Ministry of Sustainable Development, Energy, Science and Technology

St. Lucia

Background Paper

for

National Policy on Wastewater Management

Draft

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List of Abbreviations and Acronyms

ARC	Atlantic Rally for Cruisers
BOD	Biological Oxygen Demand
CALA	Canadian Association for Laboratory Accreditation
CAPEX	Capital Expenditure
CARPHA	Caribbean Public Health Agency
CARSEA	Caribbean Sea Ecosystem Assessment
CAWASA	Caribbean Water & Sewerage Association
CCC	Castries City Councils
Cd	Cadmium
CEHI	Caribbean Environmental Health Institute
CFLI	Canadian Fund for Local Initiative
CReW	Caribbean Regional Fund for Wastewater
COD	Chemical Oxygen Demand
CPA	Country Poverty Assessment
DCA	Development Control Agency
DNA	Deoxyribonucleic acid
DoF	Department of Fisheries
DRR	Disaster risk reduction
DVRP	Disaster Vulnerability Reduction Project
EIB	European Investment Bank
EHD	Environmental Health Department
EHS	Environmental Health and Sustainable Development Department
EMIS	Education Management Information System
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FC	Faecal Coliforms
FSM	Faecal Sludge Management
FSTP	Faecal sludge treatment plant
GDP	Gross domestic product
GoSL	Government of St. Lucia
GSF	Global Sanitation Fund
Hg	Mercury
IEC	Information, Education and Communication
ISO	International Organization for Standardization
IWRM	Integrated Water Resources Management
JMP	Joint Monitoring Program
KAP	Knowledge Attitude and Practice
LBS	Land-Based Sources and Activities Protocol
MBR	Membrane BioReactor

MDGs	Millennium Development Goals
MIPST	Ministry of Infrastructure, Port Services and Transport
MIS	Management Information System
MoA	Ministry of Agriculture, Food Production, Fisheries, Co-operatives and Rural Development
MoE	Ministry of Education, Human Resource Development and Labour
MoF	Ministry of Finance, Economic Affairs, Planning and Social Security
MoH	Ministry of Health Wellness, Human Services and Gender Relations
MoPD	Ministry of Physical Development, Housing and Urban Renewal
MoSD	Ministry of Sustainable Development, Science and Technology
MoST	Ministry of Social Transformation, Local Government and Community Empowerment
MoT	Ministry of Tourism, Heritage and Creative Industries
NCA	National Conservation Authority
NEMO	National Emergency Management Organisation
NGO	Non-Governmental Organization
NH4	Ammonium
NO3	Nitrate
NPS	Non-Point Source pollution
NURC	National Utilities Regulatory Agency
NWDP	National Water Development Program
NWMSP	National Wastewater Management Strategic Plan
OECS	Organisation of Eastern Caribbean States
OPEC	Organization of Petroleum Exporting Countries
PAHO	Pan American Health Organization
Pb	Lead
PCL	Produce Chemist Laboratory
PCU	Project Coordination Unit
pH	Potential Hydrogen
PCB	Pesticide Control Board
PO4	Phosphate
POPs	Persistent Organic Pollutants
PPCR	Pilot Program for Climate Resilience
PSP	Point Source Pollution
QA/QC	Quality Assurance/Quality Control
RBC	Rotating Biological Contactor
SDED	Sustainable Development and Environment Division
SDGs	Sustainable Development Goals
SLASPA	St. Lucia Air and Sea Ports Authority
SLBS	St. Lucia Bureau of Standards
SLCTVET	St. Lucia Council Technical Vocational Education and Training

SLHTA	St. Lucia Hotel and Tourism Association
SLUSWMA	St. Lucia Solid Waste Management Authority
SMMA	Soufriere Marine Management Association
SO4	Sulphate
SPCR	Strategic Program for Climate Resilience
SIDS	Small Island Developing State
SWAp	Sector Wide Approach
SPAW	Protocol Concerning Specially Protected Areas and Wildlife
TBC	To be confirmed
TOR	Terms of Reference
TS	Total Solids
TSS	Total Suspended Solids
TVET	Technical Vocational Education and Training
UNEP	United Nations Environment Programme
UNICEF	United Nations International Children's Emergency Fund
VIP	Ventilated Improved Pit latrine
WASCO	Water and Sewerage Company Inc (St. Lucia)
WASH	Water Sanitation and Hygiene
WHO	World Health Organization
WMS	Wastewater Management Services
WQM	Water Quality Monitoring
WQMAP	Water Monitoring and Analysis Program
WRMA	Water Resources Management Agency
WWTP	Wastewater treatment plant

1. INTRODUCTION

The Sanitation Policy Background Paper presents a comprehensive overview of the actual situation and the key challenges of wastewater management in St. Lucia. It is intended to serve as the basis for the next stage of the Policy and Strategy formulation process.

Chapter 2 provides definitions about the relationship between Integrated Water Resources Management (IWRM) and wastewater; the new Sustainable Development Goals (SDG) that are radically different from the Millennium Development Goals (MDGs), and its implications for modern wastewater management and future indicators for wastewater management; a visual overview on the actual wastewater situation in St. Lucia and proposes a preliminary zoning for wastewater analysis.

Chapter 3 details the actual offer for wastewater services and infrastructure: sanitation practices and technologies currently used; a description of public and private sanitation service providers in St. Lucia along the value chain; the situation with regard to wastewater expertise; an overview of actual and planned relevant studies and projects and the status of educational and behavioural change programs in the island.

Chapter 4 focuses on the demand side based on demographic growth, spatial distribution, socio-economic patterns, public health and environmental requirements as well as the expectations by wastewater producer segments.

Chapter 5 describes the enabling conditions of the wastewater service sector in St. Lucia and includes the review of the actual legal framework, the institutional arrangement, monitoring and evaluation and the relevant business conditions for the private sector.

Chapter 6 highlights the key challenges related to sanitation coverage and wastewater management that will be addressed in the Policy and Strategy plan.

2. WASTEWATER MANAGEMENT IN ST. LUCIA

2.1 Wastewater and Integrated Water Resources Management (IWRM)

Modern management of wastewater and faecal sludge has two main drivers: concerns about the health risks due to direct contact with faecal pathogens and the growing awareness about the indirect impact through deteriorated and toxic environmental risk. While the public health sector was at the origin of modern sanitation systems, today the focus is increasingly on complex environmental impacts, reinforced by climate change resilience requirements.

The modern concept of IWRM offers a tool to support St. Lucia's sustainable development. Wastewater management can be understood as being part of the broader IWRM as shown in the following illustration (Figure 1).

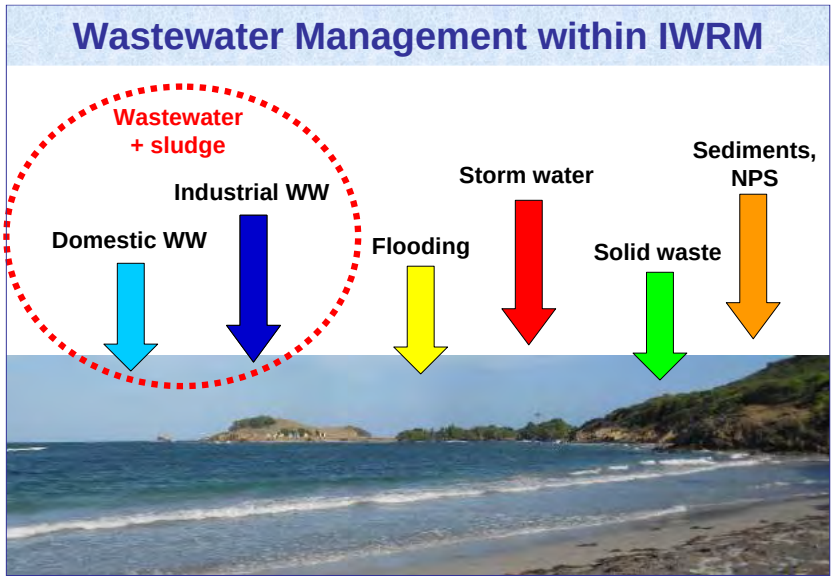

Figure 1: Wastewater Management within IWRM

In order to understand the effects of wastewater management, it is important to recognize first that even the most efficient wastewater (and sludge) management alone does not eliminate all environmental contamination risks. Secondly, successful wastewater management needs to be coordinated with other interventions.

From the environmental perspective of water resources protection, only a comprehensive analysis of the main contamination factors can determine the priorities for interventions in each subsector such as sanitation, solid waste, agriculture or drainage. The Background Paper for the Wastewater Policy and Strategy does not include such comprehensive risk evaluation. It focuses on basic principles and objectives for safe wastewater management in St. Lucia and will include the domestic and public health perspective.

The following illustration (Figure 2) shows the position and focus/scope of the Wastewater Management Policy and Strategy within the broader IWRM context in St. Lucia.

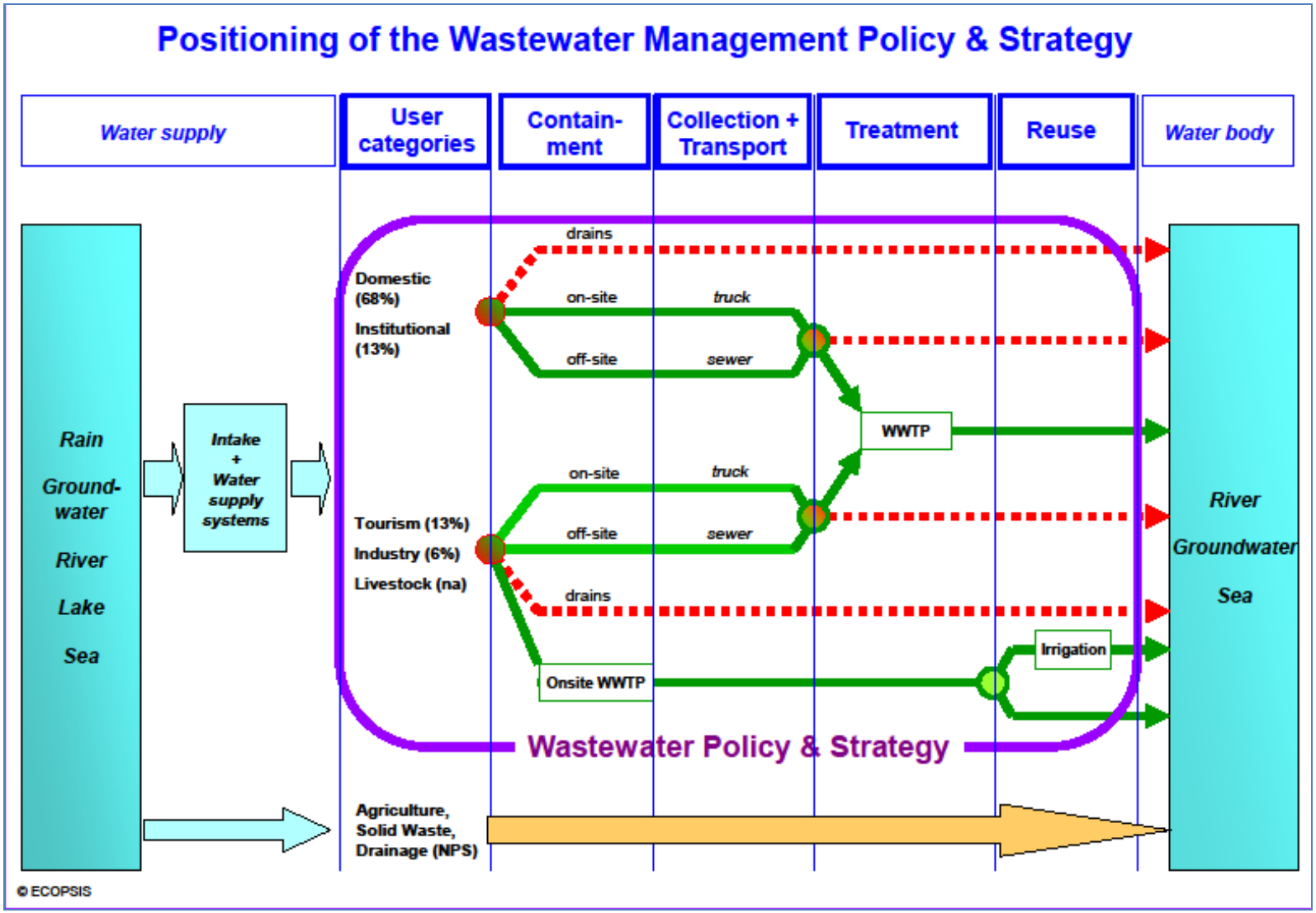

Figure 2: Positioning of the Wastewater Management Policy & Strategy

2.2 Wastewater and Excreta Management Concepts

Four concepts impact the analysis of the situation in St. Lucia. Its key challenges and the formulation of the Policy & Strategy and their definitions are of significant importance; example, for the distribution of responsibilities and M&E in sanitation:

- Wastewater & faecal sludge management along the value chain (new SDG definition)
- Difference between individual and collective sanitation approaches
- Definition of safe latrine/toilets
- Coverage and access to safe sanitation

2.2.1 Post-2015 Sanitation SDGs are different from MDGs

The UN General Assembly agreed on the broader SDG mandate in September 2015. Given that the proposed goals and targets for WASH have to date received significant support and reflect the consensus of a broad array of governments and sanitation sector partners, it is likely that these goals will be included in the final SDG mandate. The proposed sanitation SDGs are radically different from the MDGs for sanitation:

- Calls for Universal Access – sanitation for all;
- Gives priority to the poor and disadvantaged;
- Ending the practice of open defecation;
- Higher levels of sanitation service delivery especially safe management of faecal sludge in urban areas;
- Moves beyond households to schools and health facilities;
- From building infrastructure to changing behaviours and establishing new social norms;
- Seeks sustainability of sanitation service delivery programs, facilities and behaviours.

For the purpose of the St Lucia Policy, the new proposed target of safe management of faecal sludge is quite relevant. As noted in Figure 3 below, during the MDG era, having access at the containment level (household level access) was suffcient to meet JMP criteria for basic access to sanitation.

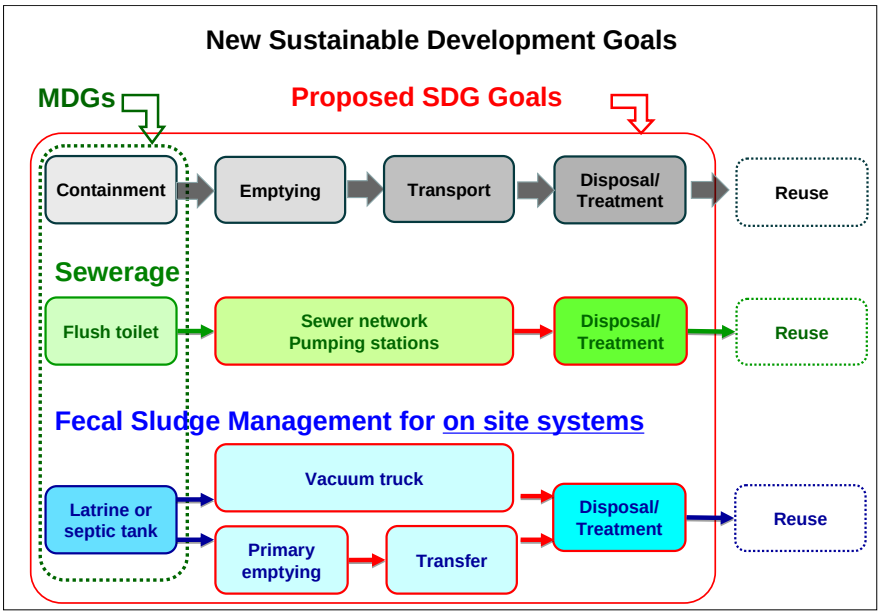

Figure 3: Sustainable Development Goals vs. Millennium Development Goals

The main reason that "safe" was included in the SDGs was a recognition by the global community that households may have access to "basic" sanitation at the household level - but that the related poorly functioning sanitation value chain of containment, emptying, transport, treatment/disposal creates a health hazard for households, communities and environment and hence would be considered "unsafe".

Ultimately, St. Lucia will need both, "basic" and "safe" sanitation, to reduce the public and environmental health risks associated with human contact with faeces and pathogens. Depending on the location and private and public socio-economic conditions, in some areas and for the next years, the first priority may still be access to a “basic” sanitation (facility) as a first step before moving up the sanitation ladder to “safe” wastewater and excreta management.

For St. Lucia’s population to achieve universal access, it is not sufficient to build only latrines and toilets; a “public service” must provide “safe” services for transportation and treatment for both on-site and off-site systems[1].

[1] Such collective services can be provided by public utilities or the private sector. In both cases, the service must be monitored and regulated.

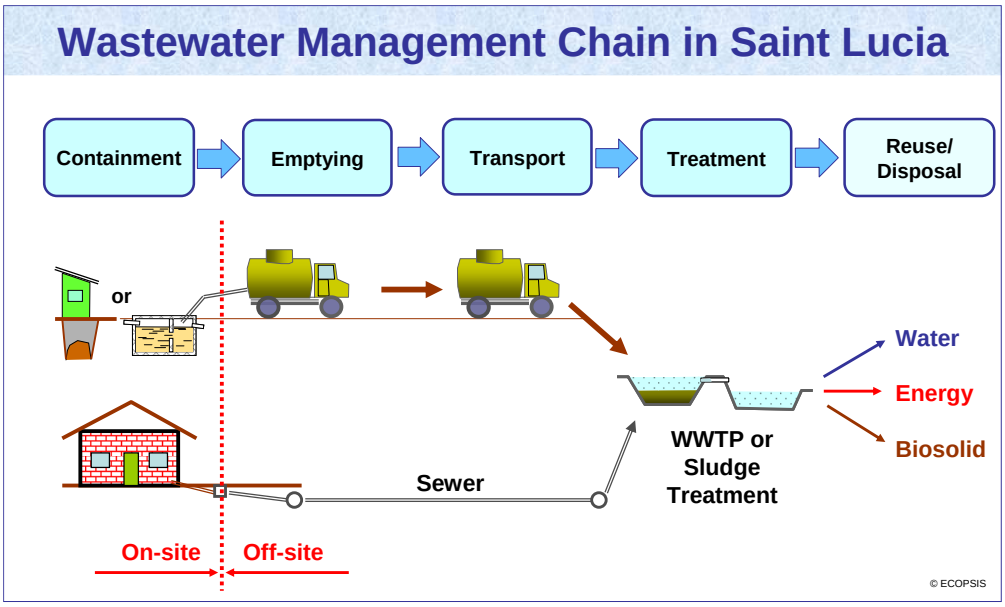

Figure 4: Wastewater Management Chain in St. Lucia

2.2.2 Individual vs. collective sanitation

Unlike water supply tasks and responsibilities of sanitation, services are much more shared between individual (household level) and collective service providers and the definitions of (a) individual and collective and (b) on- and off-site sanitation need to be carefully set. Table 1 below defines each type of service in the sanitation chain in accordance with the SDG.

Definition of sanitation services		
	Individual sanitation	**Collective sanitation**
On-site sanitation	Sanitation facilities at household level (latrines, septic tanks, infiltration pits)	Institutional sanitation: • Collective toilets (schools, health centres…) • Public toilets (markets, squares, bus stations, etc.)
Off-site sanitation	Faecal Sludge Management (collection by vacuum tankers and transportation to a faecal sludge treatment plant)	• Centralized sewerage (conventional) • Decentralized sewerage (condominial) • Wastewater & Faecal Sludge Treatment Plants

Table 1: Definition of Sanitation Services: On/Off Site vs. Individual/Collective

The definitions above show that all facilities at the household level are on-site and individual. However, "individual sanitation" does not imply that all the services are to be provided by households alone: complementary *off-site* and *collective service provision* for emptying, transportation and treatment of faecal sludge from individual on-site sanitation is needed.

2.2.3 Definition of safe latrines/toilets

The Joint Monitoring Program (JMP) for Water and Sanitation (UNICEF/WHO) has defined for monitoring that an "improved" sanitation facility is one that hygienically separates human excreta

from human contact. It defines improved/unimproved sanitation hardware as follows:

WHO / UNICEF definitions of sanitation facilities	
Improved sanitation facilities	**Unimproved facilities**
Use of the following facilities in home/compound: ○ Flush / pour-flush to: ▪ piped sewer system ▪ septic tank ▪ pit latrine ○ Ventilated improved pit (VIP) latrine ○ Pit latrine with slab ○ Composting toilet	○ Use of following facilities anywhere: ▪ Flush / pour-flush to elsewhere ▪ Pit latrine without slab / open pit ▪ Bucket ▪ Hanging toilet or latrine ○ Use of a public facility or sharing any improved facility ○ No facility, bush or field (open defecation)

Table 2: WHO / UNICEF definitions of sanitation facilities

This definition remains useful for several purposes. As a benchmark criterion it will support technical strategies while formulating urban master plans and rural sanitation projects. Improved sanitation facilities also remain a starting point for progress data gathering at individual house level, although such data is not sufficient to comply with the new SDG and policy requirements to measure adequate sanitation coverage.

2.2.4 Coverage and access to safe sanitation

The sanitation indicators – coverage and access to safe basic sanitation – are the most important indicators for the sanitation service sector.

Access to basic sanitation: % of people able to *acquire* affordable services and improved private *sanitation* facility as well as safe on- or off site treatment and disposal of wastewater and sludge.

This definition of **access** means that households (and industries, trade) should have sufficient financial resources and the local market should be able to provide solutions and services that are affordable. Households also need to access the suitable information for them to be able to decide upon the best solution for their needs and resources in line with environmental standards.

"Access to basic sanitation" will make it possible for the community to *sustain the coverage rate* since:

a) the enforced social norm will motivate old and *new households* to acquire and use a sanitation facility;
b) the market will make it possible for the new households to buy one;
c) The public sector regulates and provides or delegates the provision of reliable and affordable collective services;
d) the households will be able to *maintain* their facilities with locally available and affordable material and services.

Coverage is different from *access;* coverage goes beyond access and means sustainable, continuous use and access over time.

Coverage *of* **basic sanitation**: % of people *using* an improved private sanitation facility and safe on- or off site treatment and disposal of wastewater and sludge.

Access contributes to sustainable coverage. **But it is coverage not access that provides St. Lucia with the return on investment and the economic benefits the country is aiming at.**

"Using" also means people apply a new social norm, translated into a suitable, responsible and healthy behaviour, both at household and community levels (through formal or informal enforcement of the local social norm). They *use* the facility ("having" a facility is not enough).

Therefore, the policy and the strategy will propose to develop a *coverage indicator* as the ultimate objective and sole indicator for (i) coverage (ii) access and (iii) adequate hygiene behaviour.

It should be noted that the above definition is for practical monitoring purposes; it follows the SDGs and includes the entire value chain, from improved latrines/toilets to safe reuse/disposal.

2.3 Indicators for Wastewater Management & Hygiene

While the indicators under the MDG were simple and clear (number of safe facilities), discussions are still on-going about the structure and content of the appropriate indicators for sustainable and safe wastewater and sludge management.

A safe sanitation management concept (coverage, including facilities and service provision) as outlined in the SDG will require the development of specific indicators based on a revised survey methodology with reliable data collection and calculation methods. This may take several years to be reliable and representative. It is particularly important to ensure that the definitions and questionnaires used by the Central Statistics Office of St. Lucia as well as the sector MIS are in line with the Policy/SDG definitions.

