risk
10-100	C (yellow)	17	52%	Intermediate risk
100-1000	D (orange)	0	0%	High risk
>1,000	E (red)	0	0%	Very high risk
		33		

Analysis against the Wastewater discharge standards parameters

Result of Water Quality Analysis

Testing undertaken by the Chinaimo Water Treatment Plant Laboratory, Nakhoneluang, "Nam Papa Vientiane".

Ref	Sampling Location	Sampling day	pH	Sulfide (S^2)	COD_{Mn}	BOD_5	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Settable Solids (SS)	Results from separate comparative test against DWS: Faecal Coliform
N.1	Sokpaluang temple 1	28/09/2010	5.7	0.05	0.4	6.1	<2	48	<0.1	0
N.2	Sokpaluang temple 2	28/09/2010	5.2	0.03	7.8	7.8	7.8	76	<0.1	16
N3	Saladeng temple	28/09/2010	6.6	0.02	11.4	11.4	10.4	215	0.1	23
N4	That khao temple	28/09/2010	8.3	0.04	4.9	4.9	3	394	<.1	2.2
N5	Sangwery village	28/09/2010	5.6	0.04	3.4	3.4	<2	133	<0.1	16
N6	Dongsavath village 1	28/09/2010	4.6	0.05	2.2	2.2	<2	87	<0.1	5.2
N7	Dongsavath village 2	28/09/2010	4.7	0.03	5.1	5.1	<2	49	<0.1	23
N8	Nongping village 1	28/09/2010	6.6	0.01	3.8	3.8	<2	73	<0.1	9.2
N9	Nongping village 2	28/09/2010	5.5	0.02	0.8	3.9	10.4	63	<0.1	0
N10	Haiysok village	28/09/2010	8.8	0.05	2.1	4.8	2	270	<0.1	23
N11	Khamsavath village 1	30/9/10	6.1	0.02	2.3	11.1	12.4	726	0.1	>23
N12	Khamsavath village 2	30/9/10	6.2	0.03	1.5	4.1	<2	46	<0.1	0
N13	phonpanaow village	30/9/10	6.2	0.03	2.5	4.6	<2	197	<0.1	5.1
N14	Thatluang village 1	30/9/10	6.4	0.01	5	3	38	187	<0.1	>23
N15	Thatluang village 2	30/9/10	6.1	0.03	2.7	6.6	2	203	<0.1	0
N16	SNV	30/9/10	6	0.01	1.9	0.3	<2	118	<0.1	>23
N17	Tainoy Temple	30/9/10	6.6	0.02	5.7	5.3	<2	444	<0.1	>23
N18	Oupmoung Temple	30/9/10	6.8	0.01	9.5	3.4	<2	329	<0.1	>23
N19	NongDouang village	30/9/10	6.7	0.01	1.7	3.4	<2	221	<0.1	>23
N20	NongDuang thong village	30/9/10	6.2	0.01	1.7	3.3	<2	416	<0.1	>23
N21	NongDuang neua village	30/9/10	6.6	0.02	5.3	11.6	12	347	0.1	>23
N22	Phonsavath Neua village	12/10/2010	6	0.09	17.7	0.4	208	30	<0.1	16
N23	Dongnasok Temple	12/10/2010	5.9	0.04	19.4	1.2	16	59	<0.1	16
N24	Nongbuathong NeuaTemple	12/10/2010	5.9	0.01	18.1	0.4	5	64	<0.1	16
N25	Phonkham Temple	12/10/2010	5.4	0.03	17.9	0.2	<2	37	<0.1	2.2
N26	Nongbaothong tai Temple	12/10/2010	5.4	0.05	18.6	15.7	10.4	34	<0.1	9.2
N27	Dongpalap Temple	12/10/2010	5.5	0.02	17.9	2.4	<2	105	<0.1	0
N28	Chommany Neua village	12/10/2010	5.1	0.04	18.1	3.8	<2	237	<0.1	16
N29	Amone village	12/10/2010	5.6	0.05	20.5	2.9	6.7	63	<0.1	9.2
N30	Nonesavang village	12/10/2010	5.8	0.04	17.5	2.2	<2	87	<0.1	9.2
N31	Phonpapaow village	12/10/2010	5.2	0.05	18.5	8.8	<2	83	<0.1	5.1
N32	Phonpapaow Teample	12/10/2010	6.1	0.04	17.7	1.6	<2	234	0.1	>23
N33	Sapanthong village	12/10/2010	6.8	0.04	17.7	1.6	<2	315	<0.1	0

	pH	Sulfide (S^2)	COD_{Mn}	BOD_5	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Settle able Solids (SS)	Faecal Coliform
Parameters	**6-9.5**	**4**	**350**	**60**	**50**	**1500**	**0.5**	**>0**
33	15	0	0	0	0	0	0	27
	45%							82%