The WHO/UNICEF JMP which has monitored progress towards MDG targets for water and sanitation, has developed proposals for goals, targets and indicators for WASH in the post-2015 agenda, the new SDGs. The JMP has started to identify a list of updated sanitation and hygiene indicators (Table 4 and Table 5) which eventually could be used for monitoring the proposed SDG targets in all countries.

The following JMP proposal is currently being discussed globally. St. Lucia under the lead of the Ministry of Sustainable Development, Energy, Science and Technology (MoSD) in collaboration with the Central Statistics Office of St. Lucia shall harmonize the development of its own set of new indicators for sanitation and hygiene with the ongoing approach led by the UN and development partners in 2016 and beyond.

JMP proposal: **SDG Target 6.2 – "By 2030, achieve adequate and equitable sanitation and hygiene for all, and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations".**

Refer to Table 3 below:

Target language	Normative definition of target elements
6.2 – By 2030, achieve	
access (for all)	Implies facilities close to home that can be easily reached and used when needed
to ***adequate***	Implies a system which hygienically separates excreta from human contact as well as safe disposal of excreta in situ, or transport to a treatment plant
and ***equitable***	Implies progressive reduction and elimination of inequalities between population sub-groups
sanitation	Sanitation is the provision of facilities and services for safe management and disposal of human urine and faeces
and ***hygiene***	Hygiene refers to the conditions and practices that help maintain health and prevent spread of disease including hand washing, menstrual hygiene management and food hygiene
for all	Suitable for use by men, women, girls and boys of all ages including people living with disabilities
end ***open defecation***	Excreta of adults or children that is: deposited (directly or after being covered by a layer of earth) in the bush, a field, a beach, or other open area; discharged directly into a drainage channel, river, sea, or other water body; or wrapped in temporary material and discarded
paying special attention to the ***needs of women and girls***	Implies reducing the burden of water collection and enabling women and girls to manage sanitation and hygiene needs with dignity. Special attention should be given to the needs of women and girls in 'high use' settings such as schools and workplaces, and 'high risk' settings such as health care facilities and detention centres.
and ***those in vulnerable situations***	Implies attention to specific WASH needs found in 'special cases' including refugee camps, detention centres, mass gatherings and pilgrimages

Table 3: SDG Sanitation Target Goals by 2030

Proposed indicators for monitoring sanitation services (JMP 2015)

Sanitation service ladder	Proposed indicator	Definition	Data sources and measurability	Disaggregation	Timeline
Safely managed sanitation	Percentage of population using safely managed sanitation services (Core)	Population using a basic improved sanitation facility which is not shared with other households and where excreta is **safely disposed in situ or transported to a designated place for safe disposal or treatment**.	Household surveys can provide info on types of sanitation facilities and disposal in situ. Administrative, population and environmental data can be used to estimate safe disposal/transport of excreta, when no country data are available	Urban/rural Wealth Affordability Others TBC	Elements from household surveys can be reported short term. Excreta management will initially be estimated.
Basic sanitation	Percentage of population using a basic sanitation service	Percentage of population using a basic improved sanitation facility not shared with other households	Household surveys	As above	Immediate
Shared sanitation	Percentage of population using a shared sanitation service	Percentage of population using a basic sanitation facility shared with other households	Household surveys	As above	Immediate
Unimproved sanitation	Percentage of population using an unimproved sanitation facility	Percentage of population using unimproved sanitation facilities, with or without sharing with other households	Household surveys	As above	Immediate
Open defecation	Percentage of population practicing open defecation	Percentage of the population practicing open defecation (defecating in bushes, fields, open water bodies or other open spaces)	Household surveys	As above	Immediate
Basic sanitation in schools	Percentage of pupils enrolled in schools that provide basic sanitation services	Percentage of pupils enrolled in primary and secondary schools with functional basic separated sanitation facilities for males and females on or near premises[2]	Institution surveys, admin data, EMIS	Urban/rural Gender	Medium term monitoring package needs to be standardized;
Basic sanitation in health care facilities	Percentage of beneficiaries using health care facilities providing basic sanitation services	Percentage of beneficiaries using health care facilities with functional basic separated sanitation facilities for males and females on or near premises[3].	Institution surveys, admin data, EMIS	Urban/rural	

Table 4: Proposed indicators for monitoring sanitation services (JMP 2015)

[2] At least one toilet/latrine for every 25 girls, at least one toilet/latrine for female school staff, a minimum of one toilet/latrine and one urinal for every 50 boys and at least one toilet for male school staff

[3] At least one toilet for every 20 users at inpatient centers, at least four toilets – one each for staff, female, male and child patients – at outpatient centers

Proposed indicators for monitoring hygiene (JMP 2015)

Hygiene indicators	Proposed indicator	Definition	Data sources and measurability	Disaggregation	Timeline
Hand washing at home	Percentage of population with hand washing facilities with soap and water at home (Core)	Population with a hand washing facility with soap and water in the household	Household surveys	Urban/rural Wealth Affordability Others TBC	Immediate
Hand washing in schools	Percentage of pupils enrolled in schools with basic hand washing facilities	Percentage of pupils enrolled in primary and secondary schools with functional handwashing facilities, soap (or ash) and water available to girls and boys.	Institution surveys, admin data, EMIS	Urban/rural Gender	Medium term (monitoring questions need to be agreed; monitoring systems require national and international support)
Menstrual hygiene management in schools	Percentage of pupils enrolled in schools with basic menstrual management facilities	Percentage of pupils enrolled in primary and secondary schools with adequate and appropriate sanitary facilities for washing and change management and disposal of menstrual waste. These facilities must offer privacy, safety and dignity to menstruating students and teachers.	Institution surveys, admin data, EMIS	Urban/rural Gender	
Hand washing in health care facilities	Percentage of beneficiaries using health care facilities with basic hand washing facilities	Percentage of beneficiaries using health care facilities with adequate hand hygiene supplies (running water, liquid soap, single use towels/alcohol-based hand rinse) available at key locations.	Institution surveys, admin data, HMIS	Urban/rural	Medium term (monitoring questions need to be agreed; monitoring systems require national and international support)
Basic menstrual hygiene management in health care facilities	Percentage of beneficiaries using health care facilities with basic menstrual management facilities	Percentage of beneficiaries using health facilities with basic separated sanitation facilities for females that provide privacy; soap, water and space for washing hands, private parts and clothes; and places for changing and disposing of materials used for managing menstruation.	Institution surveys, admin data, HMIS	Urban/rural	

Table 5: Proposed indicators for monitoring hygiene (JMP 2015)

2.4 Overview - Coverage of Water and Wastewater in St. Lucia

2.4.1 Water supply and sanitation coverage at household level

Table 6 gives an overview of the water supply and the sanitation coverage in St. Lucia. These data are based on the MDG indicator concept. It appears that if water supply coverage is very high with about 87% of piped water supply, sanitation coverage is probably almost as high. Based on the literature, observations on the fields and interviews with stakeholders, JMP data tend to over-estimate the sanitation coverage.

Access Water supply			Access to Sanitation		
Source of Water supply	Census 2010 [%]	JMP 2015 [%]	Type of sanitation facility	Census 2010 [%]	JMP 2015 [%]
Total Improved	**93**	**96**	**Improved**	**82**	**91**
Piped on premises	87	87	Shared	-	7
Other improved	6	9	Other Unimproved	12	0
Unimproved	-	4	Open Defecation	6	2
Surface water	-	-			
Other/Not Stated	7	-			

Table 6: Water Supply and Sanitation Coverage in St. Lucia (Census vs. JMP data)

Observation of the distribution of sanitation facilities by district revealed that sanitation coverage varies enormously among the districts (cf. Table 7). Indeed, in Canaries district almost 50% of the inhabitants rely on public toilet facilities and practice open defecation.

DISTRICT	Linked To Sewer		Septic Tank		Pit Latrine		Other		None		Not Stated	
	2001	2010	2001	2010	2001	2010	2001	2010	2001	2010	2001	2010
	percentage of households											
Castries	9.1	9.7	50.9	65.0	31.8	20.4	0.9	1.3	4.4	3.5	2.9	...
Anse La Raye	0.7	1.4	29.3	48.1	36.6	33.1	0.5	5.5	30.2	11.9	2.7	...
Canaries	1.3	1.6	35.3	43.1	9.0	6.1	0.8	0.3	53.2	49.0	0.4	...
Soufriere	0.6	1.0	53.9	69.5	23.3	11.7	2.4	0.9	18.8	16.8	1	...
Choiseul	0.8	1.4	38.2	60.0	49.1	29.8	0.4	1.8	11.0	7.0	0.4	...
Laborie	0.4	0.5	42.7	63.3	46.1	28.7	0.1	2.0	8.9	5.6	1.8	...
Vieux Fort	1.5	4.9	46.3	62.0	40.2	25.0	1.5	0.9	9.7	7.1	0.9	...
Micoud	1.3	1.1	42.6	59.6	44.3	32.1	0.8	0.9	10.4	6.3	0.6	...
Dennery	1.2	1.5	29.7	45.4	47.2	42.6	2.8	1.9	18.0	8.7	1.1	...
Gros Islet	8.9	11.1	59.9	70.9	26.1	14.2	0.2	0.6	3.2	3.1	1.6	...
Total Island	**5.3**	**6.6**	**47.2**	**62.8**	**35.3**	**23.1**	**1.0**	**1.3**	**9.2**	**6.2**	**1.9**	**...**

Table 7: Distribution of Households by Toilet Facilities and District, 2001 and 2010 (Census 2010)

In 2012, it was also reported that 82% of the population had handwashing facility at home with soap and water (JMP 2015), reflecting an acceptable hygiene level.

2.4.2 Illustration of the actual domestic wastewater situation in St. Lucia

Based on available data, interviews and observation in the fields, the following indicative diagram (Figure 5) illustrates the actual situation of blackwater and faecal sludge management at the domestic level in St. Lucia in accordance with the SDG principles, from the toilets via collection to treatment and/or disposal of treated or untreated wastewater.

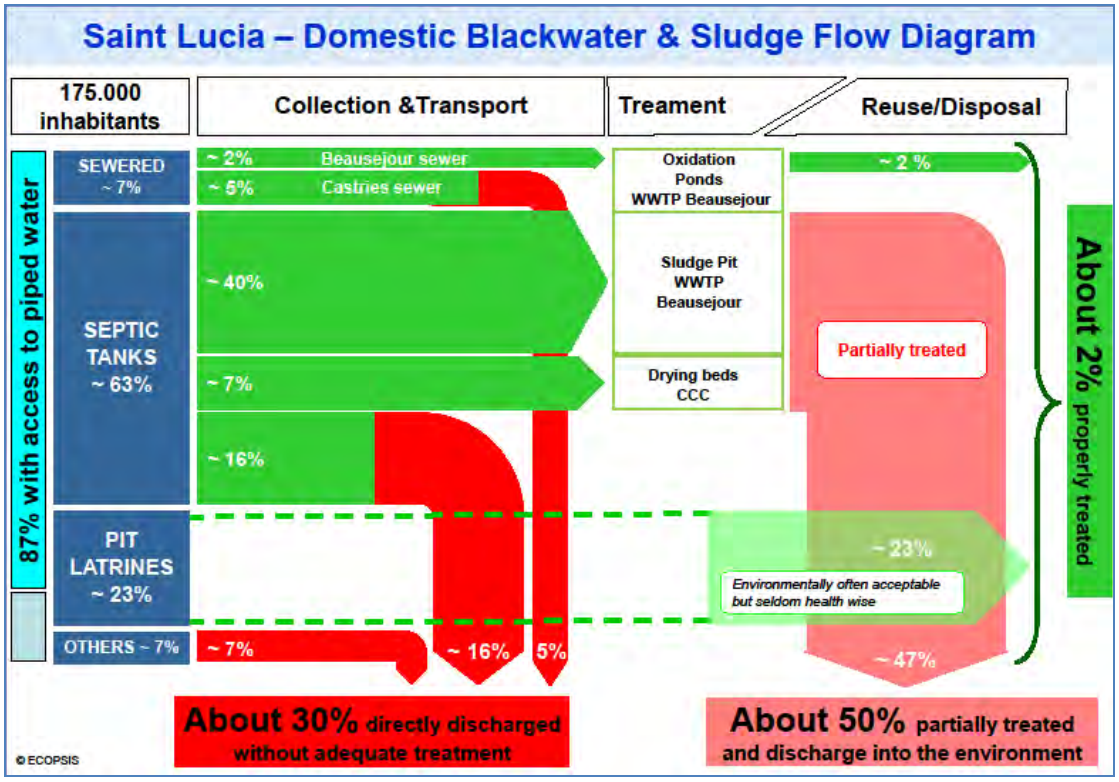

Figure 5: Domestic Blackwater & Sludge Flow Diagram in St. Lucia

87% of St. Lucia's population has access to piped water supply, but only about 7% of the population in Castries and Gros Islet have access to a public sewer system and only about 2% of St. Lucia's wastewater is treated before reaching the environment and/or the receiving water bodies.

A majority of 86% of the population has invested in their own private on-site solution (pits or septic tanks) in order to be able to dispose every day of half a ton of wastewater, in accordance with their technical and financial conditions. Most of the septic tank owners use a mechanical emptying service and the sludge is partially treated in one of the two sludge treatment plants. Based on St. Lucia's geological conditions, and providing septic tanks are watertight, it is possible that infiltration from septic tanks into the ground may be a perfectly safe treatment. However, no data is available yet and above all, many septic tank owners do dispose in parallel greywater; not into the septic tank (with a subsequent cesspool or drain field), but without treatment into the drainage system that flows into rivers and the sea.

The Diagram clearly shows that St. Lucia has made enormous progress in (public) water supply, while public investment for wastewater as well as sanitary education, public service provision and enforcement of safe standards are lagging behind.

The diagram also locates the key challenges in wastewater management: at individual household level as well as the service provision along the value chain.

2.4.3 Illustration of the actual industrial wastewater situation in St. Lucia

The following indicative diagram (Figure 6) illustrates the actual wastewater management (industrial liquid waste, FS / black- and greywater) at industrial level in St. Lucia.

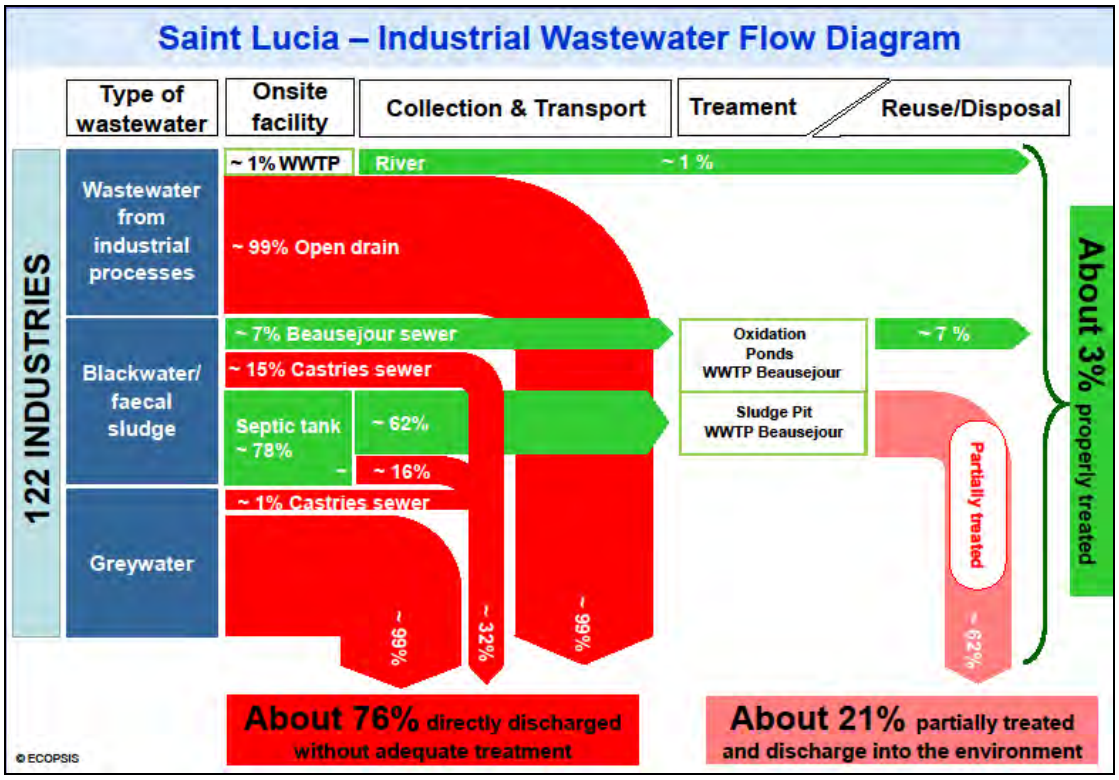

Figure 6: Industrial Wastewater Flow Diagram

Only one industry island wide is equipped with a wastewater treatment plant (WWTP) package while the remaining ones directly discharge wastewater from industrial process directly into the environment. Based on Figure 2, industries represent only 6% of the total water consumption which is roughly equivalent to the wastewater production. However, due to the specific waste that can be produced through industrial processes, industrial wastewater is a serious threat to human and environmental health.

Faecal sludge, black- and grey water management present a similar pattern as domestic wastewater flows.

2.4.4 Illustration of the actual hotels wastewater situation in St. Lucia

The following indicative diagram illustrates the actual wastewater and FS management at hotels in St. Lucia.

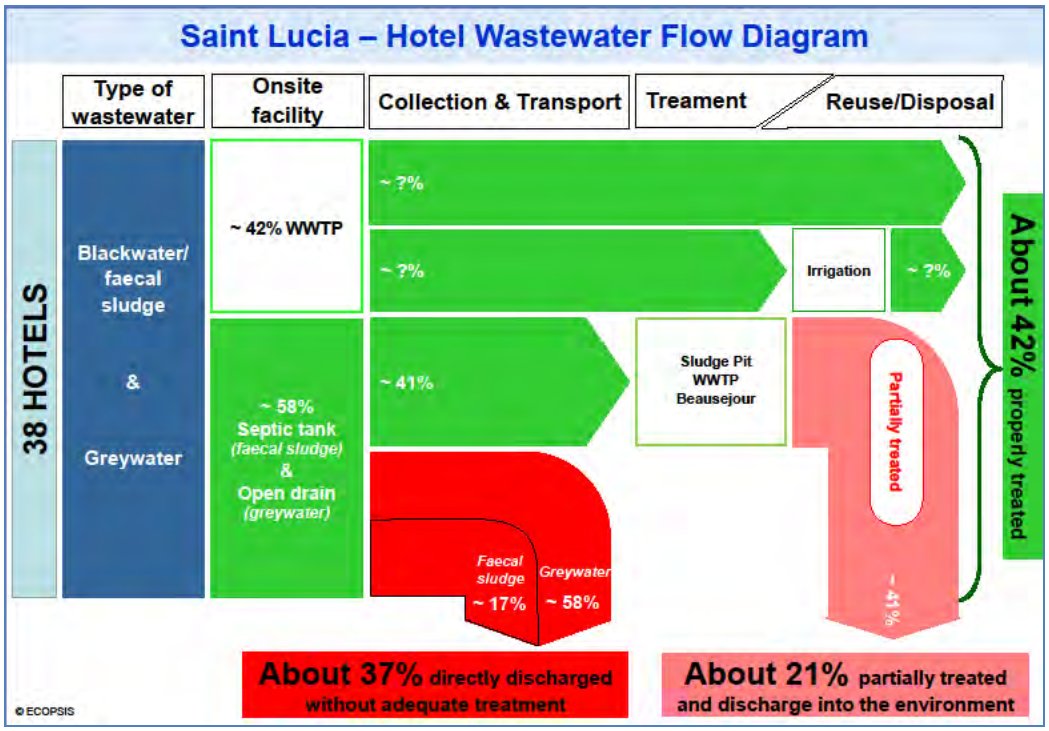

Figure 7: Hotel Wastewater Flow Diagram

Almost half of the hotels are equipped with WWTP package. Most of these hotels are high standing hotels. This diagram reveals that hotels and the broader tourism sector does not rely on public service to address the wastewater management issues. Indeed, high environmental expectations from its customers (e.g. green labels) requires the tourism sector to manage its wastewater in order to offer a good quality environment.

2.4.5 Illustration of the actual liquid waste management of livestock farms

Farming is a major issue in terms of manure and wastewater management. 322 swine farms are registered in St. Lucia with an estimated number of about 10,000 swine. Figure 8 shows the distribution of pig farms in the country. Critical issues are expected to be raised in the north-west of Vieux-Fort, Castries and Gros Islet districts where pig farms are concentrated. It is important to note that most of the pig farms located in Choiseul and Laborie districts are small (cf. Table 8). Figure 8 illustrates the risk of contamination by pig farm activities, to the WASCO drinking water intakes. Some of the intakes are located downstream of the pig pens, and therefore at risk of contamination from poor manure and wastewater management.

Pen Size	
Small	Less than 20 Pigs
Medium	20 - 50 Pigs
Large	50 or more Pigs

Table 8: Pig Farms Sizes

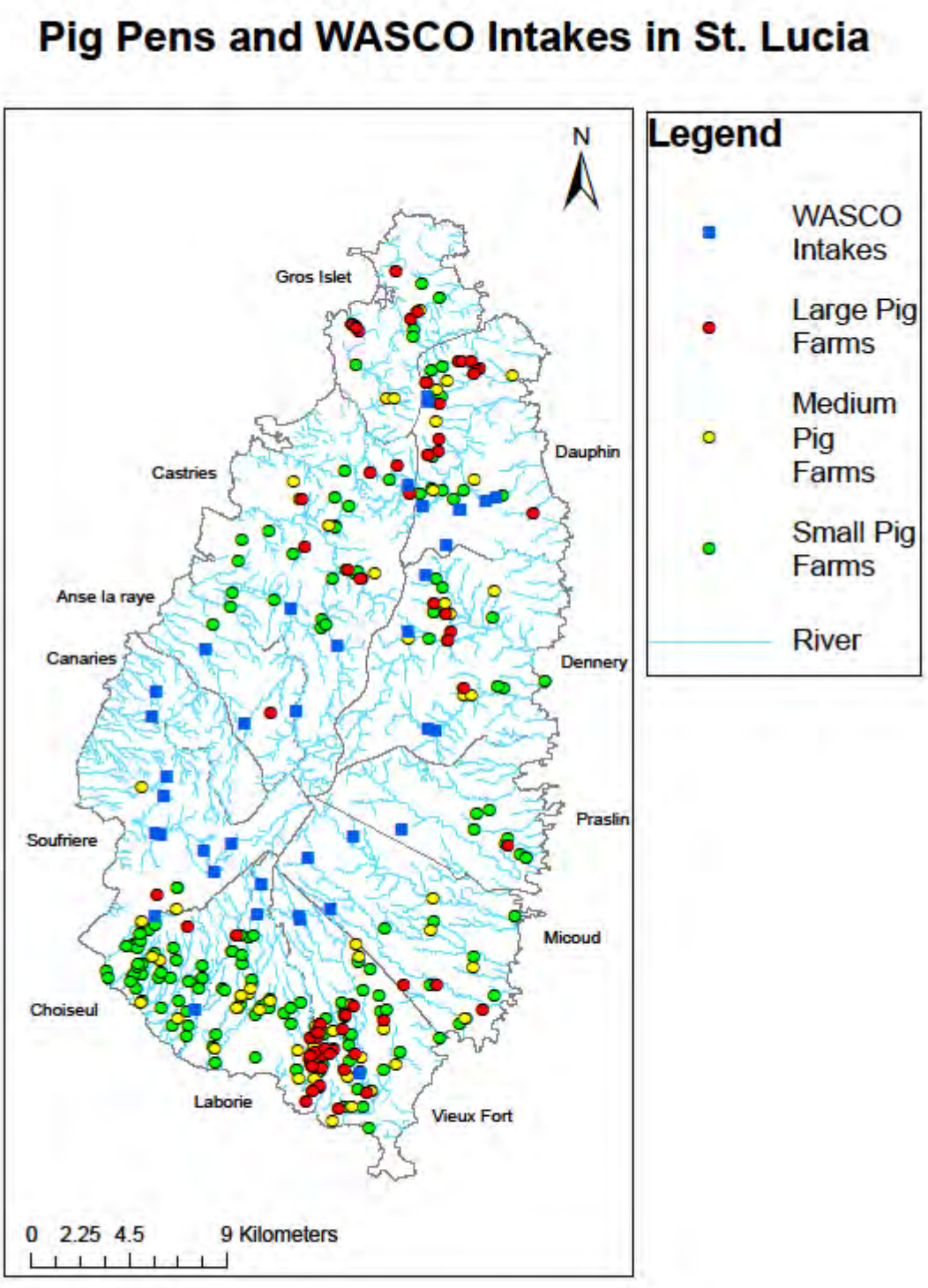

Figure 8: Pig Pen Distribution and WASCO Intakes in St. Lucia

(Prepared by ECOPSIS/FDL based on 2014 census data)

The total manure and wastewater production of the swine farms is based on the average daily production per swine. The University of Missouri[4] estimates that the total manure and wastewater production averages about 1.4 gallons per animal per day including all operating activities as pen washing. Table 9 shows an estimation of the amount of manure and wastewater produced each year; it equals to about 2/3 of sludge produced by St. Lucia's population.