Appendix 17 Drinking Water and Environmental Waste Water Quality Standards

DRINKING WATER QUALITY STANDARDS (PRIORITIES OF PARAMETERS)

Decision on the Management of Quality Standards for Drinking Water and Household Water Supply *(No. 1371/MoH) October 2005*

No.	Parameters	Units	Concentration
1	pH		6.5-8.25
2	Turbidity	NTU	<10
3	Taste and odour		Acceptable
4	Conductivity	uS/cm	1000
5	Iron	mg/l	<1
6	Manganese	mg/l	<0.5
7	Arsenic	mg/l	<0.05
8	Fluoride	mg/l	<1.5
9	Nitrate	mg/l	50
10	Thermotolerant coliform	No/100 ml	0
11	Total hardness	mg/l	<300
12	Nitrite	mg/l	3
13	Residual chlorine in chlorinated water supply	mg/l	0.2

Wastewater Discharge Standards from the Urban Area (5.5)
Wastewater Discharge Standards
Agreement on Natural Environmental Standards Vientiane Capital 2010,following **Instruction #2734/PMO/WREA dated December 7 2009),**

#	Parameters	Symbol	Standards				
			A	**B**	**C**	**D**	**E**
1.	Biochemical Oxygen Demand	BOD5	Not more than (mg/l)				
			30	40	50	60	200
2.	Suspended Solids	SS	Not more than (mg/l)				
			30	40	50	50	60
3.	Settle able Solids	-	Not more than (mg/l)				
			0.5	0.5	0.5	0.5	
4.	Total Dissolved Solids	TDS	Not more than (mg/l)				
			3000	2500	2000	1500	
5.	Chemical Oxygen Demand	COD	Not more than (mg/l)				
			120	130	150	350	400
6.	Sulphide	S^{2-}	Not more than (mg/l)				
			1.0	1.0	3.0	4.0	
7.	Total Kjeldahl Nitrogen	TKN	Not more than (mg/l)				
			35	35	40	40	
8.	Fat Oil and Grease	-	Not more than (mg/l)				
			20	20	20	20	100
9.	Temperature	t	Not more than (degree Celsius)				
			40	40	40	40	40
10.	Potential of Hydrogen	pH	Not more than				
			6-9.5	6-9.5	6-9.5	6-9.5	6-9.5
11	Faecal Coliform						

Classification of buildings according to the Wastewater Discharge Standards (table 5.5.2)

No	Types of Buildings	Size of Buildings	Standard
1.	Buildings	Less than 100 rooms From 101 to 500 rooms Above 501 rooms	D C B
2.	Hotels	Less than 60 rooms From 61 to 200 rooms Above 201 rooms	D C B
3.	Dormitories	From 10 to 50 rooms From 51 to 250 rooms Above 251 rooms	D C B
4.	Medical Centers, Hospitals, Clinic	No bed From 1 to 30 beds. Above 31 beds.	C B A
	Classification of buildings per Area		
	Residential, temple	From 5,000 to 10000 sq. m Above 10001 sq. m	E D
6	Entertainment zone, health center swimming pool, Fitness Center	From 1000 to 5000 sq. m Above 5001 sq. m	D B
7	School, Educational institutions, College, Universities	From 5000 to 25000 sq. m Above 25001 sq. m	B A
8.	Office, enterprises, foreign and private buildings, Hall	From 5000 to 10000 sq. m. From 10001 to 55000 sq. m Above 55001 sq. m	C B A
9.	Commercial centers and Supermarkets	From 5000 to 25000 sq. m Above 25001 sq. m	B A
10.	Markets	From 500 to 1,000 sq. m From 1001 to 1500 sq. m From 1501 to 2500 sq. m Above 2501 sq. m	D C B A
11	Restaurants	Less than 1000 sq. m From 500 to 1000 sq. m From 1001 to 1500 sq. m From 1501 to 2500 sq. m Above 2501 sq. m	E D C B A
12	Auto service center (Motorbike, car)	From 500 to 1000 sq. m From 1,001 to 1500 sq. m From 1,501 to 2500 sq. m Above 2501 sq. m	D C B A
13	Terminal Stations, Airport.	From 5000 to 10000 sq. m From 10001 to 55000 sq. m Above 55001 sq. m	C B A
14	Slaughterhouse in City	From 500 to 1000 sq. m From 1001 to 1500 sq. m From 1501 to 2500 sq. m Above 2501 sq. m	D C B A