The combined Manure & Wastewater production from swine farms per year		
Swine farms		322
Number of swine		10 150
Manure + wastewater production per animal per day	[l/swine/day]	5,3
Manure + wastewater production per year	**[m3]**	**19 634**

Table 9: Assessment of Yearly Manure and Wastewater Production from Swine Farms in St. Lucia

2.5 Preliminary Zoning: Clusters for Wastewater Analysis

In order to guide the analysis of the existing sanitation situation and the identification of suitable and affordable technical solutions by cluster, a preliminary zoning has been developed. The clustering is based on the data made available, interviews with stakeholders and observations in the field. The criteria and parameters used to determine the clusters have been divided into three categories: physical and environmental; water and wastewater coverage and practices; and physical development of the communities and their capacities; refer to Table 10 below.

Physical parameters	Water and sanitation	Community development and capacity
➢ Geographic localization (mountain, coastal, rural) ➢ Topography (relief, slope, altitude etc.), ➢ Geology (soil type, landslide risk, infiltration capacity), ➢ Water table	➢ Water supply, ➢ Type of wastewater produced (organic matter, total solid, nutrients, toxic chemical, heavy metal, grease, oil, etc.), ➢ Vicinity to a sewer systems,	➢ Settlement density (high, low), ➢ Settlement structure (formal, informal), ➢ Size land plots, ➢ Socio-economic conditions (financial capacities of inhabitants and communities) ➢ Situation land title

Table 10: Criteria and Parameters Used to Determine Clusters

Based on these criteria 9 zones have been defined:

[4] http://extension.missouri.edu/publications/DisplayPrinterFriendlyPub.aspx?P=EQ349

1. **Urban centre of main cities/towns zone (Urban Centre)** (Castries, Rodney Bay & Gros Islet): These areas represent more than one third of the total population of the island. It is characterized by high daily activities (residential, institutional buildings, industries, harbours, market and trade centres) and a high tourist presence. Part of the population is connected to a sewer network.

Picture 1: Castries City Centre (Google Earth)

2. **Small and medium size coastal towns/villages zone (Coastal Towns)** (Vieux Fort, Anse la Ray, Canaries, Soufrière, Laborie, Choiseul, Micoud, Dennery, etc.): The isolated coastal towns border vulnerable marine environment. Their old centres are congested, highly dense and poorly served by appropriate onsite sanitation facilities and sanitation services. Soil is mostly clayey and saturated with a high water table which disrupts the absorption function of septic tank and soakaway (cf. Appendix 2). This area can also be prone to flooding. This situation results in high environmental and human health risks. In addition, the high unemployment rate and the poor financial capacity within the communities make these areas very challenging.

Picture 2: Canaries Village

3. **Rural Village zone** (Au Leon, etc**.):** Rural villages are usually less dense and smaller than coastal villages. Also the infiltration capacity of the soil is higher since most of the rural part of the island comprises agglomerate soils.

Picture 3: La Resource (Vieux Fort)

4. **Poor informal, high density settlements zone (Informal settlement):** These are very often unplanned dense areas that develop on the outskirts of the towns, or near an industry. People usually have no access to onsite sanitation, resulting in open defecation and night soil disposal practices or use bucket latrines. Residents are also known to have very low financial capacities and low level of education. These communities are the most vulnerable in terms of human health risk.

Picture 4: A Settlement in Soufriere Town

5. **Low standard low density zone:** These communities are usually located in the rural areas and on the outskirts of the towns. Population relies on onsite sanitation facilities (septic tanks or pit latrines). Also most of the centres of the island are constituted with agglomerate soils which have usually good infiltration capacity (cf. Appendix 2).

Picture 5: Anse la Raye District

6. **Medium-high standard low density zone:** These communities are usually developed on the outskirts of touristic areas (Rodney Bay, Gros Islet) or where large land properties are available. They are characterized by a high financial capacity and it can be expected that they comply with good sanitation practices and best onsite sanitation technologies.

Picture 6: Gros Islet District (Google Earth 2016)

7. **Areas with specific activities generating point source pollution (PSP);** (hospital, industries, livestock, hotels, restaurants, gas stations)**:** This zone generates the activities that are responsible for land-based point-source pollution. These activities have been identified as producing large volumes of liquid waste (hotels and restaurants, industries) and/or particular and harmful liquid waste (hospital, chemical industry, refinery) causing severe environmental and human health threat. Industries that have been recognized by the LBS Protocol as a

Picture 7: Rum Distillery, Anse-la-Raye District

major point source of pollution and operate in St. Lucia are oil refineries, sugar factories and distilleries, food processing, beverage manufacturing, pulp and paper manufacturing, chemical industries. Livestock farms are mostly swine farms. The manure production from swine farms is the results of a mix of urine, faeces, water used for cleaning activities and wasted drinking water. The wastewater is composed by water from cleaning activities (if directly dumped into the environment) and effluent of the storage systems.

Picture 8: Pig pen, Beausejour Agriculture Station (Vieux-Fort)

8. **Marinas and harbours zone (Rodney Bay, Castries harbour, Marigot bay, Soufriere):** Marinas have been identified as a special zone since boats, yachts and vessel ships have been identified as a coastal water pollution source.

Picture 9: Castries Harbour

9. **Non-Point Source (NPS) pollution zone refers to agricultural practices.** The use in excess of pesticides and fertilizers (nitrogen and phosphorus) contaminate the water bodies through crop and land run-off water and leaching. Even at low concentration it has been demonstrated that pesticides can be highly lethal to aquatic life (fish, zooplankton, coral) and harmful to human health and the overall environment. Also some pesticides are considered as persistent organic pollutant (POPs). These compounds resist degradation and thus remain in the environment for years. Nutrients when entering water bodies are responsible for the eutrophication phenomenon. This algae bloom has negative environmental effects as hypoxia (depletion of dissolved oxygen) which may cause death to aquatic animals.

Picture 10: Roseau Banana field

As described above, each zone can potentially affect human health, ecosystems, biodiversity, sustainability or the economy in a significant manner. However, the impact of each zone is not likely to be equal. In order to define priorities, an environmental and human health risk analysis has been performed (Table 11). The risk has been classified as low, medium or high. In the

absence of consistent data from water pollution modelling (rivers, mangroves and coastal waters), the level of risk of each zone has been estimated based on the population (or volume of wastewater production), density, type of sanitation facilities and maintenance (households, centralized systems, industries, hospitals, livestock, etc.), type of wastewater generated (organic pollutants, microbial pathogens, nutrients, toxic and harmful chemicals, persistency and bio-accumulation of pollutants), performance of the treatment if any, proximity to sensitive waters (i.e. Class 1 waters).

Zone	1 Urban centre	2 Coastal Town/Village	3 Rural Village	4 Informal settlement	5 Low standard	6 High standard	7 PSP	8 Marinas	9 NPS
Risk	High	High	Low	Medium-High	Low	Low	High	Medium	High

Table 11: Risk analysis of the impact of each zone on the environmental and human health

The zones with the highest impact risk on the environmental and human health are the urban centres and coastal towns, especially due to the large amount of domestic wastewater produced and discharged untreated to open drains and water bodies combined with the high density and the poor access to improved sanitation (i.e. coastal towns). Zones with special activities and non-point source (i.e. agricultural activities) are also classified as high impact risk, since they produce large quantities of liquid waste (domestic wastewater form hotels, industrial wastewater, wastewater from pig farms) with some of them very harmful (industrial wastewater, pesticide from runoff water) that remains untreated before entering the environment.

Informal settlements zone is considered as medium-high impact risk. Indeed, populations living in informal settlements usually have poor financial capacity, and often rely on no sanitation systems. Combined with the poorer hygiene practices, this population remains very vulnerable to water borne disease. However, this population is in the minority which results in small amount of domestic wastewater directly discharged into the environment. Marinas and harbours are also classified as medium impact risk since they have a direct impact on sensitive coastal water and marine biodiversity. However, in the absence of reliable and consistent data, it is estimated that the amount of wastewater released by boats and yachts is smaller than for urban centres and coastal towns zones.

Rural villages as well as low and high standard low density zones are classified as low impact risk. These zones represent a small population which results in small domestic wastewater production. Also the low population density and the geological localization of these populations facilitate most probably domestic wastewater running off and infiltrating with a biological degrading process into the environment.

3. ACTUAL OFFER IN WASTEWATER SERVICES AND INFRASTRUCTURE

3.1 Sanitation Practices and Technologies Currently Used

Domestic wastewater

As shown in chapter 2.4, both on-site and off-site sanitation facilities are used in St. Lucia to manage grey- and blackwater, but most households rely on on-site sanitation facilities (86% of households rely on septic tanks and pit latrines). Septic tanks are emptied by emptying companies only when they gets full or when problems occur (overflow, odour, and complaints from neighbours). There are still people practicing open defecation in St. Lucia, e.g. in Anse-la-Raye village, 29% of households have no on-site sanitation facility[5].

Greywater – a critical issue

Most of the greywater (from domestic or industrial production) is discharged untreated into open drains which lead to watercourses and ultimately the marine environment. The main reason is that people understand that greywater will fill up the septic tank and they want to reduce the maintenance frequency. This situation can be observed in some cases even if the households are connected to a sewer. This practice may lead to several negative impacts:

- Greywater ends into water bodies without any treatment resulting in important negative effects on the marine biodiversity and human health (organic pollutant, phosphate, grease, oil, etc.). Indeed, greywater contains organic pollutants that are more readily available for micro-organism than the one contained in blackwater. This can drastically decrease the dissolved oxygen when entering in large quantities to water bodies. Greywater contains only small concentration of microbial pathogens.
- In the event of flooding, drains overflow thereby causing severe human health risk.
- Grease and oil contained in greywater can settle and clog the drains, which contribute to mosquito breeding and bad odour.
- Drains are not always properly maintained and greywater remains in the drain.
- In coastal areas, where villages are below sea level, seawater can flush back into the drain and be mixed with greywater. Greywater remains therefore in the drains.
- In the case of people connected to a sewer network, this practice can disrupt the proper functioning of the sewer itself due to a low hydraulic flow in the sewer. This also depends on the design of the sewer.

[5] Montoute_Cashman_2015_KAP_water_sanitation_hygeine_CTR_78

Picture 12: Greywater flowing into the river (Castries)

Picture 11: Kitchen greywater flowing in the drain (Anse-la-Raye)

It is important to note that specific management of greywater can have positive impacts on the wastewater treatment process. Greywater decomposes much faster than blackwater. Organics are, relative to the organics in blackwater, more readily available to micro-organisms. Also greywater contains only ten percent of the nitrogen contained in blackwater. Nitrogen (as nitrite and nitrate) is one of the more serious (causing cancer) and difficult-to-remove pollutant affecting drinking water. Furthermore the nitrogen found in greywater is around half organic nitrogen and can be filtered out and used by plants. In addition, greywater contains lower pathogen concentration and therefore requires softer and cheaper treatment processes than blackwater. The simplest, most appropriate treatment technique consists of directly introducing freshly generated greywater into an active, live topsoil environment. This allows organics to degrade rapidly and plant to recover organic nitrogen. However, in dense areas, centralized extensive (or intensive according to land available) treatment process (waste stabilization ponds) are more appropriate.

Hotels and restaurants

Picture 13: Free-water surface constructed wetland (reed beds)- Jade Mountain Resort

Almost 50% of the hotels on the island have a wastewater treatment plant to treat both black- and greywater. It is important to note that they represent more than 50% of the total hotel customers (and then more than 50% of the wastewater production) since these hotels are among the biggest on the island. Some of them reuse the treated wastewater for watering and wetting the road to avoid dust. The other hotels rely mostly on septic tanks; a few of them are connected to the sewer networks. Some of the restaurants have grease traps but they are often not maintained properly.

Industries

A few industries are also equipped with pre-treatment or wastewater treatment plant packages in order to prevent industrial wastewater contamination issues. However, most of the industrial wastewater is directly discharged into open drains and water bodies.

Health sector

Wastewater from operational public and private hospitals is directly dumped into water bodies without pre-treatment, which exposes the population to pathogens from contaminated sources. The new Castries hospital (Dr. Owen King-EU Hospital) which is under construction will be equipped with a WWTP.

Farming

Only few livestock farms are equipped with a biogas plant (5 out of 322 swine farms). Biogas plants are expensive investments and so are operation and maintenance; they require qualified staff to operate them. The gas produced is fully saturated in water and needs to be treated before being used. The majority of swine farms use septic tanks. According to Mr. Vernon A. Valmont[6], a livestock expert, septic tanks are not appropriate for manure management. It has been observed that manure has a lower density than human excreta, therefore part of the manure floats at the surface and disrupts the septic tank performance; as a consequence septic tanks tend to overflow directly into the environment and water bodies. Some of the livestock farms try to reuse valuable products such as compost, dry manure, and biogas from the treatment processes. Demand for fertilizers is high in St. Lucia.

A summary of the sanitation technologies currently used in St. Lucia in the 9 clusters is presented in Table 12 below.

Zones	Sanitation technologies and practices
1: Urban centre of main cities/towns	➢ Collective sewer networks (sewerage) ➢ Septic-tanks with 2 chambers and a soak away (charcoal)
2: Small and medium size coastal towns/villages	➢ Semi-collective system with collective septic tanks ➢ Public toilets with laundry area and showers ➢ Septic-tanks with 2 chambers and a soakaway (charcoal). Volume is usually 8*4*5 ft. ➢ VIP (a few with concrete slab) ➢ Open defecation, night soil disposal
3: Rural villages	➢ Public toilets with laundry area and showers ➢ Septic-tanks with 2 chambers and soakaway (charcoal) ➢ VIP (a few with concrete slab) ➢ Open defecation, night soil disposal
4: Poor informal, high density settlements	
5: Low standard, low density areas	
6: Medium-high standard, low density areas	➢ Septic tanks with 3 chambers equipped with a filter made with sand, charcoal and graded gravel layer on geo textile fabric.
7: Areas with specific activities	Restaurants: ➢ Septic tanks ➢ Sewer network ➢ Grease trap
	Hotels: ➢ Septic tanks ➢ Sewer network ➢ WWTP process: settling tank, activated sludge, free-water surface constructed wetland, aerated ponds, waste stabilization ponds, rotating biological contactor (RBC)
	Industries: ➢ Septic tanks ➢ Sewer network ➢ WWTP process: anaerobic reactor, membrane bioreactor (MBR)

[6] Disaster risk mitigation in agriculture project, FAO & Ministry of Agriculture, Lands, Forestry and Fisheries. 2011

	Livestock: ➢ Septic tanks ➢ Composting unit ➢ Biogas plants
	Hospitals: ➢ Septic tanks
8: Marinas and harbours	➢ Public toilets and showers ➢ Wastewater pumping station for boats ➢ Septic tank for the boat wash down area
9: NPS	➢ Runoff water and leaching

Table 12: Sanitation Technologies Currently Used in St. Lucia

Technical Support

There is no selection process nor independent technical support to help different entities (households, hotels, industries, etc.) to evaluate and select the best suitable sanitation technologies. The Ministry of Health delivers only some generic recommendation on sanitation systems dimensioning (septic tanks, Imhoff tanks, sewage settling tank, sewage biological filters, package plants, oxidation ditch, oxidation ponds and intermittent sand filters). The plans must be approved prior to the start the construction.

3.2 Sanitation Service Providers

3.2.1 Faecal sludge collection and transport

Faecal sludge (FS) emptying service is offered by both public and private sectors, but private sector covers most of the market. Most of the sanitation facilities that are emptied are septic tanks. They also empty sludge from WWTP package and provide when necessary grease traps cleaning service. Table 13below shows how the FS emptying service is distributed between the public and private sector. It appears that 92% of the FS emptied is achieved by the private sector:

Distribution of the faecal sludge emptying service in St. Lucia		
Service providers	Volume collected per year [m3]	[%] of the total volume of FS collected
Private companies	12,600	**92%**
Public sector	1,150	**8%**

Table 13: FS Empting Service Distribution between Public and Private Sector

The private sector is represented by 3 emptying companies and 1 company providing mobile public toilets. The 3 emptying companies are listed below:

1. **Lazarus funeral home** mainly operates in the southern part of the island, from Dennery to Soufriere.
2. **Rockers Sanitary Cleaning Company** operates island wide.
3. **R&S Company** mainly operates in the greater Castries, Rodney Bay, Gros Islet and Roseau areas.

Picture 14: Emptying truck (Vieux-Fort)

The 3 companies use second-hand vacuum trucks from 1500 imperial gallons (6800L) to 3000 imperial gallon tanks (13600L). They all agreed that there are no difficulties accessing the septic tanks. They can connect hoses in line with a length of up to 300 ft. (90m).

SLECL Company provides mobile public toilets for special events. They use a mobile vacuum pump mounted on a tank to empty the mobile toilets. The capacity of the tank is about 200 gallons (900L) which is too small to operate septic tank desludging.

All companies indicated that vacuum trucks and pumps are regularly serviced, every 2 to 6 months. Service and maintenance are usually done by employees.

Vacuum trucks are most of the time imported from the United Kingdom but import duties are high and hamper the development of this crucial sector. Also spare parts are hardly found on the island and usually have to be imported directly from abroad, which increases the maintenance cost. TNH Company is known to be the only company island wide providing spare parts.

The public sector is represented by the Castries City Council and WASCO:

- **Castries City Council** (CCC) has a vacuum truck and offers emptying service. Mainly it empties septic tanks from households in the Greater Castries but also operates island wide for desludging septic tanks of institutional buildings and schools. The vacuum truck has been donated by the Public Health Ministry (MoH) and the pump was initially designed to deal with water. Therefore, the small capacity of the pump limits the distance allowed between the truck and the septic tank to a maximum of length of 100 ft. (30m). To ensure that the truck will be able to access the septic tank closer than 100 ft, a team with a pickup van is first sent to the site; however, it costs time and money. Also, CCC offers a medical check every 6 months to its employees that operate FS emptying. In 2013, CCC applied for Canadian Fund for Local Initiative (CFLI) to purchase a second-hand septic removal truck; unfortunately the application was not approved by the CFLI.
- **WASCO** used to offer FS emptying service for public and private sectors but its truck is out of service for 2 years.

The service fee is set per load and varies depending on the kind of users (household, hotel, institutional building, etc.), the distance between the truck and the septic tank, the distance to be covered by truck and the truck size. Existing fees are as follows (Table 14):

Service providers	Client categories	Fee including VAT [$EC]	
		Lowest	highest
Private companies	Households	500	650
	Hotels	800	1600
	Institutional buildings	800	
Public service	Households	460	690

Table 14: FS Emptying Service Fee

Based on the 2010 Census data and the hypotheses that the average size of a septic tank of a household is 4.5 m^3 (regular design of a septic tank in St. Lucia is 8*4*5 ft., and minimum of 3.5 m^3 recommended by the MoH), the septic tanks are partially emptied with 80% of FS removal and an average emptying frequency of every 5 years. Table 15 shows that about 26,800 m^3 per year should be collected from household septic tanks.

Assessment of the volume of FS production from households		
Total households	Household	58 920
Percentage of septic tanks	[%]	62,8%
Average size of a septic tank	[m^3]	4,5
Partial emptying of the septic tank	[%]	80%
Emptying frequency of a septic tank	[year]	5
Total Household FS production	**[m3/year]**	**26 823**

Table 15: Assessment of the FS Production Volume from Household Septic Tanks

Based on 2014 hospitality data from the Ministry of Finance and Economic Affairs (St. Lucia), Table 16 shows that the WWTP sludge and FS production from hotels is about 2,400 m^3/year.

Assessment of the volume of FS and WWTP sludge production from hotels		
Population connected to a septic tank	Inhab	104 911
FS production per year	[m3]	26 823
FS production per inhabitant per year	[m3/Inhab/year]	0,2557
Number of tourists in 2013 that stay over	Inhab	338 158
Touristic growth affluence per year	[%]	5%
Estimation of the number of tourists in 2016	[Inhab]	388 882
Average length of stay	[day]	8,8
Inhabitant equivalent per year	[Inhab]	9 376
Total Hotel sludge (FS+WWTP sludge) production	**[m3/year]**	**2 397**

Table 16: Assessment of the Sludge Production Volume from Hotels (FS & WWTP Sludge)

The total annual volume of sludge (FS and sludge from WWTP package) production in St. Lucia is about 29,000 m^3. Figure 9 shows that today less than 50% of the total amount of FS that could/should be collected per year is emptied. This number does not take into consideration the relatively small amount of FS from industries.