Appendix 18 Sanitation Construction Materials

Maximum median and minimum process reported and stockage count

			Lao Kip				US dollar equivalent (US$1+8040 Kip)		
Hardware type	**Items**		**Max**	**Mean**	**Minimum**	**Count**	**Max**	**Mean**	**Minimum**
(Toilet pans)	(Cistern Flush Toilet) VN		**455,000**	**446,000**	**442,000**	4	$56.6	$55.5	$55.0
	(Cistern Flush Toilet) Thai		**728,000**	**562,000**	**468,000**	10	$90.5	$69.9	$58.2
	(Pour flush Pan ceramic),VN		**60,000**	**50,000**	**50,000**	13	$7.5	$6.2	$6.2
	(Pour Flush Pan concrete)					0	$0.0	$0.0	$0.0
	(Pour Flush Pan plastic)					0	$0.0	$0.0	$0.0
Pipes	PVC P'100 Lao		**130,000**	**70,000**	**60,000**	15	$16.2	$8.7	$7.5
	PVC Pipe '100 Thai		**185,000**	**116,000**	**60,000**	12	$23.0	$14.4	$7.5
	PVC P'18 Lao		**70,000**	**13,000**	**9,000**	15	$8.7	$1.6	$1.1
	(copper pipe)			**70,000**	**70,000**	1	$0.0	$8.7	$8.7
	(Green Hose Pipe) TH		**4,000**	**3,000**	**1,500**	13	$0.5	$0.4	$0.2
	(White Hose Pipe)VN		**4,000**	**3,000**	**3,000**	4	$0.5	$0.4	$0.4
	(hosepipe) Lao		**5,000**	**3,250**	**1,500**	6	$0.6	$0.4	$0.2
Cement and Aggregate	(cement-"green")		**37,000**	**36,000**	**35,000**	15	$4.6	$4.5	$4.4
	(cement-"red")		**41,000**	**40,000**	**36,000**	15	$5.1	$5.0	$4.5
	("1,2" aggregate/gravel) 1m3		**120,000**	**120,000**	**120,000**	1	$14.9	$14.9	$14.9
Roofing	(6ft roofing sheet- "white")		**68,000**	**30,000**	**22,000**	9	$8.5	$3.7	$2.7
	(8ft roofing sheet- "white")		**36,000**	**30,000**	**28,000**	9	$4.5	$3.7	$3.5
Rebar	(smooth rebar 12mm)		**75,000**	**55,000**	**29,000**	13	$9.3	$6.8	$3.6
	("edged" rebar 12mm)		**57,000**	**36,000**	**24,000**	14	$7.1	$4.5	$3.0
	(smooth rebar 10mm)		**68,000**	**47,000**	**22,000**	13	$8.5	$5.8	$2.7
	(edged rebar 10mm)		**48,000**	**25,000**	**17,000**	11	$6.0	$3.1	$2.1
	(smooth rebar 8mm) VN		**28,000**	**17,000**	**12,000**	6	$3.5	$2.1	$1.5
	(smooth rebar 6mm) VN		**28,000**	**15,000**	**7,000**	11	$3.5	$1.9	$0.9
	(smooth rebar 6mm) Lao		**18,000**	**13,500**	**7,000**	8	$2.2	$1.7	$0.9
Nails	(Nails) 4 (5-12) cm		**18,000**	**12,500**	**10,000**	16	$2.2	$1.6	$1.2
	4 cm (Nails)		**20,000**	**16,500**	**13,000**	14	$2.5	$2.1	$1.6
Bricks blocks and (precast) columns	(bricks)		**300**	**300**	**300**	2	$0.0	$0.0	$0.0
	(Concrete blocks)		**1,500**	**1,400**	**1,400**	7	$0.2	$0.2	$0.2
	(Ventiltation Block)		**1,700**	**1,600**	**1,500**	2	$0.2	$0.2	$0.2
	(precast concerete columns) 10*200		**130,000**	**82,500**	**35,000**	2	$16.2	$10.3	$4.4
	(precast concerete columns) 10*250		**110,000**	**77,500**	**45,000**	2	$13.7	$9.6	$5.6
Precastring ring	(Pre-cast rings) 80*50cm		**65,000**	**65,000**	**65,000**	1	$8.1	$8.1	$8.1
	(Pre-cast rings) 100*50cm		**75,000**	**75,000**	**75,000**	1	$9.3	$9.3	$9.3
	(Pre-cast rings) 120*50cm		**85,000**	**85,000**	**85,000**	1	$10.6	$10.6	$10.6
	(Pre-cast rings) 150*50cm					0	$0.0	$0.0	$0.0

Appendix 19 Current Institutional Framework National to District levels

Institution	
National Level	
Ministry of Public Works and Transport (MPWT)	Article 2 of PM37/99 states that the Ministry will carry out the function of "facilitation and coordination of the development process for water supply and wastewater management systems in urban and rural areas throughout the country".
Department of Housing and Urban Planning (DHUP)	While The Department of Housing and Urban Planning (DHUP) will assist the Minister of MCTPC (now MPWT) in state administration on the water supply sector.
Water Supply Authority now the Water Supply Regulatory Office (WASRO)	The WASA (WASRO) will carry out the function of: 1. Assisting the Minister of MPWT in technical issues of the Water Supply Sector, including redevelopment of the MPWT strategic plan in water supply and wastewater management system which set out in more detail planning, action plan and detailed projects in urban and rural areas throughout the country, 2. Setting norms, regulations, technical standards and technico-economic specifications on water supply and wastewater management systems
Public Works and Transport Institute (PTI) of MPWT	No role mentioned?
Ministry of Health (MOH) Department of Hygiene and Disease Prevention	Article 2.2. of PM37/99 The Ministry of Public Health shall be responsible for the facilitation, coordination and direction of all rural water supply, and urban and rural environmental hygiene activities throughout the country.
Centre for Environmental Health and Water Supply (Nam Saat)	Shall be responsible for the management of technical aspects in promoting rural water supply, and urban and rural environmental hygiene throughout the country.
Provincial/ Municipal Level	
Provincial and by implication Municipal Government	Article 2.5 of PM37/99 Provincial Governments will be responsible for: 1. coordination, facilitation, and investment support in the development of water supply and wastewater management systems, and environmental hygiene; 2. collaboration with the Department of Public Works and Transport (DPWT) of the province concerned in finding out suitable solution to assist low income households which cannot afford the cost of sanitary facility. 3. direction of water supply and sanitation sector project implementation in the province concerned.

Institution	
	4. institutional arrangements for the implementation and management of centralized wastewater management systems as for water supply when these systems become economically and financially viable, but until such time on site treatment will be pursued and the implementation and management of the facilities shall be the responsibility of the individual owner, and 5. Rural water supply, and urban and rural environmental hygiene in the province concerned.
Provincial Department of Public Works and Transport (DPWT)	Would follow the mandate/ direction of national line Ministry with guidance an instruction from the provincial authority
Water Resources and Environmental Office (WREO)	Would follow the mandate/ direction of national line Ministry with guidance an instruction from the provincial authority
Provincial Department of Health, Environmental Health and Water Supply Division	Would follow the mandate/ direction of national line Ministry with guidance an instruction from the provincial authority
Urban Development and Administration Authorities (UDAA)	Would follow the guidance an instruction from the provincial authority.
Nam Papa State-owned Enterprises (NPSEs)	Article 2.5 Nam Papa State-owned Enterprises (NPSEs) shall be responsible for: 1. Management and operation of all water supply and wastewater management system and development of raw water in urban and rural areas within their respective provincial boundaries. The operation shall be on commercial principle and in accordance with three-year rolling corporate plans; and 2. Compliance of the management of sanitary facilities with the sanitation regulation issued.
District Office of Public Works and Transport (OPWT)	
District Office of Health –Environmental Health and Water Supply	