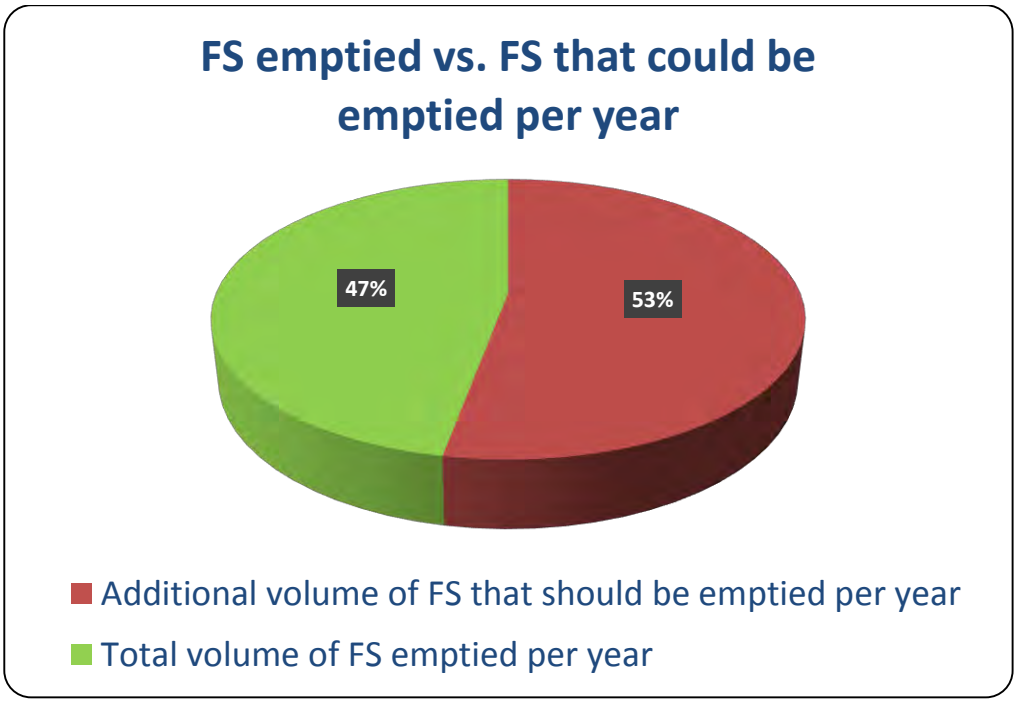

Figure 9: Proportion of FS Emptied on the Total FS that Should be Emptied

The potential for FS emptying service is high. The volume of FS to be emptied and the related business could increase with adequate septic tank management (operation and maintenance).

3.2.2 Faecal sludge disposal

The FS collected in St. Lucia is discharged at 3 different sites; unfortunately none of them is safe according to environmental standards:

1. The Beausejour WWTP has a sludge pit where emptying companies can discharge the FS. The sludge pit is a single pit about 5m depth. The liquid part of the sludge infiltrates into the soil without any control which increases the risk of soil and groundwater contamination. It can be estimated that the organic matter is partially degraded by anaerobic micro-organisms inside the pit. Also the pit has never been emptied and there is no plan for recycling the sludge as fertilizer.

Picture 15: Pit sludge at Beausejour (Gros Islet) WWTP

   Emptying companies are charged 200 $EC per load, irrespective of the volume of FS discharged. It is also important to note that the access to the WWTP is restricted to office hours, while emptying services are often performed on evenings and on weekends.

2. The CCC built its own faecal sludge treatment plant (FSTP) at Union, Castries. It is equipped with 3 transfer/storage tanks, each directly connected to a drying bed. The drying beds are surrounded by a concrete wall and are equipped with a sand filter. However, the leachate infiltrates into the soil and probably ends up in the river which

flows nearby. After an average drying time of about 1 week, the dried sludge is removed and thrown into the river. It can be estimated that there is a partial degradation of the organic matter inside the transfer station due to the anaerobic conditions. However, pathogen reduction seems inefficient due to the very short drying time and the absence of secondary treatment of the leachate. Access to the FSTP is restricted to the CCC employees. The CCC is seeking to increase the FSTP capacity by extending the drying beds but this plan is directly linked to the acquisition of a new vacuum truck. The CCC is also investigating the possibility of a new site for the FSTP in order to increase the distance between the treatment facilities and the river. The biggest primary school in Castries is very close to the actual site too.

Picture 16: CCC FSTP at Union

3. Some of the FS is discharged directly onto open lands without any treatment. There is no protection to prevent the surrounding environment from contamination by the FS (soil, run off water, coastal water).

Picture 17: Faecal sludge dumping site (St. Lucia)

The following table shows the estimated volume of FS disposed at each site per year.

Faecal sludge disposal in St. Lucia				
FS disposal site	Total FS production [m3]	Total FS collection [m3]	FS disposal [m3]	[%] of the total volume of FS collected
Beausejour WWTP: FS pit	29 220	13 750	10 000	**73%**
FSTP of Union: Drying beds			1 150	**8%**
Dumpsite			2 600	**19%**

Table 17: Production, Collection and Disposal of FS

Figure 10 illustrates the distribution of the FS being disposed.

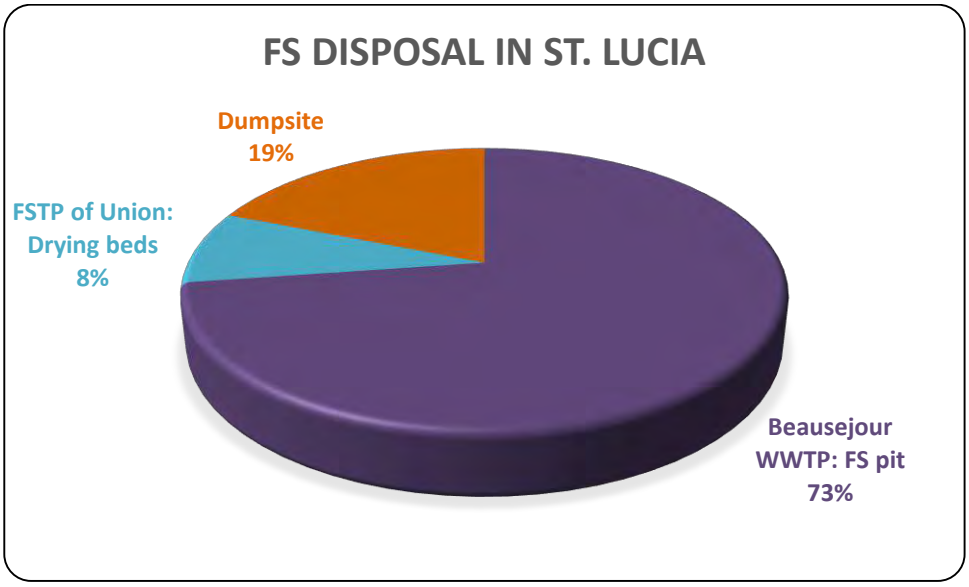

Figure 10: FS Disposal in St. Lucia

Most of the FS collected in St. Lucia is disposed in the sludge pit at the Beausejour (Gros Islet) WWTP. Although the pit sludge is not an efficient and adequate treatment, the improvement of the FS treatment is possible due to the proximity of the aerated and maturation ponds and the land available around the WWTP.

Three complaints have been reported: high discharging fee, especially if no particular FS treatment is performed, no plant in the southern part of the island and limited opening hours. The location of the two official sites in the northern part increases the costs of the emptying service in the South. Emptying services are often performed at night and during weekends, thus emptying trucks should have access to the WWTP accordingly.

81% of the FS collected onsite can be considered to be partially treated, but 19% is dumped directly into the environment (on open land). The lack of proper FS treatment increase human health and environmental risks.

3.2.3 Centralized and semi-centralized sanitation systems

There are two sewer networks in St. Lucia; Castries sewer network serving Castries City and the Beausejour sewer network serving mostly Rodney Bay and Gros Islet town. Both sewers are operated and maintained by WASCO.

Table 18 shows the number of households connected to the sewer in the different areas[7]. In total, there are about 4,000 of households connected to both sewers representing about 10,000 of inhabitants. Although in the centre of Castries there is more than 80% of connections, the total average of connection in Castries is low with about 27% of connections. In Rodney Bay and Gros Islet this number is even smaller with only 15% of households connected to the Beausejour sewer network. The potential for increasing sewer connection is high.

[7] Only areas where there is at least one connection to the sewer are shown

Castries and Beausejour sewer networks coverage				
	Area Covered	Water # of Accounts	Sewer Connections	Sewer coverage
CASTRIES SEWER NETWORK	L'Anse Rd, Sans soucis, Bernard Hill, Darling Rd, Morne Pleasant, Conway, Reclamation Ground, John Compton Highway	909	427	47%
	Vigie, Peninsula, Point Seraphine	222	1	0,5%
	Calvary Rd, Chaussee Rd, New Village, Pearts Gap, Trinity Church Road	392	254	65%
	La Pansee, George Ville, Chase Gardens, Carellie, Karebelle, Agard Lands	1096	80	7%
	Morne Du Don, Rose Hill, Fond Le Grand, Bois Patate, Hill Crest, Agard lands,	1558	138	9%
	Leslie Land, Waterworks road, Lastic Hill, Patterson Gap, Lower Entrepot	909	421	46%
	Cedas, Sunbuilt, Ravine Chabot, Upper Entrepot, Independence City	966	267	28%
	Upper Bridge St., Morne Rd, Old Morne Rd, Pavee	570	11	2%
	Maynard Hill, Trou Rouge, River side road	436	1	0,2%
	Marchand Main Rd, Bagatelle, Arrundel Hill	814	81	10%
	Rock Hall, Black Mallet, Ravine Tootwelle	470	32	7%
	George Charles Boulevard	130	20	15%
	Bishop Gap	293	3	1%
	Jeremie St, Victoria St, St. Louis St, High St, Micoud St., Brazil St., Maryann St., Grass St.	756	629	83%
	Chisel St., Coral St., Broglie St., Peynier St. Laborie St., William Peter Boulvard, Bridge St., Mongiraud St., Manoel St. Bourbon St.	367	306	83%
	Total	**9888**	**2671**	**27%**
BEAUSEJOUR SEWER NETWORK	Marisule, Bois D' Orange, Morne Trulau, Morne Giraud, Trouya, Corinth, Morne Serpent, Grande Riviere, Monier, Degazon, Piat, Ingle Woods, Assau Canal.	4440	30	1%
	Town of Gros Islet (Massade (Left side)	800	383	48%
	Reduit, Rodney Bay, Bonne Terre, Cas En Bas, Cap Estate, Rodney Heights, Bella Rosa, Bour Se Jour, Belle Vue	3149	873	28%
	Total	**8389**	**1286**	**15%**
TOTAL		**18277**	**3957**	**22%**

Table 18: Castries and Beausejour Sewer Networks Coverage (WASCO)

The Castries Sewage System is only a collection system with no treatment. It collects mainly blackwater from the city centre, as well as the surrounding communities of Entrepot, Marchand, Sans Souci, Ravine Chabot and Independence City. The sewer network of Castries, which is over 50 years old and in poor condition (infiltration and exfiltration) results in raw sewage being dumped directly into the Castries Harbour through an outfall that has been broken for over 30 years. WASCO estimates that 1.5 million imperial gallons (approximately 6,800 m3) of untreated sewage is pumped daily directly into the Castries Harbour.

The Beausejour sewer network collects wastewater from Rodney Bay, Gros Islet village and some areas to the west and north of the cricket stadium which are then discharged into the Beausejour WWTP.

The legislation that regulates connection to the sewer networks only stipulates that properties have to be connected if the estate is located within reasonable distance to the network. The term reasonable would need to be properly defined to avoid confusion. Currently, the enforcement of this rule remains low. People usually prefer to rely to onsite sanitation system to avoid paying monthly fees for the sewer service. In addition to that, the initiative must be taken by the household that has to submit a request to WASCO for a quotation. If the household agrees with the quotation of WASCO, it bears 100% of the connection costs.

Once connected to the sewer, the tariff varies with the type of client and is based on 100% water consumption.

Client category	Price [EC$ / 1,000 imperial gallons]	
	< 3,000 imperial gallons	> 3,000 imperial gallons
Domestic*	$8.22EC	$15.61EC
Commercial/Industrial	$20.66EC	
Hotels	$22.02EC	
Government	$12.82EC	

*Domestic customers are charged a minimum fee representing 2,000 imperial gallons = $16.44EC

Table 19: Wastewater Discharge Tariff when Connected to a Sewer

It is mandatory for all hotels / restaurants to be equipped with a grease trap but compliance is not enforced. Oil and grease are a major concern for the sewer network since it can clog the sewer and damage the pumps. Authorities are aware of this issue, but it is proven difficult for existing establishments without grease traps to install one because no provisions were made during construction.

At the Beausejour WWTP, WASCO employed an Advanced Integrated Pond System in order to properly treat the wastewater. The sewage is first screened in order to remove garbage and large solids, and scum is removed by a scum collector. The effluent flows through 5 lagoons, of which the first two work in parallel and are equipped with surface reactors (55,000 m^3 each). The effluent from the two aerated ponds flows into a maturation pond (10,300 m^3), and 2 facultative aerobic ponds with U-shape to increase the retention time (9,900 m^3 and 9,600 m^3 respectively). The effluent then flows into a river to Epouge Bay (Google Map, Feb 2016).

Picture 19: Aerated Ponds at Beausejour WWTP

Picture 18: Facultative Aerobic Pond at Beausejour WWTP

In the actual situation, the inlet flow is about 1,500 m^3/day (750m3/day for each aerated pond), but it is assessed that each aerated pond has a maximum capacity of about 13,000 m^3/day. Therefore, the Beausejour WWTP only works at less than 10% of its installed maximum capacity.

Table 20 reveals that according to the capacity of the WWTP the Beausejour sewer network could serve about 36,000 inhabitants. Taking into consideration the number of inhabitants of Gros Islet district in 2010 (25, 210 inhabitants) and the specific annual population growth of the district (2.3%), the population of Gros Islet could reach 36'000 people in 2028. Obviously this should be in accordance with the current design of the network.

Potential of increasing connections to the Beausejour sewer network	
Actual Sewer Connections	1286
Average household size [Inhab]	2,8
Actual Population connected [Inhab]	3616
Actual working Capacity of the WWTP	10%
Total potential of connection	12860
Potential Population connected [Inhab]	**36161**

Table 20: Potential of increasing connections to the Beausejour sewer network (Census 2010)

Figure 11 shows that there is potential for improving the Beausejour sewer network. Households that are located in Caye Manje, Bonne Terre, Beausejour, Reduit, Cas-en-Bas could be easily connected to the Beausejour sewer. Indeed, as mentioned above, the capacity of the Beausejour WWTP is under-utilized.

Figure 11: Beausejour sewer network (WASCO 2016)

Figure 12 shows the distribution of households connected to the Castries city sewer network; however, due to lack of data the whole sewer network is not represented on the map. The black line shown on the map (Figure 12) surrounds the city centre where most of the buildings are connected to the sewer. WASCO is expected to provide a more recent map with updated data

regarding sewer connection. Nevertheless, the high density of population on the outskirts of Castries city centre has to be considered when identifying and designing sanitation solutions. If a WWTP has to be proposed for the actual Castries sewer network, assessing the potential of connection of this population is crucial in order to optimise the efficiency of the network and sanitation facilities.

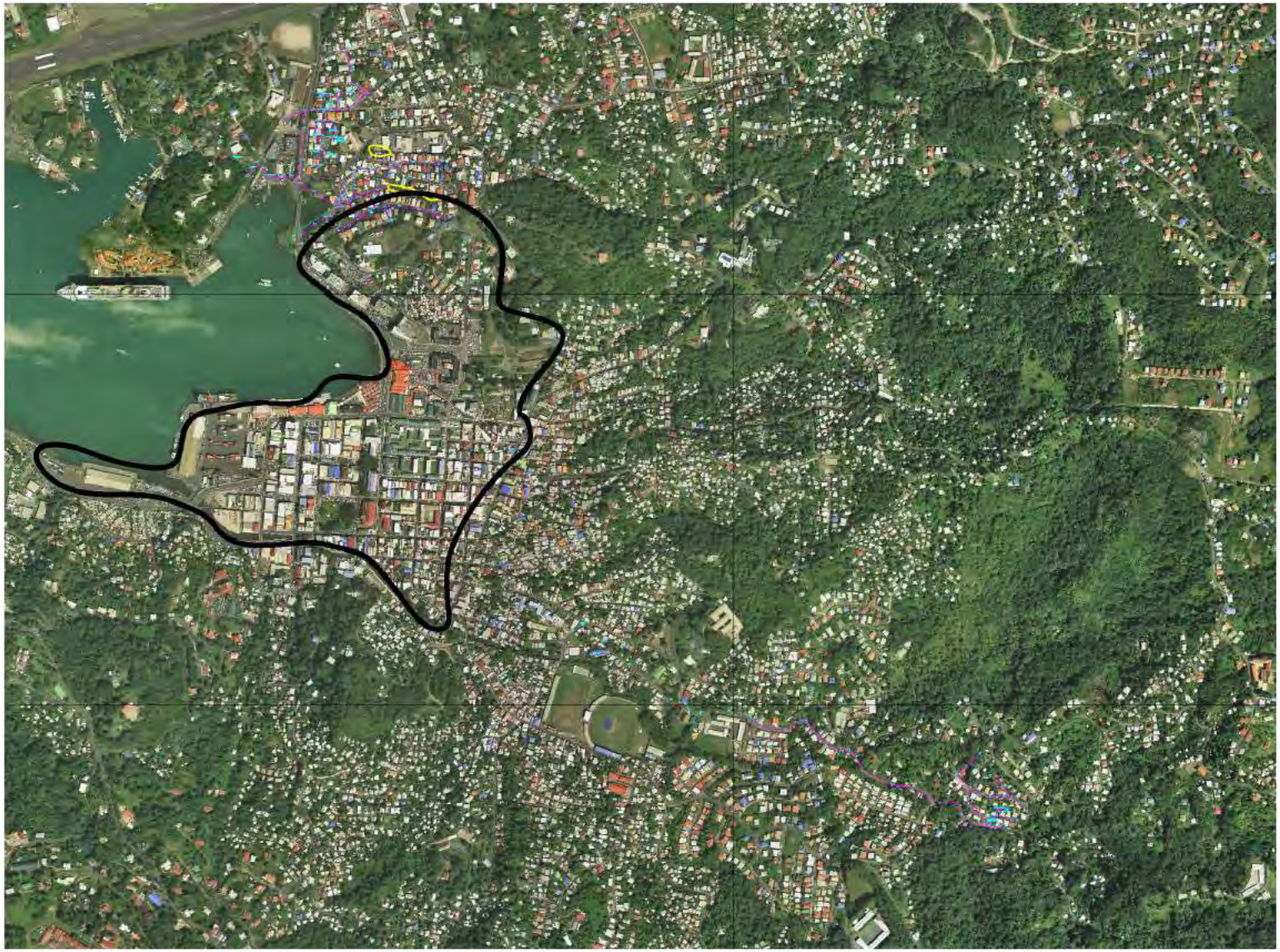

Figure 12: Castries City Sewer Network (WASCO 2016**)**

WASCO performs daily monitoring and testing of the inlet and outlet to comply with the Public Health Act and WHO guidelines. Data shown in the Table 21 was provided by WASCO.

Parameters	LBS Protocol		Inlet of WWTP	Outlet of WWTP	Efficiency of the treatment [%]
	Class 1 waters	Class 2 waters			
TS [mg/l]			1053.2	904	14
TSS [mg/l]	30*	100*	157	48	69
COD [mg/l]	150	300	309	196,6	36
BOD_5 [mg/l]	30	150	256	19,4	92
NH_4 [mg/l]			0,42	0,42	
NO_3 [mg/l]				4,04	
SO_4 [mg/l]			48,7	52,0	
PO_4 [mg/l]	1	No limit established	3,74	3,74	
FC [1mpn/100ml]	200	No limit established	Too numerous	1	

*Does not include algae from treatment ponds

Table 21: Inlet and outlet water testing of the Beausejour WWTP

Conclusions treatment performance:

Biological Oxygen Demand (BOD_5) and Faecal Coliform (FC) concentrations comply with Class 1 waters of the LBS Protocol while Total Suspended Solids (TSS) and Chemical Oxygen Demand (COD) comply with Class 2 waters of the LBS Protocol. Phosphate (PO_4) concentration is higher than the limit for Class 1 waters (there is no limit established for Class 2 waters). Also the treatment process is highly efficient with 92% of BOD_5 reduction. TSS reduction is acceptable with a rate of 69%; this rate could increase if algae were removed by filtration process. The abatement of FC is very efficient with a concentration of 1 cfu/100ml at the outlet. Total Solids (TS) and COD reduction rate reach only 14% and 36% respectively. These values are considered as low. The phosphate concentration is higher than the limit for Class 1 waters, which can have a negative impact on the environment through eutrophication. The effluent can therefore be discharged in Class 2 waters (non-sensitive water stream). Treated wastewater has been reused for irrigation of the golf course in Cap Estate and the Beausejour Cricket Stadium in the past, but due to high concentration in TSS, partly due to algae growing in the ponds, and bad odour, this practice has been suspended.

There is a semi-centralized sewer network in Vieux-Fort with a system of collective septic tanks. The system serves 496 lots (NDC housing phases 1 & 2 contains 256 lots; Hewanorra Orchid development contains 120 lots; and NHC 3A contains 120 lots). Currently it hasn't been maintained nor is it operational. Recently the sanitation system turned into the responsibility of WASCO which plans to get it functioning in 2016.

Three other semi-centralized sanitation systems are operating in St. Lucia:

- La Pansee with approx. 45 households; developed by a private developer

- Fond St. Jacques with approx. 11 households; developed by the Ministry of Planning (Government project);
- Emerald Heights with approx. 4-5 households; developed by NIC (Government project)

La Pansee and Emerald Heights systems are operated and maintained by WASCO. Fond St. Jacques system is in the process of being handed over to WASCO for operation and maintenance.

3.2.4 Wastewater emptying service for boats and yachts

Rodney Bay and Marigot Bay marinas both offer wastewater emptying services to empty the wastewater tanks from the boats and yachts.

The vacuum pump installed at the dock of Marigot Bay is connected to the WWTP of the Capella Marigot Bay Resort. Unfortunately the pump is currently out of service.

Picture 20: Mobile pump and onshore pumping station at IGY Rodney Bay Marina

The Rodney Bay Marina is equipped with an on-shore pumping station and a mobile pump unit for bigger boats that cannot access the on-shore pumping station. The mobile pump is mounted on a 55-gallon volume (250L) tank. All the wastewater collected from vessels is discharged into the Beausejour sewer network.

On average, about 2 out of every 40 vessels that dock at the Marigot Bay or 2 vessels per month at the Rodney Bay Marina use the wastewater emptying service, with a slight increase during the high season and the ARC event. The service fee is charged by a per ft. basis and is affordable.

Boat length [ft.]	Service fee [US $]
< 80	20
80 - 130	50
> 130	120

Table 22: Wastewater Emptying Service Fees at Rodney Bay Marina

The poor promotion and marketing campaign combined with the lack of regulation and enforcement can explain the very low demand. Indeed, in the actual context there is no regulation that requires owners of boats to lock the wastewater tanks when they are docked at the marina. The very low number of users of the service also reveals the very poor environmental awareness and consciousness of both sailors and yacht owners, whose affordability is assumed to be sufficient for this kind of service.

It is important to note that the management of the marina tries to limit the production and discharge of wastewater into the marina by offering toilets and showers to the customers. This service is open 24/24.

The Rodney Bay marina also has a ship wash down area. The wastewater is captured through a gutter which is connected to a septic tank. The effluent of the septic tank which probably contains high concentration of heavy metal, oil and toxic chemicals is directly released into the

harbour (cf. Picture 21). Also the septic tank process might not be appropriate for such liquid waste since solids may hardly settle. Furthermore such chemicals are not likely degraded by anaerobic processes. These chemicals (for example Hg, Pb, and Cd), which are usually very persistent in the environment, are often toxic for marine wildlife even at low concentration. They can bioaccumulate into the organism and may adversely affect DNA and enzymatic processes, hence interfere with life processes. This can cause potentially severe effects on the marine biodiversity and human health through consumption of fish and seafood.

Picture 21: Effluent of the septic tank flowing into the Rodney Bay Marina

The St. Lucia Air and Sea Ports Authority (SLASPA), which is responsible for managing waste and wastewater management at the major seaports in Castries and Vieux Fort, but also the smaller points of entry such as Soufriere and the marinas at Rodney Bay and Marigot, does not provide emptying service for boats, yachts and cruiser ships. However, it operates two aerobic ponds at Hewanorra Airport in Vieux-Fort.

3.2.5 Monitoring and water quality testing service

In order to monitor and perform water quality testing in St. Lucia, several laboratory facilities are available, with varying levels of capacity and capabilities.

- EHS-CARPHA Environmental Laboratory

  Located in Castries, the environmental laboratory is currently the most equipped of such facilities in St. Lucia. The highly trained and experienced staff operating the laboratory is capable of executing water quality monitoring (WQM) field operations and analyses and capacity building initiatives in WQM at the national and regional levels.

  WQM support and service are provided to government agencies, the private sector (mostly hotels and a few manufacturers) and NGOs for testing of potable, coastal water and wastewater effluents.

  This laboratory is also accredited to ISO 17025 by the Canadian Association for Laboratory Accreditation (CALA). Some of the relevant wastewater tests conducted are listed in the table below:

Categories	Parameters analysed
Physico-Chemical	pH Conductivity Salinity Dissolved Oxygen Oil and Grease Total Dissolved Solids Total Suspended Solids Turbidity Metals (lead, zinc, copper, iron, chromium, arsenic, tin, mercury, arsenic)

Categories	Parameters analysed
Biological	BOD_5
Chemical	Nitrates Phosphates Ammonia Nitrogen COD
Microbial	Total Faecal Coliform Enterococci E. Coli

Table 23: Parameters analysed at EHS-CARPHA Environmental Laboratory

- WASCO Water Quality Laboratories

WASCO owns and operates two WQM laboratories. One lab is dedicated to potable water quality testing while the one located at the Beausejour WWTP is dedicated to testing the quality of raw and treated wastewater. Technical staff members are also highly trained with many years of experience in WQM.

The analytical capacities of the laboratory at Beausejour are listed in the table below.

Picture 22: Wasco's Laboratory at Beausejour

Categories	Parameters analysed
Physico-Chemical	pH Conductivity Salinity Turbidity Total Suspended Solids Heavy Metals
Biological	BOD_5
Chemical	Nitrates Phosphates Ammonia COD
Microbial	E Coli Enterococci

Table 24: Parameters Analysed at WASCO Water Quality Laboratories

- Gros Islet Polyclinic Environmental Laboratory

This laboratory is part of the polyclinic of the MoH. It supports WQM initiatives by the Environmental Health Department (EHD) and other government agencies such as the Department of Fisheries (DoF). The staff are well trained in laboratory procedures and analyses and have many years of experience supporting environmental monitoring initiatives of government agencies.

Categories	Parameters analysed
Physico-Chemical	pH Salinity Turbidity Total Suspended Solids
Biological	BOD_5
Chemical	Nitrates Phosphates COD
Microbial	Faecal Coliforms Enterococci

Table 25: Parameters Analysed at Gros Islet Polyclinic Env. Laboratory

- Water Resource Management Agency (WRMA)

The WRMA has endeavoured to develop WQM capabilities to support their mandate for management of freshwater resources in St. Lucia. Basic WQM equipment are resident in the agency, but this should be complemented by additional equipment and supplies that will be obtained under a donor funded. Presently, the agency collaborates with the EHS-CARPHA for implementation of WQM programmes and conducting field operations and laboratory testing.

- Laboratories to support in-house WQM of private enterprises

Some hotels in St. Lucia that are equipped with WWTP with resident onsite operators, have some level of WQM capabilities. These capabilities are usually limited to field testing using hand-held equipment/meters that can measure basic physical, biological and chemical parameters. In most cases, services for WQM are procured from EHS-CARPHA and involve sampling and analyses on a monthly basis of drinking water supplies, end-of-pipe treated wastewater and recreational waters.

- Produce Chemist Laboratory (PCL) of the Ministry of Agriculture (MoA)

Historically the PCL has not been very active in WQM but has assisted with environmental monitoring initiatives of the DoF. There is potential to develop WQM capabilities within the PCL to support the departments and units of the MoA that are involved in aspects of water resources. However, expanding the services of the PCL by integrating WQM to support the agricultural programmes will require access to resources for staffing, procurement of equipment, consumables and training of technicians.

There are several laboratories in St. Lucia with high capacity in performing water quality testing and monitoring. The laboratories cover a wide range of parameters related to sewage contamination that can be analysed as physical-chemical parameters (temperature, pH, TS, TSS, dissolved oxygen), organics (COD, BOD_5), nutrients (NH4, PO4 and NO3) and microbial parameters (FC). If working together and being well organized they could assist the National Utilities Regulatory Commission (NURC) and EHD to conduct routine monitoring and water testing of effluent from sanitation facilities.

In addition the Water Quality Monitoring and Analysis Program (WQMAP) published in 2015 provides WQM field operations and sample management standards and recommendations as well as laboratory analysis and protocols (QA/QC, etc.).

3.3 Sanitation knowledge and training

Several schools provide training and deliver certificates in St. Lucia in a broad range of domains. The most important are the:

- Secondary schools (O'level)- in environmental health, chemistry, biology, building technology and technical drawing.
- Sir Arthur Lewis College (A'level, CAPE, Associate Degree)- in agriculture, arts science and technology, technical education and management studies (hotel and tourism, building technology, architecture, engineering, plumbing, electrical, technician, etc.).
- National Skills Development Corporation and CARE schools (plumbing certificate, electrical certificate, etc.)

However, there are no specific sanitation courses attached to existing programs in the Technical Vocational Education and Training (TVET) programs in St. Lucia. In addition, there is no training or certificate delivered to attest to the competencies of the masons despite the fact that they are often requested to build septic tanks or other sanitation facilities.

At the regional level, regional agencies provide courses and training in sanitation and wastewater management. The Caribbean Water & Sewerage Association (CAWASA) provides training and certification of wastewater operators (laboratory analyst, WWTP operator). They are also thinking about extending the program to private wastewater plant operators. CARPHA provides training for monitoring and water testing. The TVET unit partnered with CAWASA to provide a certificate in water and wastewater management for WASCO's employees.

There is also no national agency that provides technical support in the sanitation sector. WASCO has organized some punctual training for industries or hotels but no continuous program exists.

Since poor sanitation and poor water quality directly impact the tourism sector, hotels have tried to address this major concern by improving their wastewater management. Due to the lack of sanitation experts and the absence of sanitation training in St. Lucia, employees have been sent overseas in order to be trained in the sanitation sector as well as operating and maintaining a WWTP package. Also the tourism sector can utilise the expertise of Mr. Carl Hunter, environmental engineer and specialist in wastewater management, who is fully employed by Jade Mountain Resort.

The industrial sector has very poor knowledge about wastewater management. DBC seems to be the only company island wide that address the wastewater management issues. The staff in charge of the operation and maintenance of the WWTP have been trained regionally and internationally. The supplier of the system also provided support.

MoH has knowledge and competencies in sanitation. They provide technical support for governmental agencies when it is required. They are also in charge of approving sanitation facilities by delivering a permit.

The lack of sanitation courses in the Technical Vocational Education and Training (TVET) programs may have a direct impact on the sanitation sector and the poor attention that one gives to the sanitation and wastewater management issues. However, the TVET unit and the SLCTVET certify that the demand has not been identified as important in order to include the sanitation sector in the curriculums and programs.

3.4 Relevant studies, actual and planned projects

A certain number of documents were reviewed for the Inception Report elaboration. However, the subsequent paragraphs provide short descriptions of additional pertinent studies, ongoing and planned projects that are relevant for the development of the NWMSP.

The French firm SAFEGE is currently conducting a feasibility study for the establishment of a WWTP and water outfall for Castries urban and sub-urban areas[8]. The final report is due on March 10th, 2016. The global objective of the project is to improve municipal wastewater infrastructure in compliance with LBS Protocol. This study addresses two main issues: Castries sewer network is old and in poor condition (infiltration of sea water) and the wastewater is discharged into the harbour untreated. However, it does not plan to significantly increase the number of connections to the sewer network. In 2011, the connection rate was estimated to be 25.3% (SW study); the current study plans to get 30% of the total population connected to the sewer by 2030. Also the site preferred for the construction of the WWTP is Ganters Bay next to Castries airport. This land seems to be the only land available and suitable for the construction of a WWTP.

The Assessment of wastewater infrastructure and go-forward options for the village of Canaries project[9] was published by Island Water Technologies Company on January 20th. Open defecation and untreated wastewater discharged into open drains pose significant health risks to the local population. These practices are directly linked to the high pollution of the bay which affects the development of tourism, and invariably a negative impact on the local economy. Based on this statement, this project identified various suitable and affordable sanitation facility options in order to address the poor and inadequate sanitation practices and technologies used by the communities of Canaries. Strategies for short term and long term visions have been determined incorporating low-complexity, cost effective solutions for improved wastewater management to a centralized network of piping that would drastically reduce risk associated with faecal borne illness, and allow for improved tourism based activities. It is important to note that this study is of high interest since Canaries has a similar development and organization to other villages/communities on the island.

The Ministry of Physical Development, Housing and Urban Renewal (MoPD) initiated recently a new project “Assessment of soil/geology to inform suitable sewage and liquid waste disposal methods in settlement areas”. This project is the consequence of Hurricane Thomas which hit St. Lucia in 2010 resulting inter alia in numerous landslides. The MoPD believes that a number of these landslides were induced by poorly constructed / none functional sewer systems in communities built along slopes. As a result, Mrs. Elizabeth Soomer was contracted to provide consultancy services to the Ministry, to develop terms of reference to assist the EHD in approving different sewer systems based on soil type and geology. Currently the EHD has no criteria for approving such systems.

The study[10] led by Mr. M. C. Montoute and Mr. A. Cashman in 2015, “A knowledge, attitudes and practices study on water, sanitation and hygiene in Anse-la-Raye Village, St. Lucia”

[8] Feasibility Study for Wastewater Treatment Plant and Outfall, Inception Report, Final version, Safege, 2015

[9] Assessment of wastewater infrastructure and go-forward options for the village of Canaries, Island Water Technologies Company, 2016

[10] Montoute_Cashman_2015_KAP_water_sanitation_hygeine_CTR_78

provides a relevant analysis on behavioural practices in terms of water supply, hygiene and sanitation. It was revealed that fewer individuals had access to improved sanitation resulting in cases of open defecation and night soil disposal on the Anse-la-Raye waterfront and the two rivers bordering the village. The high water table in Anse-la-Raye also renders septic tank absorption systems ineffective hence further compounding environmental health issues. This study also highlighted that land space restriction and land title issues were among the causes of the poor access to improved sanitation. This study gives a significant understanding of the hygiene and sanitation issues that the population of Anse-la-Raye faces. These outputs are highly relevant due to the similarity between Anse-la-Raye and other villages of St. Lucia.

Also the Consultants have been informed about three different projects that might be relevant for developing the NWMSP:

- Waste Control Areas Project
- Development of a strategic waste management plan for livestock farms
- New environmental health policy in draft version

Unfortunately, none of these reports have been made available yet.

3.5 Hygiene Behaviour and Education

3.5.1 Hygiene, Sanitation and Environmental Education

In 2010 a Situational Analysis of Environmental Education in St. Lucia was undertaken. This report stated that educational and awareness activities in St. Lucia were inadequate, unsustained and uncoordinated. Subsequent to this, several programmes have been developed. One of these is "My Island - My Community" which is a strategic Communications for Behaviour Change program that builds knowledge, shifts attitudes and changes behaviours to help create resilient island communities.

Additionally, in 2015, the MoSD, Fisheries Division, Department of Forestry, St. Lucia National Trust and St. Lucia Solid Waste Management Authority (SLUSWMA) visited schools throughout the island to provide information to students of schools, island-wide, on healthy lifestyle and environmental issues. The students were entertained with the portrayal by mascots on the different presentations and performances by popular artistes.

Educational awareness programmes are usually components of specific projects undertaken by different agencies but usually end with the life of the projects. However, in addition to the Sustainable Development Unit, CARPHA, the OECS, National Trust, PAHO, the SLUSWMA and the Forestry Departments are all involved in public education and awareness in the environmental field.

In primary schools, sanitation education is not taught. However ‘Health and Family Life Education’ is taught where basic hygiene education is captured.

A knowledge, attitudes and practices study on water, sanitation and hygiene in Anse-la-Raye Village indicates that the community nurses and to a lesser extent the village council are the most influential groups for disseminating information on water, sanitation and hygiene[11]. Participants of the study indicated that information is mainly received from five sources: health communicators, television, radio, newspapers and loudspeaker; however public campaigns was considered as the most informational source.

[11] Montoute_Cashman_2015_KAP_water_sanitation_hygeine_CTR_78

This study also mentions that in terms of the frequency of hygiene practice it was shown that most residents wash their hands very frequently under the various conditions indicated in the Table 26. From the results it was noticed that washing of hands is part of routine hygiene practice for the majority of villagers. 80% always wash their hands after a visit to the toilet.

	Always	Sometimes	Never
After changing baby's nappy	77.6	20.7	1.7
Before handling of food and food preparation	75.5	24.5	0
Before eating	63.8	36.3	0
After a visit to the toilet	80	20	0
After housecleaning and/or disposing of rubbish	84	16	0

Table 26: Frequency of Hand Washing

(Source: Montoute_Cashman_2015_KAP_water_sanitation_hygeine_CTR_78)

3.5.2 Environmental Awareness

The 2010 Situational Analysis recognised that the citizens of St. Lucia were superficially aware of many environmental issues but this awareness needed to be transformed to appropriate behavioural change. Persons still blamed Government agencies for environmental problems without recognising how their own behaviours were contributing to the problem or realising that they could effect change themselves.

In 2007, Environmental Awareness in the OECS was examined through a KAP (Knowledge Attitude and Practice) Survey conducted in six OECS Member States. Only 18% of those surveyed claimed to be "very" familiar with environmental issues (18.0%); the majority instead regarded themselves as "somewhat familiar". There was even less familiarity with Governments' response to the environment. A range of factors has encouraged increased awareness over time; these include important global and regional events, more proximal evidence of degradation, having been actively involved in environmental activities, and being impacted by communication efforts. It is interesting to note that wastewater/liquid/sewage management was not specifically mentioned as a threat in this Survey.

The National Environmental Summary for St. Lucia, 2010 stated that Civil society partnership and participation in environmental management was weak and recommended a need for awareness building at all levels and sectors including at the political level and needed awareness and sensitisation for greater ownership of the environmental assets of St. Lucia by the population targeting resource use in all the sectors.

The State of the Environment Report for St. Lucia, 2015 indicated that there should be sustained management public education and awareness programmes for all environmental issues. The Report also noted that the Forestry Department has a dedicated staff for environmental education. So not surprisingly, surveys carried out have shown that the public has a good grasp of the importance of forests.

4. DEMAND FOR WASTEWATER SERVICES

4.1 Population growth, spatial distribution and land development

With a population of 65 656 inhabitants in 2010, Castries district represents approximately 40% of St. Lucia's total population which is 165 595 inhabitants (cf. Table 27).

St. Lucia has a global annual population growth of 0.55%; however, the population growth is not uniform and varies highly among the districts.

District	2001 Population	2010 Population	Annual Growth
Total Castries	**64 344**	**65 656**	**0,23%**
Castries City	12 439	4 173	**-7,38%**
Castries Sub-urban	25 110	17 938	**-3,17%**
Castries Rural	26 795	43 545	**6,95%**
Anse-la-Raye	6 060	6 247	**0,34%**
Canaries	1 788	2 044	**1,59%**
Soufriere	7 656	8 472	**1,18%**
Choiseul	6 128	6 098	**-0,05%**
Laborie	7 363	6 701	**-1,00%**
Vieux Fort	14 754	16 284	**1,15%**
Micoud	16 041	16 284	**0,17%**
Dennery	12 767	12 599	**-0,15%**
Gros Islet	20 872	25 210	**2,31%**
TOTAL	**157 773**	**165 595**	**0,55%**

Table 27: St. Lucia- Population and Population Growth (Census 2010)

The table shows that the population of Castries decreased by 7.38% per year between 2001 and 2010. During the same period, Rural Castries, Vieux-Fort, Gros-Islet, Soufriere and Canaries had the highest population growth with more than 1% per year. It shows clearly that there has been substantial movement of the population away from Castries City in Rural Castries and Gros-Islet. The rural to urban movement has been observed with Vieux-Fort and Soufriere recording above average increases in population size (Census 2010). This movement has probably been reinforced by the depopulation of the poorest districts (Laborie, Choiseul, Dennery) as people leave to find job opportunities in other urbanized or resort areas with better job opportunities (cf. Figure 13). Indeed, most of the touristic and economic activities of the island are concentrated in these areas (Castries, Vieux-Fort, Gros Islet and Soufriere) which will lead to an increase of the population and density in these cities/towns.

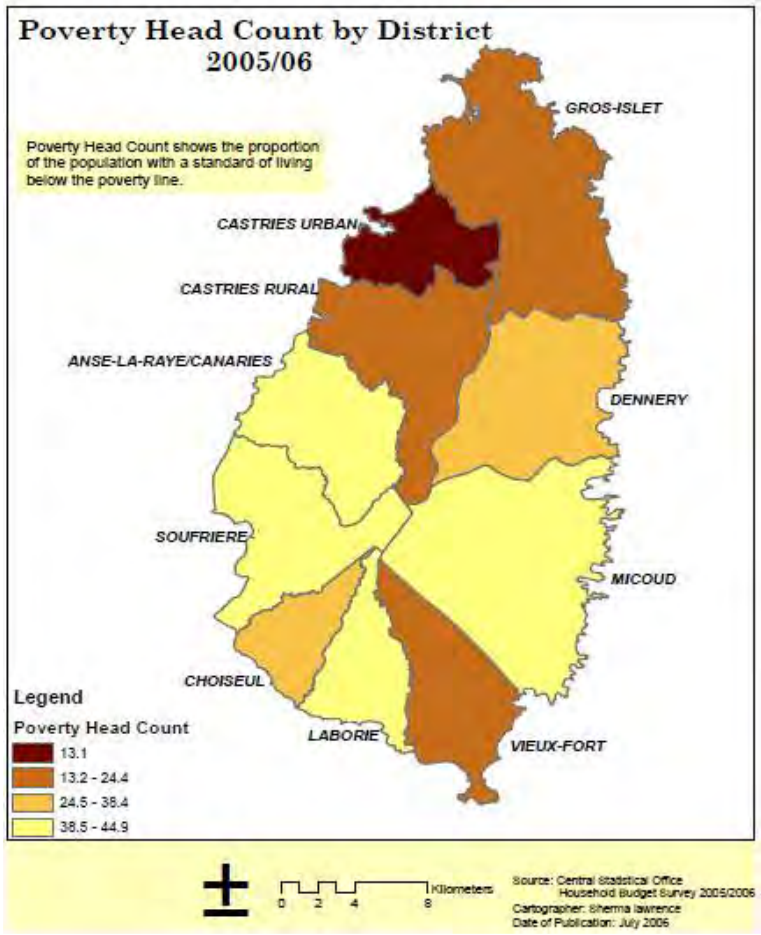

Figure 13: Poverty Head Count by District 2005/06[12]

It has been noted that physical growth in coastal towns zone took place mainly through the process of infilling, for example, the process of building small houses within open yards to maximize the use of land space. As a result of this there is not enough space in many locations to install proper sanitation on-site facilities such as septic tanks and soak away systems. This has left many individuals dependent on public toilets[13]. In Canaries district, for example, 49% of households do not have toilets[14]. In some cases the poor maintenance of the public toilets can encourage open defecation practices. In addition, these facilities are usually closed at night, therefore many villagers use bucket latrines after closing hours.

Picture 23: Public Facility (Micoud village)

[12] Trade adjustment and poverty in St. Lucia 2005/06, Main Report: Volume I, The Caribbean Development Bank

[13] Montoute_Cashman_2015_KAP_water_sanitation_hygeine_CTR_78

[14] 2010 Population and housing Census, Preliminary Report, Central Statistics Office, St. Lucia

The development of poor informal settlements occurs in many places, among them in Castries, Soufriere, Anse-la-Raye Districts. They are often the result of haphazard development on government land (Crown Land) without public infrastructure. These communities often rely on standpipe water and public sanitation facilities. Poor financial capacity combined with the lack of land limit proper development of on-site sanitation facilities.

Table 28**:** Distribution of Households by Type of Tenure (Census 2010) shows that land tenure in St. Lucia has been noted as being mainly private (74.3 % are fully owned). However, in some villages such as in Anse-la-Raye, fully owned households represent only 52.2% of households[15]. In similar areas (i.e. Coastal towns zone) land ownership issues have been considered to be a major constraint to development. In many places development has occurred in a random and unplanned manner and sanitation had not been properly integrated into the overall development of villages. In a study led in Anse-la-Raye in 2015, when households were asked if they were willing to borrow money to install toilets, equal numbers responded positively and negatively (50% each). Those who were not willing to borrow money mainly indicated that it was due to land ownership issues (63.2%) and space restrictions (21.1%). Only a small percentage (10.5%) indicated that they were not able to afford private toilets[16]. The ad hoc nature of land use issues and the lack of reference to a land development or proper zoning plan have resulted in land uses being considered as conflicting.

TYPE	1980	1991	2001	2010
		percentage of households		
Fully Owned	64.7	72.4	74.7	74.3
- Owned with mortgage				8.0
Squatted	0.3	0.2	0.2	0.1
Rented - Private	23.4	21.2	17.1	17.6
Rented - Gov't	1.5	1.3	1.0	0.9
Leased	1.1	0.3	0.1	0.2
Rent Free	6.8	4.0	5.4	5.3
Other	0.3	0.5	0.5	0.5
Not Stated	1.9	0.7	1.0	1.1
Total Households	**24,810**	**33,079**	**41,481**	**58,920**

Table 28: Distribution of Households by Type of Tenure (Census 2010)

Also it has been recognized that a major concern in coastal villages is the high water table due to the proximity of the sea. The hydrogeology conditions make these zones not suited for septic tank and soak-away absorption systems. Despite this, in Anse-la-Raye 65.4% of respondents in a study (162 randomly selected households) confirmed they own a flush toilet linked to a septic tank system[17]. The saturated zone may facilitate a higher rate of migration of faecal contaminants towards the near shore marine environment due to the presence of advection currents. These currents are also expected to be higher in the rainy season after periods of heavy rainfall due to peaks in groundwater flow. In addition, landslide events have been observed in St. Lucia. Some communities initiated development on very steep lands without pre-

[15] 2010 Population and housing Census
[16] Montoute_Cashman_2015_KAP_water_sanitation_hygeine_CTR_78
[17] Montoute_Cashman_2015_KAP_water_sanitation_hygeine_CTR_78

studies of the soil structure and cohesion. Combined with the poor management of grey- and blackwater (infiltration and runoff), this may result in decreasing the stability of the soil structure.

4.2 Financial capacity by segments and zones

Economic conditions per segment is a key factor to be taken into account in the design of a realistic Policy and Strategy. Ability and willingness of each user category to pay, will guide the development and propositions of affordable sanitation solutions. In addition, this allows determination of financing mechanisms, example, in the form of smart or targeted incentives, justified by economic benefits, to accelerate and support the poorest households to access to safe sanitation.

Figure 14 illustrates a general case of how budget is allocated in poor communities, based on UN definition of “poor” (below USD 1.25). Although the figure is not statistically representative of poor households in St. Lucia, it illustrates the message that after essential expenses for food, clothes and transportation, little is left for “everything else”.

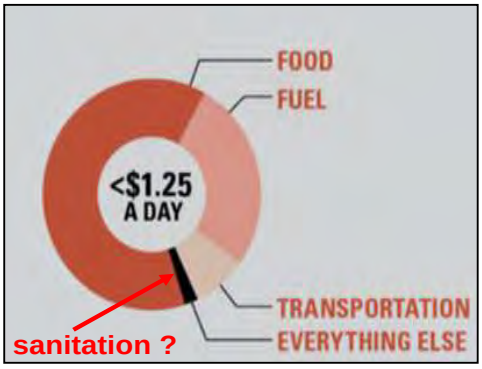

Figure 14: Budget distribution in poor communities

Table 29 shows that poverty in St. Lucia increased from 25.1% in 1995 to 28.8% in 2005.

INDICATOR (%)	1995	2005/05
Poor Households	18.7	21.4
Poor Population	25.1	28.8
Indigent Households	5.3	1.2
Indigent Population	7.1	1.6
Gini Coefficient	0.5	0.42

Table 29: Indigence, Poverty and Inequality 1995 and 2005/2006 (CPA 2007)

In 2005[18], the poverty line, which is a measure of the minimum spent per adult in order to meet basic needs, was estimated at EC$ 13.93 daily (US$ 5.22). It was also reported that 11.5% of the population was susceptible to falling into poverty as a result of an unanticipated event such as a natural disaster. Considering the poor population and the vulnerability of the population to shocks, this represents more than 40% of the overall population.

18 Trade adjustment and poverty in St. Lucia 2005/06, Main Report: Volume I, The Caribbean Development Bank

Figure 13 reveals that most of rural districts such as Anse-la-Raye, Soufriere, Laborie and Micoud have exhibited high rates for poverty in excess of 38.5%, followed by Choiseul with 38.4% of poor population. Moreover, it is reported that Anse-la-Raye and Micoud districts recorded the highest rates of indigence; 5.3 % and 4.1 %, respectively. The indigent are persons whose daily average consumption is too low to guarantee adequate nutrition to maintain good bodily health. The indigence line was estimated to be EC$ 3.40 in 2005.

Closely correlated with poverty is unemployment. Table 30 shows that one fifth of the population is unemployed. This figure increases in rural communities (Canaries, Laborie, Micoud) maintaining a high rate of poor population.

Districts	**Unemployment Rate**		**Total**
	Male	Female	
Castries City	23%	27%	25%
Castries Suburban	22%	21%	22%
Castries Rural	18%	19%	19%
Anse-la-Raye	23%	27%	25%
Canaries	28%	44%	36%
Soufriere	19%	20%	20%
Choiseul	20%	21%	20%
Laborie	24%	31%	27%
Vieux Fort	22%	30%	26%
Micoud	24%	32%	28%
Dennery	22%	27%	24%
Gros Islet	13%	14%	14%
TOTAL	**19%**	**22%**	**21%**

Table 30: Unemployment rate per district and per gender (Census 2010)

Comparing these findings with the preliminary zoning, it appears that coastal towns/villages, rural villages, low standard low density and informal settlements zones represent the most vulnerable population in terms of financial capacity. Thus investments in sanitation improvements is a critical concern. Financial mechanisms may be needed to support these communities in accessing improved wastewater management.

It is expected that populations living in urban centres of main cities and medium-high standard low density zones have sufficient financial capacity to comply with the laws in terms of sanitation.

The tourism sector also seems to have sufficient financial capacity in order to properly manage the wastewater.

The industrial sector and livestock farms' low investment in wastewater management often reveals more a lack of commitment rather than insufficient financial capacity. Enforcement of adequate wastewater management is most successful if it encourages progressive improvements over time.

4.3 Public Health Requirements

Over recent decades, compelling evidence has shown that significant and beneficial health impacts are associated with improvements in access to safe drinking water and basic sanitation facilities[19].

A variety of public health risks are generated by inadequate sanitation and hygiene practices, although there is not any apparent evidence of serious illness in Saint Lucia that is explicitly linked to the five main routes of infection from water related diseases: waterborne diseases (e.g. cholera, typhoid), water-washed diseases (e.g. trachoma), water-based diseases (e.g. schistosomiasis), water related vector-borne diseases (e.g. malaria, filariasis and dengue), and water-dispersed infections (e.g. legionellosis)[20].

Through the Public Health Act (1975) which is defined in more details in the Chapter 5.1, the MoH is responsible for the promotion and preservation of the health of the inhabitants of Saint Lucia. The lack of trained personnel inhibits the MoH's ability to handle inspections, which is consequently outsourced to different institutions such as CARPHA. It receives support from both the public and private sectors to analyze and verify proper liquid waste management, including maintenance of hygiene standards. Unfortunately, tourist centres such as resorts, hotels, harbours, ports, and marinas do not benefit from continuous sanitation inspections and process controls.

In coastal towns, the risks for public health are high due to open-air drainage for most greywater, mixed sometimes with blackwater and inadequate sanitation practices such as the use of buckets with night soil disposal. It causes bad odours, the accumulation of flies and other insects as well as bacterial contamination of beaches and coastal water where children and other villagers are prone to bathe.

St. Jude's Hospital in Vieux-Fort was destroyed by fire and is now operating in a sports stadium. Until now there is no wastewater infrastructure or solid waste strategy being implemented. The EHD reported that the new construction has been financed with international aid, but the facility is not operational yet due to the lack of some equipment and trained qualified hospital personnel.

Agricultural practices are largely informal and despite the Pesticides and Toxic Chemicals Control Act (2001) there is the possibility for ground water contamination due to the overuse/misuse of pesticides.

The industrial sector does not fully comply with environmental health regulations. Many industries, in particular chemical industries continuously release untreated liquid waste into open drains and water bodies. Persistent chemicals are causing high public health risks since they accumulate in organisms.

Livestock activities is an increasing sector in St. Lucia, with the potential for increased water contamination if not managed properly; example the 322 registered pig farms contribute to a high risk of (potable) water contamination by runoff water from poor manure and wastewater management.

Low demand from the island's inhabitants for better services and little to no interest among public officials for meeting those needs may be, among other reasons, linked to a lack of

[19] Waddington H. et al (2009). Water, sanitation and hygiene interventions to combat childhood diarrhea in developing countries. The International Initiative for Impact Evaluation (3ie).

[20] Hutton Guy (2012) "Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage" WHO/HSE/WSH/12.01

understanding of how poor sanitation, a deteriorating environment, and public health are all interrelated. The lack of clear "rules of the game" regarding responsibilities around service provision particularly affects the population in small towns and rural areas.

A multi-sectoral working group is recommended to raise the level of public health awareness and interest of the national authorities to develop a management plan for wastewater. The involvement of the community and local leaders is also essential to guarantee success.

The tourist sector can particularly be affected by health problems. Santa Lucia needs to conserve its reputation as a luxury vacation destination; therefore officials should be aware that only one significant illness or outbreak of disease among tourists – or repeated negative narratives by tourists regarding coastal management – could have a severe impact on this economic activity.

Also climate change and natural disasters may impact public health and are important factors that should be considered in wastewater policy.

4.4 Environmental requirements

The mountainous landscape and tropical location of St. Lucia have endowed the island with a range of terrestrial and aquatic habitats. Ecosystems range from dry cactus scrubs to rainforest, as well as mangroves and coral reefs. However these ecosystems have a high fragility given their small size. Within these ecosystems there are over 1300 plant species, 150 birds, 250 reef fish and 50 coral species, with an exceptionally high number of endemic species: 9 endemic higher plants'; 6 endemic birds; 7 endemic reptiles; 1 endemic amphibian; 1 endemic mammal and more than 200 endemic beetles[21].

As an island, marine and coastal resources are very important to St. Lucia. St. Lucia's coastal zone and marine ecosystems are characterized by mangroves, sea grass beds, coral reefs and beaches, which play an increasingly important role in tourism and are also an integral component in natural coastal defence. Coastal and marine resources are also vital for livelihoods relating to fisheries in several rural communities, and for recreation, sports and enjoyment, and an overall source of employment for many people[22]. It is estimated that coral reef associated tourism contributes more than 11% of GDP and fisheries provides employment for over 3,000 persons[23].

The UNEP Regional Seas program has reported that 80% of marine pollution in the Caribbean Sea originates from activities on land with the main sources being sewage and run-off from poor agricultural practices and land use. This pollution increases the vulnerability of critical coastal ecosystems such as coral reefs. It is estimated that over 70% of coral reefs are affected by discharges of untreated sewage. Coral reefs have suffered bleaching in a number of areas resulting in a direct impact on the marine biodiversity[24].

St. Lucia embarked upon several projects that helped the country characterise the contaminants in wastewater and identify the source of these pollutants.

21 Convention on biological diversity: https://www.cbd.int/countries/profile/default.shtml?country=lc

22 Fifth National Biodiversity report, Ministry of Sustainable Development, Energy, Science and Technology, 2014.

23 Burke, S., Greenhalgh, D.P., Cooper, E., 2008. Coastal Capital – Economic Valuation of Coral Reefs in Tobago and St. Lucia. WRI, Final Report – June, 2008. World Resources Institute, Washington, D.C.66 pp.

24 CReW's Lines --- Newsletter of the Caribbean Regional Fund for Wastewater Management Vol. 1, Issue1, June 2012

Numerous studies, which among others, Vieux Fort Sewage Needs Assessment in 2006 and Mainstreaming St. Lucia's National Plan of Action through a North West Coast Water Quality Demonstration Project, reported that surface waters are also heavily contaminated by discharge of untreated domestic wastewater, industrial liquid waste, intensive agricultural practice and farming. Organics, nutrients and harmful chemicals have been identified among the major pollutants. These pollutions contribute to habitat change which, in turn, affects marine life and aquatic species by a decrease of biodiversity. FC is also one of the major pollutants of the coastal waters and freshwaters. This mainly causes human health risk through waterborne pathogenic diseases.

Picture 24: Eutrophication event in water body (Beausejour area)

The pollutants and their sources identified are summarised in the following table:

POLLUTANT	SOURCE	ENVIRONMENTAL IMPACTS
pH	Use of acids and basis in industrial processes	pH affects many chemical and biological processes in the water. In general aquatic animals thrive with a pH range of 6.5-8.0. Outside this range significant stresses are placed on the physiological systems of most organisms and can reduce reproduction. Low pH can also allow toxic elements and compounds to be uptaken by aquatic plants and animals impacting survivability.
TSS (sediments, etc.)	Erosion due to deforestation, urbanization, agricultural, industrial practices, wastewater	Aquatic ecosystems (e.g. coral reefs, mangroves, fish, seagrass and other marine organisms) are adversely affected by suspended solids. Particulate matter can affect organisms both directly and indirectly, leading to mortality and decreased yield. Particles in the water can decrease light penetration by absorption and scattering and thus limit photosynthesis and primary productivity.
Organics	Greywater, Black Water, Industries (food and beverage processing)	Organic degradation process consumes the dissolved oxygen of the water which can lead to anoxic conditions and the death of aquatic species.
Nutrients (NH4, NO3, PO4)	Detergent (phosphate), greywater, black water, extensive use of fertilizer due to intensive agricultural practices	Increased levels of these pollutants cause the ecosystem to experience an increase in algal blooms (eutrophication), as these organisms thrive in the presence of the added nutrients. An algae bloom occurs as the algae accumulates into dense, visible patches near the surface of the water, prohibiting light from penetrating deeper areas of aquatic body. Many marine species are unable to survive without light. When algae begin to die, the decomposition process lead to a decrease of dissolved oxygen (cf. environmental effects of organics).
Faecal Coliform		Faecal coliform (E. Coli and enterococci) are indicators of the presence of bacteria from faecal pollution that is harmful to humans. E. Coli indicator is applied for fresh water, while the enterococci bacteria are an indicator of persistent pollution, as this group of bacteria is more tolerant to saline conditions.
Oil, grease and other hydrocarbons	Restaurants, industries, mechanic shops, gas station, ships/boats, boatyard repair yards and ineffective oily-waste management	Oils and grease can smother ecosystems and can be toxic.
Toxic chemicals, heavy metals	Industries, Extensive use of pesticide due to intensive agricultural practices	These chemicals (for example Hg, Pb, and Cd), which are usually very persistent in the environment, are often toxic for marine wildlife even at low concentration. They can bioaccumulate into the organism and may adversely affect DNA and enzymatic processes, hence interfere with life processes. This can cause potentially severe effect on the marine biodiversity and the human health by consuming fish and seafood.

Table 31: Sources of pollution and their impacts on the environment

Poor wastewater management has been identified to be one of the major pollution source of the marine and aquatic ecosystems. It has been demonstrated that poor environment quality can heavily affect human health and the national economy. Therefore, protecting the environment by improving wastewater management at all levels must be a priority for St. Lucia's government.

4.5 Summary of expectations by user segment

Each category of users and stakeholders (households, industries, hotels, livestock, marinas, WASCO, public sector, etc.) has different expectations and requirements in terms of sanitation and wastewater management practices. The assessment of the expectations by user segment is mainly based on available data and interviews performed with stakeholders in St. Lucia. Stakeholders from private and public sectors are analysed separately.

4.5.1 Private sector

Low sanitation awareness due to the lack of sanitation education, low financial capacity, land restriction, land tenure issues and the thought that sanitation is a government duty are the five main reasons to explain the low demand from **households.** A study led in Anse-la-Raye[25], has observed that on a sample of 162 randomly selected households, most households (77%) agreed that wastewater should be treated before it re-enters the environment. However, only 17.0% were willing to pay for treatment. Figure 15 shows that those households which did not agree that wastewater should be treated for the most part indicated that it was either unaffordable (63.9%) or solely the responsibility of government (30.6%).

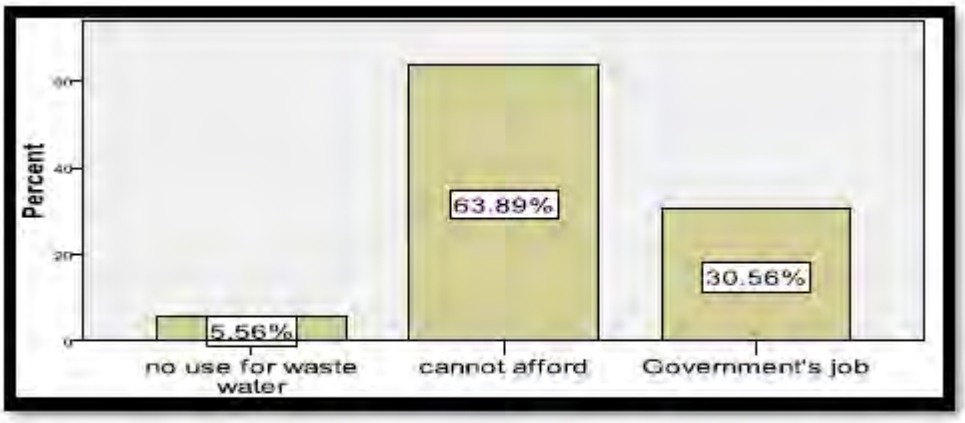

Figure 15: Reasons why wastewater should not be treated

Population living in coastal towns/villages and informal settlement zones revealed that public facilities (toilets and showers) are not always properly maintained. In addition those facilities are closed at night forcing users to adapt or to resort to night soil disposal practices. Some people estimate that the service should be provided free of charge.

Emptying companies expect from the government the construction of a safe FS disposal site with appropriate treatment technology. They agree to pay for FS disposal but the price has to be justified (treatment performed) and to be the result of a consensus among all stakeholders. In the current situation they all agree that the dumping fee at the Beausejour WWTP is too high. Also it is suggested that the dumping fee should consider the volume of the truck's tank. In addition, the FS disposal site must be opened at night since most people have to empty their septic tank outside of the working hours. In the current situation WASCO requests an early

[25] Montoute_Cashman_2015_KAP_water_sanitation_hygeine_CTR_78

notice when sludge has to be discharged at night, but despite this notice it happened several time that access to the Beausejour WWTP was refused. In order to reduce the operating cost of emptying companies (fuel consumption, etc.), it is also recommended to build a FS disposal site in the southern part of the island. All companies revealed that in terms of investment and maintenance costs, import duties for emptying equipment (vacuum truck, hoses, spare parts for repairing trucks and pumps) must be reduced. It is important to note that Rockers Sanitary Cleaning Company would be highly interested in operating a FSTP.

Within the **tourism sector**, some of the hotels have developed integrated wastewater management systems to comply with international green label certifications (for example: Green Leader Certified, Lead Gold Certified, Travel Lift Certified, Lead Gold Property, etc.). The tourism sector asserts that it is leading the employment sector in St. Lucia and has a lot of potential for growth. They are expecting the government to give priority to problems that can affect this sector, such as poor sanitation and wastewater management. They suggested that dialog with farmers (use of pesticides and fertilizers, manure production) and communities (poor sanitation practices) which has been recognized as one of the main sources of pollution of coastal water should be initiated. They expect the public sector to regulate the sanitation sector to avoid poor wastewater and solid waste management from communities annihilating efforts made by hotels to promote high quality environment. Also they consider government responsible for providing emptying service for boats. They notice that there is a gap between training and employment requirements (for example sanitation knowledge) and it is therefore recommended that Government/ school authorities include sanitation in the existing education programs (for example hospitability studies). The St. Lucia Hotel and Tourism Association (SLHTA) would agree to champion the sanitation sector if the government shows interest; they would be inclined to be part of the enforcement regime. SLHTA has also funding capacity.

The **industrial sector** is aware that poor sanitation can affect the productivity of industries (sick employees, etc.) and their commercial viability. In the current situation it is assumed that DBC Company is the only company island wide equipped with a WWTP. The low demand in wastewater management is the result of two main reasons: the absence of regulation for industrial wastewater management does not encourage industries to invest in sanitation facilities to reduce their impact on the environment; the lack of national technical support makes it difficult for (non-multinational) industries to comply with international guidelines for industrial wastewater quality. It is expected that the government will set water quality standards to prevent the discharge of wastewater into water bodies (DBC Company currently complies with ISO certification) and to perform routine monitoring and water testing of the effluent quality. The Chamber of Commerce mentioned that incentives should be put in place by the government and should be granted under certain conditions: for example industry must prove that they comply with standards (monitoring, testing, water recycling, etc.). It is expected that government supports industries with limited financial capacity in affording adequate treatment system. In other terms the regulation must be realistic to successfully comply (affordable treatment cost). The Chamber of Commerce estimates that a self-regulation could be the better option combined with routine monitoring and water testing every 6 months and certification provided each year.

Also the Chamber of Commerce suggested that, in case of industries connected to a sewer network, the wastewater bill should be reduced when part of the wastewater is treated before being discharged and when part of the water is recycled from industrial process.

It has been indicated that WASCO organized an ad hoc training in wastewater management targeting people from all sectors; however, the level of information was too high for attendants. It was also noticed that spare parts to maintain WWTP are not available on the island and has to be imported. There’s a request/desire for no import duty on such materials.

Livestock farms claim that there is a lack of technical support to encourage and build appropriate manure and wastewater management facilities. Poor awareness is probably not an issue among most of farmers. Absence of technical support and low financial capacity are more likely to be the key arguments for poor liquid waste management in livestock farms. Most of the pig farms in St. Lucia rely on septic tank despite the poor performance for such substrate. Septic tank design for manure should not be based on the same characteristics as the ones for human excreta. Also most of the owners of the pig farms own field crop where they can reuse the dried manure/compost. It has been observed that demand for dried manure and compost is high among the farmers.

According to **marinas and harbours**, Marigot Bay operators and IGY operators regret the low percentage of boats emptying their wastewater tank onshore despite providing emptying service. Such behaviour is more likely due to the ease of discharging wastewater directly into the sea combined with an absence of regulation and enforcement, than the result of a poor environmental awareness from sailors. The regulation must mandate sailors to lock the wastewater tanks when entering the marina. In some other islands in the Caribbean, staff of the marinas/harbours have the authority to check if the wastewater tank of the boat is locked. It is also suggested to directly include a fee for desludging in the fee to dock a boat at the marina.

The Soufriere Foundation which is responsible for collecting the fees for boat docking at the Soufriere docks estimates that SLASPA must be responsible for providing and regulating emptying services for boats around the island.

SLASPA which manages the Castries harbour does not provide any wastewater emptying service for cruiser ships. The low demand from cruiser ships for such service is probably due to international legislation allowing discharging wastewater into international water. Having a national legislation to regulate this could encourage tour operators to change their route preferring other islands in order to avoid paying a wastewater discharge fee. The resulting negative impact on the tourism sector could endanger the overall St. Lucian economy. Regional legislation and commitment would be a better option to regulate such practices.

4.5.2 Public sector

WASCO reported that there is no existing measure in the national regulation to force restaurants to use a grease trap and to maintain it properly. Grease and oil are among the major concerns in disrupting proper functioning of the sewer network by clogging or damaging the pumps.

EHD pointed the poor human and financial resource as major constraints for inspection of sanitation facilities (onsite household facilities, industries, hotels, hospitals). Unplanned development is often a problem since sanitation facilities are usually not properly built (uncontrolled infiltration, overflow, odour, etc.).

The **CCC**, which represents the only public emptying company and operates a FSTP, identifies the lack of technical support in order to build, operate and maintain adequate FSTP as one of the major reasons that limits the development of this sector. Also, financial support from the government in order to purchase sanitation equipment and to maintain it properly is lacking. CCC currently uses a truck initially designed to deal with water to empty septic tanks. The non-appropriate design limits the potential for CCC to develop its sanitation service. In addition, the CCC would like to improve its own FSTP in order to reduce the environmental and human health risk caused by the poor treatment performance. Such development requires sanitation specialist in order to properly design the plant. The CCC mentioned that all budgets for all activities are mixed (no specific budget for maintenance). Therefore, it is impossible to assess the viability of

this service.

Since the CCC is responsible for cleaning the small drains of Castries city, it has been noted that some restaurants directly discharge their greywater into the drain. When the hydraulic flow is too slow, the high amount of grease and oil contained in the greywater cloggs the drain contributing to foul odours.

There are courses in the actual curriculum related to sanitation. The **TVET Unit** of the Ministry of Education, Human Resource Development and Labour (MoE) indicates that there is no demand at the moment for including sanitation in the existing curriculum. However, they would agree to meet with the different stakeholders (tourism sector, industries, emptying companies, WASCO, livestock farms) to assess the demand in sanitation and find a consensus to improve the sanitation education.

The St. Lucia Bureau of Standards (SLBS) recognizes that there is no sanitation standard developed by SLBS. However, SLBS agrees that they could play a role in the development of standards that define parameters for wastewater and codes of practice for managing wastewater. A proposal has to be first submitted to SLBS from stakeholders then the procedure follows the steps described in the figure below:

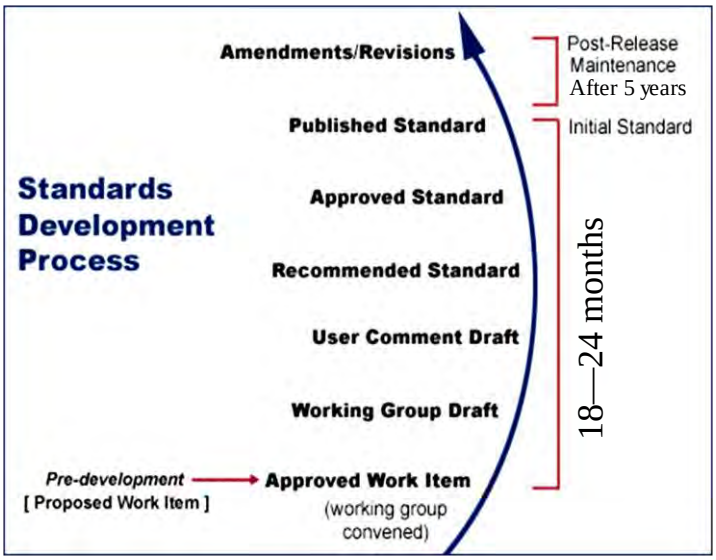

Figure 16: Standards Development Process (SLBS)

NURC mentioned that they are currently in the process of getting records from the emptying companies. However NURC highlighted that it is challenging to regulate emptying companies (how to ensure that emptying truck are not being used to carry drinking water). NURC revealed that the application procedure to issue licenses for emptying companies is currently in draft. Also it is important to notice that the NURC estimates it has limited human resource to perform water monitoring and issue licenses. NURC also formulated ideas to improve the sanitation sector as performing random independent monitoring and testing to double check the results from WASCO; more importance should be given to the population which relies on onsite sanitation facilities since they represent more than 2/3 of the global population; number of connection to the Beausejour sewer networks should be increased since the WWTP operates under capacity; households living at a reasonable distance from a sewer network should pay a fee for wastewater discharge; incentives should be defined to encourage people to connect to the sewer; low-/no income households should be assisted in affording basic utilities.

In relation to wastewater management, the **National Conservation Authority (NCA)** has the responsibility to secure sanitary conditions on a beach or protected area (wastewater from

vendors, restaurants and bars on the beach are often left to runoff). NCA plans to build public toilets on every beach. They also revealed that the fees paid by users to use public toilet (2 EC$) do not cover expenses (detergent for cleaning, toilet paper, soap) and the salary of the employee. Therefore subsidies from government are always needed. NCA also indicates that they are highly interested in being part of the enforcement regime if any. However, staff should be properly trained.

4.5.3 NGOs

The Soufriere Marine Management Association (SMMA) believes that a Management Plan should be developed by governmental agencies to give NGOs the authority to act: Communication, Work Plan, enforcement. A National Framework (national consultation) that encompasses agencies which work for the protection of the environment should be established to encourage synergy among entities. In the actual situation each Ministry makes its own policy independently. Agriculture sector should have a more holistic program to take all aspects into consideration; from the use of fertilizers and pesticides to their impact on the environment, specifically the banana industry. They should change their policy to integrate a regulation on the use of chemicals (i.e. how close to waterways, green agriculture promotion). Education at all level is also a major concern when speaking to wastewater management. They are highly interested in making public or school interventions to raise awareness about sanitation. SMMA also noticed that communication and enforcement plans are often lacking in policies.

The **Soufriere Foundation** estimates that more public toilets should be provided, especially for populations living in coastal towns and informal settlement zones. Also they believe that there is a need for deep educational program related to solid waste and wastewater management.

The St. Lucia National Trust believes that the legal framework is not adequate because once projects related to sanitation facilities construction are approved they lose interest. They suggest that independent water monitoring in addition to the monitoring achieved by the owner of the facility should be performed to ensure the proper functioning of the sanitation systems at all level. In addition, operating licenses should be issued annually to industries and hotels that operate WWTP.

5. ENABLING CONDITIONS FOR WASTEWATER SERVICES DEVELOPMENT

The description and analysis of the actual legal and organizational framework as well as the institutional arrangement supports the identification of the deficit in wastewater management services. Monitoring and evaluation and the relevant business conditions for the private sector are additional issues to ensure sustainable services.

5.1 Actual National Legal Framework

5.1.1 Legislative framework

There is legislation in place in St. Lucia to regulate the wastewater management and sanitation sector. Table 32 summarises the main Acts and Regulation that relate directly or indirectly to wastewater management in St. Lucia.

National Utilities Regulatory Commission Act (2016) is currently in draft. It will ensure economic regulation of utility supply services. NURC will be responsible for the technical regulation of utility supply service and the setting of technical standards having regard to international standards and best practices relating to utility supply services. It has to determine applications for service license to provide utility supply services pursuant to the Regulatory Acts.

AREA	ACTS	DETAILS	REGULATION	DETAILS
Water	Water and Sewerage Act, Chapter 8:14 1999 revised 2008	Controlling and protecting water and catchment areas and declaration of water and waste control areas. Allows for regulation of waste discharge into or on any land, sewer, or water body to protect water resources Established the Water and Sewerage Company Inc (WASCO) and the National Water and Sewerage Commission (NWSC).	Water and Sewerage (General Provisions) Regulations.	
			Water and Sewerage (Code of Conduct) Regulations Section 38 and 97 Water and Sewerage (Appeals Tribunal) Regulations. Water and Sewerage (Tariff) Regulations Draft Water and Sewerage (Service Licence) (Forms) Regulations	The Code of Conduct shall, in addition to the provisions of the Water and Sewerage Act, regulate the conduct of the Board and staff of the Commission. Makes provisions for a service licensee or an intervening party appeal a decision to the Appeals Tribunal For water and sewerage services supplied under its service licence, a service licensee shall charge the rates prescribed in Schedule 1 as adjusted, when required in accordance with Parts 1, 2 and 3 of these Regulations. This service licence authorises a company organized, registered and existing under the Laws of St. Lucia, to construct/maintain/manage/ and operate a water supply system,] and to provide water and/or waste services, within the service area, for the duration of the service licence, subject to the Water and Sewerage Act
Water Resources	Water and Sewerage Act, Chapter 8:14 1999 revised 2008	Efficient use and effective management of water resources Formed the Water Resources Management Agency		
Environmental Health	Public Health Act Chapter 11.01 of 1975 revised December 31, 2001	Protection of human health through the prevention, treatment, limitation, and suppression of diseases. This includes management of waste (liquid and solid), drinking water supplies and recreational waters		Non-impairment of water quality through the discharge of any waste in catchments, river, stream, the sea or other water bodies. Restrictions are outlined for waste disposal systems from areas which serve as

				catchments for drinking water supplies
Water Quality Monitoring			Public Health (Water Quality Control) Regulation No. 14 of 1978.	Pollution control, protection of human health, reduce the incidence of communicable diseases and reduce environmental degradation
Effluent Disposal			Public Health (Disposal of Offensive Matter) Regulations No. 21 of 1978. Public Health (Sewage and Disposal of Sewage and Liquid Industrial Waste Works) Regulations No.22 of 1978	Regulation of the discharge of liquid domestic and industrial waste and effluent as well as the licensing of faecal sludge emptying companies.
Waste	Waste Management Act Chapter 6:10, revised 2008	Proper waste management for construction and operation of facilities. Addresses generation, storage, transportation, and disposal of solid and liquid wastes Regulate and manage the collection and disposal of solid waste to protect health and the environment including reduce pollution of ambient waters		
	Castries Constituency Council Act No 1 of 2012	This gives responsibility to the Castries City Council for cleaning and clearing drains, waterways, streets, sidewalks, parks and recreational areas within the city of Castries and its environs.		
	Water and Sewerage Act, Chapter 8:14 1999 revised 2008	It also gives WASCO the responsibility for public sewerage facilities (Castries and Beausejour sewers, Beausejour WWTP, semi-centralized systems).		
	Litter Act 1993	The Litter Act contains comprehensive provisions for the control of littering of premises and public places. Under the Act “public place” includes a road, highway or beach.		
Agriculture	Pesticides and Toxic Chemicals Control (2001)	Facilitates good management practices for chemicals that can constitute agricultural non-point sources of environmental pollution impacting rivers and the nearshore marine waters		

Land and Marine Use and Management	Physical Planning and Development Act (Chapter 5:12)	Regulate and control physical development, designation of protected areas, sustainable development of resources to reduce the impact on the environment and degradation of the natural resource base		
Agriculture	Agricultural Small Tenancies Act (Chapter 5:03) 1983	Reduce the impacts of pollution from agricultural practices on rivers and the marine environment		
	Beach Protection Act (1967 and amendment 1987)	Focuses on protection of beaches and coastline which have additional benefits of ecosystem based adaptation to climate change and disasters and enhanced recreational use or amenity value		
	Land Conservation and Improvement Act (Chapter 5:10) of 1992	Provides for better land drainage conservation.		
	Housing and Urban Development Corporation Act (1971)	Control developments within the coastal zone, promotes coastal zone management and manages the establishment of residential area proximal to water bodies with a potential to compromise quality		
	Maritime Areas Act (1984)	Marine scientific research, and the protection and preservation of the marine environment and territorial sea. This Act is relevant to the use and the exploitation of resources within the territorial waters and the Exclusive Economic Zone (EEZ) and will affect the outcome of all activities destined for the coastal zone		These regulations apply to any fishing vessel or other vessel capable of being used for fishing within the fishery waters at a distance greater than three miles from the nearest land
	Fisheries Act 1984	Declaration of marine reserves for the purposes of protecting and preserving the nearby land and wildlife. The protection of habitats also includes water quality which is critical to the sustainability of fisheries, marine and coastal resources and ecosystem functionality	Fisheries Regulations 1994	
	Forest, Soil and Water Conservation Ordinance (Chapter 7:09) Act 1983	Make provisions for the adequate protection for forests, soil and water including the creation of protected forests to control the depletion of the resources		
Tourism	Tourism Industry Development Act (1982)	Promote and develop tourism inclusive of coastal amenities which is the main product and attraction marketed for visitors. The hotels and other properties serving the tourism industry do conduct WQM of the coastal waters and end-of-pipe discharges in accordance with their auditing requirements		
Conservation	St. Lucia National Trust Act (1975)	Promote, conserve, and manage areas specially designated as tourist attractions and heritage sites so as to preserve their flora and fauna. Ensure that areas of		

		coastline of high biodiversity value are protected and conserved		
	National Conservation Authority Act (1999)	Coastal zone and ambient water quality management through linkages between use of the resources and potential for polluting the waters		

Table 32: National Legal Framework related to Wastewater and Sanitation

5.1.2 Standards

SLBS is the only legally mandated organization in St. Lucia with the responsibility to develop and adopt national standards. However SLBS plays no active role in sanitation and wastewater management. It relies on the various agencies example EHD for standards relating to wastewater and sanitation. Various standards exist and are used to regulate the sanitation and wastewater management practices.

The **MoH** has defined standards and recommendations for the construction of sanitation system facilities such as septic tanks, Imhoff tanks, sewage settling tank, sewage biological filters, package plants, oxidation ditch, oxidation ponds and intermittent sand filters (cf. Appendix 3).

Also the **Royal Commission Standard** is used for wastewater effluent quality. It defines a TSS content of not more than 30 mg/l and a BOD of not more than 20 mg/l.

The **LBS Protocol**, which St. Lucia ratified in 2008 and entered into force in 2010, within the "Cartagena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region" provides standards for wastewater discharges and industrial effluent. It identifies two water categories: Class 1 waters and Class 2 waters. Class 1 waters represent waters that are particularly sensitive to the impacts of domestic wastewater (waters containing coral reefs, mangroves, protected areas listed in the SPAW Protocol, recreational waters, etc.). Class 2 waters means waters other than Class 1 waters which are less sensitive to the impacts of domestic wastewater.

WHO guidelines for wastewater (domestic and industrial) discharge are also used by some hotels and industries.

Appropriate rates and tariffs for water and sewerage will be provided by the **NURC**.

FAO and **WHO** standards are used to regulate the use of pesticide in agriculture.

5.1.3 Regulation

Regulation of the legislative framework regarding wastewater management and sanitation is mainly the responsibility of the EHD. However, the responsibilities are distributed among various agencies.

The construction by individuals, hotels, industrials or farmers of any sewage works (collective, semi-collective and individual sanitation systems), treatment or disposal facilities have to be first approved by the Public Health Board which is currently represented by the **EHD**. An application has to be submitted including:

- the name and address of the applicant;
- the occupation of the applicant;
- the address of the premises;
- detailed drawings and specifications of proposed works.

The Public Health Board shall within a period not exceeding 31 days after receipt of plans for approval signify its decision. The applicant has to pay a fee for application.

The public health inspector is also in charge of verifying that the soil is of such a nature that the absorption of the effluent from the septic tank or the soakaway can be achieved.

All sewers and sanitation systems shall be maintained in a good working order and good sanitary manner to the satisfaction of the public health inspectors.

The discharge of any sewage (including farm waste) or industrial liquid waste into any water course, river, stream, gulley, coastal water or any other place must be approved by the Public Health Board in order to make sure that the effluent is not offensive or deleterious to the environment and public health.

The Public Health Board together with the **NURC** is in charge of issuing license to the emptying companies that convey any kind of wastewater or faecal sludge. The tank of the vacuum truck has to be staunch, tight and closely covered so as to prevent smell or leakage. The vacuum truck must be first approved by a medical officer of health or **public health inspector**. The operating license is valid for a period which shall expire on 31 December next after issue, but may be renewed for a like period. The disposal site has also to be approved by the Public Health Board and shall be clearly indicated by a signpost.

Penalties (fine and imprisonment) have been defined for any person contravening the regulation.

The **NURC** has the mandate to enforce and regulate the Water and Sewerage Act published in 2005 and revised in 2008 by the MoH. They also have to enforce and regulate the Public Health act related to sanitation service providers (water monitoring, inspection of the emptying companies, issue license for operating). In the current situation they are responsible for the inspection of the Beausejour WWTP and emptying companies. WASCO provides NURC with quarterly water quality report of the effluent of the WWTP. They are also supposed to control the efficiency of WASCO's operations.

The **Development Control Agency (DCA)** of the MoPD is in charge of delivering construction permits. As the lead agency for the control of land development, they solicit multi-agency inputs into development decisions. The permission must be obtained before carrying out any type of development on land. The payment of a fee first is necessary for the application to be registered. There is no special application for the construction of sanitation systems, however in the case of residential or large lots (minimum of six lots) construction project, applications must include Public Health Approval or WASCO Approval (where applicable) of the sanitation facility. The procedure is similar for institutional, commercial, touristic and industrial construction.

SLASPA is responsible for managing waste and wastewater management at the major seaports in Castries and Vieux Fort, the two airports at Castries and Vieux Fort and also the smaller points of entry such as Soufriere and the marinas at Rodney Bay and Marigot.

The **Ministry of Social Transformation, Local Government & Community Empowerment (MoST)** is responsible for the cleaning of road verges, drains, streets, parks and beaches and for the collection and transportation of waste generated in these areas and other public places in the city, towns, villages and communities.

The **Ministry of Infrastructure, Port Services & Transport (MIPST)** is responsible for maintaining drains and rivers in areas outside the jurisdiction of the Ministry of Social Transformation. It is also responsible for the maintenance of large drains and rivers within these jurisdictions.

The **NCA** has the responsibility to secure sanitary conditions on a beach or protected area.

The **Pesticides Control Board** (PCB) is responsible for the safe use and handling of pesticides and toxic chemicals and ensuring safeguards against impacts on the environment. The PCB delivers license for importing or using pesticides in St. Lucia. No regular monitoring is performed.

5.2 Institutional Settings and Responsibilities

The National Environmental Summary of St. Lucia, noted already in 2010 that there was limited implementation of policies and plans and poor coordination and enforcement of laws and regulations.

St. Lucia has many policies but a significant number remain unimplemented because of limited human, institutional and financial capacities. The manner of policies implementation is affecting environmental management and the subsequent success level. Many of the policies are fragmented and therefore need to seek greater synergies both in the actual polices and implementation among the agencies. Greater institutional cooperation and coordination should be formally embedded in institutional arrangement.

Table 33 describes the actual institutional arrangement of the wastewater management sector. It identifies the responsibilities of the several agencies in terms of planning, legislation, regulation, licensing, construction, etc. according to user categories and the type of facilities and infrastructure. The complicated table illustrates that wastewater management requires efficient coordination to be effective.

Actual Organizational framework

	User categories	Wastewater												Sanitation Service
		Household, Public toilets, Institutional building (office, school), Commercial building							Industries	Hospitals	Marinas, Ports	Hotels	Livestock	Emptying companies
		Excreta and grey water separated												
	Sanitation Facilities	Latrines	Septic tanks + soak aways	Drains	Public toilets	Semi-collective systems	Sewer	WWTP	Pre-treatment or WWTP for industrial WW	Pre-treatment or WWTP for WW	Pumping station connected and wash area	WWTP package	Septic tank or manure pit / Biogas plant	Vacuum Truck and equipment
Responsabilities	*Planning (Policy and Strategic Plan)*	MoSD												
	Masterplans	MoPD, MoSD												
	Legislation proposal		MoH, MoPD	MIPST, MoH	MoH, MoPD						MIPST, MoH	MoH, MoPD, MoT	MoH, MoPD, MoA	MoH
	Standards		SLBS, DCA, EHD	MIPST, DCA	SLBS, DCA, EHD			SLBS, DCA, Royal Commission Standard, EHD, WHO, LBS			MIPST, DCA	SLBS, DCA, Royal Commission Standard, EHD, WHO, LBS		NURC
	Regulation		EHD	MIPST	EHD	EHD	EHD	NURC, EHD	EHD	EHD	EHD, SLASPA	EHD	EHD	EHD	NURC, EHD
	Coordination	GoSL												
	IEC behavior and promotion		MoH, MoE	MoH, MoE	MoH, MoE	MoH, MoE	MoH, MoE, WASCO	MoH, MoE	MoH, MoE	MoH, MoE	MoH, MoE, Marinas	MoH, MoE, SLHTA	GoSL	GoSL	MoH, MoE, Emptying companies
	TVET		MoE	MoE	MoE	MoE	MoE, CAWASA, CARPHA, WASCO						MoE	MoE, International institutions	MoE
	Investment CAPEX	Households		MIPST, Private Developers	Town councils, NCA, Foundations, NGOs	MoPD, Private Developers	MoPD, WASCO, Private Developers	MoPD, WASCO	Industries	GoSL, Private Sector	Marinas	Hotels	Farmers	Farmers	Emptying companies
	Technical support		EHD	MIPST	EHD, Architectural division of MoPD										
	Building permits		DCA, EHD, WASCO	MIPST, DCA	DCA, EHD, WASCO						MIPST, EHD	DCA, EHD, WASCO	DCA	DCA	
	Licensing				EHD			NURC, EHD				EHD	EHD	EHD	NURC, EHD
	Construction	Households	Builders						Builders, Supplier				Builders	Builders, Supplier	
	Compliance monitoring/validation (construction)														
	O&M	Households	Households	Town Councils, MIPST	Town councils, NCA, Foundations, NGOs	WASCO, Private Developers	WASCO	WASCO	Industries	Hospitals	Marinas	Hotels	Farmers		Emptying companies
	Sanitary inspection (private and public)		EHD	MIPST	EHD	EHD		NURC,EHD	EHD	EHD	EHD	EHD	EHD	EHD	NURC, EHD

Responsibility assumed
Responsibility partially assumed
Responsibility not defined or not assumed at all
Not concerned

Table 33: Existing Institutional Framework

Planning:

The MoSD is in charge of developing the National Wastewater Management Policy And Strategic Plan of St. Lucia.

Masterplans:

The elaboration and implementation of (district) Master plans will be the responsibility of MoSD together with the MoPD.

Legislation:

It can be considered that legislation covers most of the aspects related to wastewater management, with some lacking definitions such as to avoid connections to the drains. Legislation related to the wastewater management from boats and yachts could be improved by regulating the wastewater discharge (tank locked when docked in the marinas and port, emptying fee for everyone).

Standards:

It appears that the standards currently in place are limited and do not encompass the overall wastewater management sector. The national guidelines currently used for the discharge of domestic wastewater is limited to a few parameters (TSS and BOD). There are no standards in terms of wastewater quality discharge for other sectors (industries, hospitals, farming). Standard designs for sanitation systems have to be improved in order to promote sanitation facilities that better fit the St. Lucian context. Also, using several standards from various agencies may lead to a confusing situation. Developing proper standards for St. Lucia is recommended.

Regulation:

The regulation of wastewater management is limited and poorly coordinated. St. Lucia has many policies and laws but significant remain unimplemented. Most of the emptying companies are not licensed and/or inspected. Individual onsite sanitation systems are not inspected or monitored. Effluent from industries is not controlled. Hotels are mandated to perform monitoring and water testing of their WWTP. However it seems that hotels enjoy immunity due to the importance of the touristic sector in St. Lucia. There is no enforcement procedure in place to control if boats and yachts have their wastewater tank locked when docked in the marinas. Manure and liquid waste management from swine farms as well as the pesticides and fertilizers applications are not regulated.

The lack of human resource and financing have been mentioned as the major constraints to explain the limited enforcement of wastewater management regulations. The regulatory framework needs to be reorganized in order to designate appropriate agencies to regulate each sector. MoSD may be involved in regulation activities too (re monitoring, inspection, licensing, etc.). Also, there are several laboratories, agencies and NGOs in St. Lucia with technical, human resource and financial capacities that could be involved in the enforcement regime.

Coordination:

This requires all governmental activities to plan, implement, coordinate, supervise and monitor wastewater policies, strategies, action plans, implementing activities and investments of own programs and projects as well as those performed by third parties, example by development partners or the private sector. Actually wastewater management responsibility is shared among several administrative entities without a clear leadership as table 32 illustrates.

Monitoring and Evaluation are of particular importance. Given the challenge to develop sustainable services, a more comprehensive and forward-looking approach to monitoring and evaluation is needed, backed up by reliable data management or a management information system. Monitoring uses indicators to measure effectiveness over time including during the life of a program. Evaluation is the long-term systematic and objective assessment of an ongoing or completed project, program, or policy, and its design, implementation, and results. M&E should result in learning that is the process of incorporating lessons learned into ongoing practices to increase effectiveness and sustainability over time. Learning includes documenting and sharing best practices and lessons learned both internally and externally among all stakeholders

Information, Education and Communication (IEC) behaviour and promotion: EHD and MoE are in charge of disseminating good hygiene and sanitation practices through IEC programs. Even if good hygiene practices are well spread around the island, sanitation still lags far behind. Various organizations, among others governmental agencies and NGOs, are involved in the communication and promotion of environmental programs. However, it appears that awareness activities are inadequate, unsustained and uncoordinated. A dialogue should be opened between the different organizations already involved to set the objectives of the IEC programs, assess the strengths and weaknesses of each entity in order to optimize the role and responsibility of each stakeholder within the IEC programs. Hygiene and sanitation promotion need to be held together in order to successfully scope with waterborne diseases.

TVET:

There are no specific wastewater or sanitation TVET programs in St. Lucia causing a gap between training and employment requirements. However, the TVET Unit of the MoE and the SLCTVET estimate that currently there is no demand in wastewater education, but they agree to discuss with the different stakeholders to assess the gap in sanitation education.

Sanitation courses could be attached to existing programs (for example: Associate Degree in Construction Management, hospitality programs, etc.).

Investment CAPEX:

Private sanitary facilities are financed and built by their owners and St. Lucia has not invested sufficient amounts into public infrastructure. There are no subsidies to encourage the construction of sanitation facilities and to support poorest households. St. Lucia's government through city and town councils and NCA is responsible for providing public facilities (toilets, showers and laundry areas). However, due to the lack of public financing, NGOs still play a key role in offering such services.

Technical support:

There is no specific technical support agency able to provide independent and systematic recommendations in the wastewater management sectors. However it has been reported that the Architectural division of the MoPD and the EHD can make recommendations for designing a sanitation facilities.

Building permits:

Building permits are delivered by the DCA with, if applicable, the approval of the Public Health Board. However a large number of unplanned developments with inadequate sanitation facilities can be observed.

Licensing:

Licensing of emptying companies is not done systematically although licensing should be delivered for public (CCC has never been controlled) and private sector operators. Licenses should also be issued for hotels and industries operating wastewater treatment plant (followed by inspection).

Construction:

Local builders are responsible for the construction of sanitation facilities (onsite improved sanitation systems, sewer, drains, wastewater treatment plant). When it is related to a WWTP package with complex system, the equipment supplier usually provides support to build it and assist initial testing and operation.

Compliance monitoring/validation (construction):

There is no certification procedure that verifies that the facility was built in compliance with the design and plans previously approved by the DCA and Public Health Board.

O&M:

Households, industries, hotels, livestock farms, hospitals, marinas and emptying companies are responsible for the operation and maintenance of their facility or equipment.

It appears that onsite sanitation systems are poorly operated and maintained often leading to overflow. Septic tanks are often emptied when problems occur or when it gets filled.

Industries and hotels that are equipped with WWTP package achieve proper operation and maintenance with regular service and monitoring.

Livestock farms sanitation systems are mostly poorly operated and maintained resulting in direct discharge of untreated effluent into the environment.

Marinas and emptying companies usually service regularly their facilities (vacuum truck, pumps, hoses, motors). However some of the vacuum trucks are out of service for a while.

WASCO is in charge of the operation and maintenance of the sewers of Castries and Beausejour as well as the Beausejour WWTP. Monitoring and water testing of the inlet and outlet of the WWTP are done daily. Sludge has been removed in each of the 5 ponds once during the last 4 years. In case of storm or heavy rainfall, the level of water in the aerated ponds is decreased to avoid flooding. However there is no maintenance of the FS pit receiving FS from emptying companies. The sewer networks are maintained and serviced (monitoring and water testing, network cleaning, pumping stations servicing and cleaning) but the sewer network of Castries is old and in poor condition (exfiltration and infiltration of sea water) and would need to be repaired.

Drains are maintained and cleaned by the MIPST and the town councils. However, it seems that larger drains are not regularly serviced engendering flooding; for example, the pumps installed in the drain on Micoud Street in Castries have been out of service for a while.

Sanitary inspection:

It appears that sanitary inspection is almost inexistent. Some hotels are requested to provide water testing of the effluent of their WWTP package, and the vacuum trucks of a few emptying companies have been checked by public health inspectors.

Random sanitary inspections including visual inspection and if necessary monitoring and water testing of onsite sanitation facilities, WWTP, WWTP package, sanitation facilities of hospitals and farming activities should be performed.

Critical wastewater production sectors such as hotels, industries, livestock farms and hospitals should provide regularly, water testing results of the effluent to the EHD. The frequency could be defined according to the type of waste and the amount of wastewater produced. When testing is self-operated, routine monitoring by independent agency should be performed occasionally.

Also it is recommended to include the MoSD to work in collaboration with the EHD in order to improve the inspection processes.

5.3 Relevant Business Conditions for Wastewater Management

Business in Saint Lucia

Over the last years, Saint Lucia has continuously improved its position for ease of doing business and has been ranked 2nd among CARICOM countries, according to the 2015 World Bank Doing Business rankings. The ranking measures regulations affecting 11 areas of the life of a business known as indicators. Ten of these areas are included in this year's ranking: starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency[26].

Figure 17: Ease of Doing Business in St. Lucia

The Private Sector Assessment Report (2013 IADB[27]) mentions a number of strengths that are expected to contribute to the future growth of the private sector in Saint Lucia. The country performs well on international indicators in relation to government effectiveness, economic freedom and the ease of starting a business. Inflation is low, and there are no restrictions on capital flows.

However, there are a number of weaknesses in St. Lucia that hinder private-sector development, especially in the areas of the cost of doing business, electricity, transportation, an inadequately

26 http://www.tradingeconomics.com/st-lucia/ease-of-doing-business

http://www.doingbusiness.org/reports/global-reports/doing-business-2016

27 http://www.caribank.org/uploads/2014/11/2014-St. Lucia-PSAR.pdf

educated workforce, tax rates, access to finance (e.g. collateral for credits are up to 194% of loan amount and a large spread is applied between lending and deposit rates), and the lack of a government strategy for the sector or co-ordination with private-sector stakeholders.

The global financial crisis had a profound effect on St. Lucia's economy, as tourism and demand for exports contracted. The crisis also impacted jobs, with the unemployment rate rising steadily since 2007, actually about 20%; one of the highest rates in the region and Youth unemployment of about 40% of total unemployment.

The Report concludes that the private sector desires a clear commitment from the government regarding private-sector development, and that it would benefit from both a clearly defined strategy and a forum for communication and engagement between the public and private sectors. Additionally, the PSAR recommends that technological advances be utilized to improve efficiency and reduce the cost of doing business; the regulatory environment be enhanced to support and encourage alternative financing; and education and skills capacity-building be implemented to strengthen the labour market and improve productivity.

Private Sector and Wastewater Management

The GoSL intends to put more emphasis on planning and coordination of the wastewater sector than on extending operation and encourages the private sector to invest and provide services thus contributing to the overall improvement of the quality and standard of infrastructure on island[28].

The Government has identified opportunities for private business participation in Wastewater activities, but the sector has not been included in the priority hard and soft infrastructure: airports, seaports, bridges, roads and highways; and health care facilities, research institutions/facilities, reputable offshore universities, voice and call centre operations, business process outsourcing (BPO), knowledge process outsourcing (KPO) operations, technology and hospitality training institutions and alternative energy production.

Besides the operating activities of two public entities, WASCO and CCC, Saint Lucia's private sector and individuals has already planned, built and operated a large part of public and private wastewater infrastructure. The private sector also sells sanitary products and construction material and operates wastewater services such as repairs and sludge emptying[29]. The actual business structure in Saint Lucia's wastewater management is characterized by small scale interventions and volume wise, mostly by on-site facilities.

Although general business conditions are improving steadily, wastewater will remain a niche market. Size of operations, locations, financing costs and the actual enforcement practice hamper the attractiveness of the sector and the private business may continue to show a very selective interest to invest. Nevertheless, it is possible to identify actual and possible business opportunities for different business categories along the wastewater value chain.

[28] "Invest Saint Lucia", the official Investment Promotion Agency (IPA) http://www.investstlucia.com/general_pages/view/about-us

[29] Not considered: drainage systems and solid waste management

Private Business Opportunities in the Wastewater Value Chain in Saint Lucia						
Business category	**Marketing, storage, sales**	**Engineering projects**	**Construction**	**Collection**	**Treatment**	**Recovery, disposal**
Sole trader			Private toilets, septic tanks, VIP	*Manual emptying pit latrines (VIP)*		
Micro (< 10)		Individual + small public infrastructure projects	Private + public toilets, septic tanks, connections	Emptying truck, O&M sewer	O&M treatment plants	Irrigation, biogaz fertilizer
Small (< 25)	Sales sanitary products + construction material	Medium private + public infrastruct. projects	Toilets, tanks, connections, ponds, Small WWTP	Emptying truck, O&M sewer	O&M treatment plants	Irrigation, biogaz fertilizer
Large	Sales sanitary products + construction material	(Large) public infrastructure projects	(Large) public Infrastructure projects			
Multinational	Production + import sanitary products + construction material					

Table 34: Private Business Opportunities in the Wastewater Value Chain in St. Lucia

Sole traders like masons and plumbers focus on individual clients and small repairs in hotels and institutions. Micro enterprises (with up to 10 employees) may access a broader market if qualified, from engineering to construction of small to medium size infrastructure. They also may assume operation and maintenance of sewers and treatment facilities, e.g. in condominiums and resorts. Small businesses (up to about 25 employees) may be active in sales of products and offer the entire range of services along the value chain.

Larger business, national or foreign subsidiary, can be active in production and sales of products and local and imported construction material and may have an interest in engineering and construction of larger infrastructure projects, such as the planned rehabilitation and extension of Castries sewerage system[30]. Multinational companies will most probably focus on sales of imported goods for wastewater infrastructure produced elsewhere.

The table above does not represent the relative competitive strengths of the business categories in each activity.

Within the formulation of the Wastewater Strategy, specific support by the GoSL to improve private participation and investments in wastewater shall be detailed and recommended. The support strategy may include propositions such as simplified registration, service contracts, preferential access to finance (e.g. guarantee to lower collateral requirement, interest rates), tax incentives/holidays or smart subsidies, revised building standards, combined demand promotion, enforcement of standards.

[30] The size of Castries and Gros Islets sewerage systems with about 3,000 and 1,300 connections is may be too small to attract a concessionaire.

6. KEY CHALLENGES

This chapter aims to identify the deficit and key challenges in the sanitation and wastewater management sector. The deficit is assessed by comparing the existing services (the “offer”) and the demand for services (the “demand”). The identification of key challenges will help then to define the policy statements.

1. Reasons for low demand at all levels

In global terms the demand for sanitation and wastewater services in St. Lucia is low. Limited financial capacity seems to be the main reason at all levels. However this is usually combined with additional factors. At the household level, the lack of technical support, the land restriction (Coastal towns zone), the tenure land issues, the habit ("*it has always been that way, why change*?") and the education in sanitation are also important reasons for the low demand in sanitation (23% of households rely on pit latrines and 6% has no toilet at all). At the industrial level, the combination of the lack of technical support, the lack of commitment and the lack of regulation and enforcement are the main reasons for large quantity of industrial wastewater entering untreated in water courses (only one industry is properly equipped with wastewater treatment process). At livestock farms level, the lack of technical support to build appropriate manure and wastewater management systems together with the lack of commitment for environmental protection can explain the low sanitation demand. Sailors and yacht owners seem to have a very poor environmental awareness and chose the easiest way of dealing with wastewater with only a few of them using wastewater emptying services. The hotel sector is the only sector addressing wastewater management issues. About half of the wastewater produced is properly treated. This is mainly due to the high environmental expectation of customers. Also such practices are driven by the fact that a poor environmental quality directly impacts the tourism sector in terms of income.

2. Greywater being discharged into open drains

The greywater is mainly discharged untreated into open drains which lead to watercourses and ultimately the marine environment. The existing separation between black and grey water at household level, the saving on septic tank maintenance and to some extend the sanitation education can be considered as the main reason for such practices; population seems to not link such practices with poor coastal water quality for example. This situation can be observed where households are connected to a sewer network. This could be the consequence of a global thought that such practice will reduce the wastewater bill. The introduction of a new approach that will include greywater as a main issue is a key challenge in order to cope with this practice. It is also a technical challenge since most of households are directly connected with pipes to the drains.

3. Disposal (and reuse) of FS and wastewater

The disposal of wastewater and FS is critical in St. Lucia. Castries sewer network directly discharges untreated wastewater into the Castries harbour daily. 81% of FS collected is partially treated (Beausejour and Union FSTP) and 19% is directly dumped on open land. Such practices cause a severe threat to environmental and human health. Since most of the population relies on septic tanks, FS disposal facilities should be better distributed with at least one facility in the

North and one in the South. Proper FS treatment should be performed and potential for reusing treated FS as fertilizer assessed.

In the current situation reuse of treated wastewater is only performed by hotels. Although the country has been experiencing plenty rainfall throughout the years (2000mm per year), St. Lucia faced a drought in 2015 with water rationing procedure that has been put in place. This event should drive the Authorities to better consider the potential reuse of treated wastewater. Reusing wastewater is also an alternative in order to reuse the treatment cost.

4. Livestock farms manure and liquid waste management

With 322 swine farms and a production of manure and wastewater estimated to be close to the overall production of FS of the island, swine farms are a severe threat to the environment. The poor actual management of the manure and liquid waste by farmers and the location of a few farms above WASCO's drinking water intakes make this sector a key challenge.

5. Industrial liquid waste management

Among the 122 industries registered in St. Lucia, only one addresses the industrial wastewater management issues by operating a wastewater treatment process. The absence of technical support together with the lack of consideration for the environment and human health risk from industrials makes this sector a key challenge. The NWMSP has to be realistic and has to take into consideration that strong legislation can endanger the economic viability of industries (i.e. high treatment cost, etc.).

6. Environmental and human health risk

Poor sanitation practices directly expose users to faecal pathogens (FC, helminth eggs, virus, etc.). In coastal towns and informal settlements zones, percentage of people still using bucket latrines or practicing open defecation can be high (49% of households in Canaries district have no toilet).

Impact on the human health can be indirect through poor quality environment. Highly contaminated surface and coastal waters by faecal pathogens (poor maintenance of septic tanks, night soil disposal, absence of proper treatment, etc.) exposes the population to waterborne diseases. Greywater settling in open drains encourages mosquitoes breeding and stimulates development of bacteria having potentially severe consequence on human health.

Also it is recognized that persistent chemicals released into the environment by industries and pesticide use in agriculture bioaccumulate into the organism and may adversely affect DNA and enzymatic processes, hence interfere with life processes. This can cause potentially severe effect on the marine biodiversity and the human health by consuming fish and seafood.

High concentration of organics and nutrients (greywater into open drains, absence of treatment, poor maintenance of sanitation facilities, poor agricultural practices) into water bodies severely affects aquatic and marine ecosystems (eutrophication, reduction of dissolved oxygen and sunlight).

These factors described above can result in important economic losses:

- Limit baby brain development
- Increase in health care expenses

- Work day lost
- Reduced incomes in the fishing sector
- Reduced incomes in the tourism sector

7. Threat to tourism sector

Tourism is the leading industry in St. Lucia. In fact, it contributes approximately 13.8% of the GDP and direct employment of over 20,000 employees (www.investstlucia.com). Poor coastal water quality and reduction of the marine biodiversity is a serious threat for this sector and government should therefore consider it as priority.

Also, it has already been observed (in South East Asia) that European Tour Operators require environmental labels for hotels and resorts to appear in their offers. It can be expected that it will be soon apply to other areas around the world.

8. Climate change resilience requirements

Due to various factors such as its geographic location within the hurricane belt; the small size and limited land space; the location of major settlements and infrastructure in low-lying coastal areas prone to flooding and storm damage; its location within a tectonically active area; St. Lucia is highly vulnerable to the impacts of climate change and natural hazards. Indeed Climate change has to be taken into consideration when addressing sanitation and wastewater management issue. Wastewater management facilities and work have to be located and designed in ways that minimize their vulnerability to natural hazards. This considers:

- Decentralized systems: decentralized facilities are less vulnerable than centralized schemes
- Subsidiary: wastewater facilities should be handled by the smallest, lowest or least centralized competent authority
- Capacity building: specific capacity building of all parties involved in the service, whether it be at the normative, regulation, building, service, operation and maintenance levels. Capacity building should include specific information and training on disaster risk reduction (DRR) and recovery.
- Adapted regulation: investigate if existing regulations are compatible with the climate change threat
- Introduction of resilient technologies (for example by reducing the reliance on energy-powered equipment)

9. Towns at sea level

Part of Castries and most of the coastal towns/villages (cf. Coastal towns zone) are at or under sea level. This location has serious implications for wastewater management. The hydrogeology conditions with a high water table make these zones not suited for septic tank and soak-away absorption systems. The saturated zone may facilitate a higher rate of migration of faecal contaminants towards the near shore marine environment due to the presence of advection currents.

It should be outlined that this challenge may become more serious in the future as a consequence of climate change. A rise in sea level and natural events causing flooding may lead to water infiltration into sanitation facilities.

Also most of the towns//villages visited (and other drainage channels near the sea) are facing a situation where sea water is entering into the drains in particular at high tide time. This situation is a critical issue as today a lot of households are discharging their greywater into the drain. Sometimes black water is also discharged into the drain (where individual facilities are either missing or not operating properly). However, this critical issue can be highly mitigated by proper greywater management and increasing access to sanitation.

10. Landslide

It has been observed that some communities initiated development on very steep lands without pre-studies of the soil structure and stability. Combined with the poor management of grey- and blackwater (infiltration and runoff), this results in decreasing the strength of the soil structure thereby contributing to landslide events.

11. Communication, advocacy and technical support

Technical support is needed at all levels, from households to industries, in order to choose and build adequate sanitation systems. An official unit dedicated to the communication, advocacy and technical support in the sanitation sector should be created. This unit would be in charge of promoting sanitation by efficient communication campaigns and advocacy. The unit would also be responsible of providing technical support to households, institutional buildings, hotels, restaurants, health care centres, industries, marinas, farmers, etc. This unit should be co-developed by several ministries as MoH, MoSD, MoA, MoE, MoPD and MoST.

12. Training

TVET programs in the sanitation sector are broadly lacking at all levels in St. Lucia. There is a gap between training and employment requirements. Professionals have to hire sanitation specialists at regional or international levels or send their employees overseas for training in sanitation.

Sanitation engineering should be included in the curriculum as part of an existing technical program curriculum (for example: Associate Degree in construction management). Basic sanitation practices could be included in the hospitality programs, while wastewater management, manure management and resource recovery could be attached to agricultural programs. SLCTVET could partner with WASCO, CAWASA and CARPHA in order to provide official programs and certifications.

13. Missing Public Service Model for Wastewater and Faecal Sludge Management for all

Since they are dedicated to public service officials firstly consider collective systems when it comes to sanitation. In St. Lucia it can be estimated that public services manage from 5 to 10% of global FS and wastewater production. WASCO which has the mandate to deliver sanitation services island wide manages both sewer networks and the Beausejour WWTP. Both networks represent approximately 7% of households and only 2% of wastewater is properly treated at the WWTP. The FS disposal offers from private empting companies is only a pit sludge and not a proper treatment.

This figure shows the necessity to create a Public Service Model for Wastewater and Faecal Sludge Management integrating both collective and individual systems as well as other sectors such as industries, hotels, restaurants, etc. This model has to integrate all aspects of the sanitation chain which includes containment (onsite/connected to a semi-centralized or centralized system), collection and transport (emptying companies/sewer), treatment (FSTP/WWTP) and reuse (fertilizer/irrigation).

14. Regulation and enforcement

The regulation of wastewater management is limited and poorly coordinated. St. Lucia has many policies and laws but most remain unimplemented. Enforcement seems to be non-existent. Indeed, most of the emptying companies are not licensed and/or inspected. Individual onsite sanitation systems are either not inspected or monitored. Industrial effluent is not monitored. Hotels are mandated to perform monitoring and water testing of their WWTP. However it seems that EHD does not enforce. There is no enforcement procedure in place to control if boats and yachts have their wastewater tank locked when docked in the marinas. Also manure and liquid waste management from swine farms as well as the pesticides and fertilizers applications are not regulated.

It appears that even if standards exist in order to facilitate the regulation, standards currently in place are not sufficient to encompass the overall wastewater management sector. The national guideline for the discharge of domestic wastewater is limited to a few parameters. To overcome this issue agencies and industrials resort to several different regional or international guidelines which can lead to confusing situations. There are no standards in terms of wastewater quality discharge for other sectors (industries, hospitals, farming). Standard designs for sanitation systems have to be improved in order to promote sanitation facilities that better fit the St. Lucia context.

It seems that lack of human resource and financing are the major constraint to explain the lack of wastewater management regulation. However, St. Lucia needs first to reorganize the regulatory framework in order to increase the efficiency of the procedures.

15. Effective and efficient institutional arrangement

Responsibilities, competences and tasks are located in a series of governmental organizations and no specific wastewater budget line exists in the national budget. Official Stakeholders must agree on a feasible arrangement and coordinate efforts allocated to different departments.

16. Financial sustainability of modern wastewater management under actual socio-economic conditions

High expectations for modern wastewater services from a touristic perspective contrast with financial constraints faced by many inhabitants. St. Lucia has reduced poverty level, but a significant portion of its population does not have the financial means to cope with wastewater costs, especially in adverse geographic locations such as high density, low-lying coastal and poor rural areas. The achievement of universal access will most probably require targeted CAPEX subsidies as incentives.

18. Agricultural NPS pollution

In many countries contamination of water resources from agriculture has become the main pollution factor. The challenge is less about infrastructure than behavioural change. It is a combination of awareness creation, regulation and enforcement of the use of pesticides and fertilizers and technical support to adjust exploitation methods.

7. ATTACHMENTS

Attachment 1: **Terminology**

Attachment 2: **Soil Map of St. Lucia**

Attachment 3: **Standards for sanitation systems designing, MoH**

Attachment 4: **Meetings with stakeholders**

Attachment 5: **References and Bibliography**

Attachment 1

Terminology

Unless cited under another reference the terminology presented here is firstly based on the Public Health Act definitions. When necessary (because a definition is missing in the Public Health Act) the definitions have been complemented based on the CReW 2012 - Baseline Assessment Study St Lucia.

"**activated sludge**" means flocculent sludge produced by the growth of bacteria and other organisms in raw or settled sewage when it is continuously aerated;

"**activated sludge process**" means a biological sewage treatment: process in which a mixture of sewage and activated sludge is agitated and aerated. The activated sludge is subsequently separated from the treated sewage by sedimentation and may be re-used;

"**absorption**" means the adherence of dissolved, colloidal or finely divided solids on the surface of solid bodies with which they are brought into contact;

"**aeration**" the bringing about of intimate contact between air and liquid by one of several methods, i.e. spraying the liquid in the air, forcing air through the liquid, agitating the liquid to promote surface absorption of air;

"**blackwater**" is used to describe wastewater containing faeces, urine and flushwater from toilets along with anal cleansing water (if water is used for cleansing) or toilet paper.

"**biochemical oxygen demand (BOD)**" means the amount of dissolved oxygen consumed by chemical and micro- biological action when a sample is incubated at 20°C for a period of 5 days;

"**biological filter**" means an artificial bed or inert material over which sewage is distributed and through which it penetrates to under drains, thus giving an opportunity for the formation of biological slimes which bring about oxidation and clarification of the sewage;

"**chemical oxygen demand**" (COD) means the amount of oxygen used in the chemical oxidation of the matter present in a sample by a specified oxidising agent under standard conditions;

"**colloidal material**" means finely divided solids which will not settle but which may be removed by coagulation;

"**combined sewer**" means a sewer designed to carry both sewage and surface water;

"**coverage**" % of population served with sewerage, septic tanks, latrines and open defecation

"**crude sewage**" means sewage which has received no treatment;

"**detritus tank**" means a tank in which sand, grit and other heavy inorganic materials are removed by sedimentation from sewage;

"**digestion**" means the biochemical decomposition of organic matter using anaerobic bacteria, which results in the formation of simpler and less offensive compounds;

"**dilution**" means the ration of the volume of a stream to the volume of sewage effluent discharging to it;

"**domestic wastewater**": all discharges from households, commercial facilities, hotels, septage and any other entity, that includes the following definitions:

a) toilet flushing (**blackwater**);

b) showers, wash basins, kitchens and laundries (**greywater**); and

c) small industries, provided their composition and quantity are compatible with treatment in a domestic wastewater system.

"**dry weather flow**" (d.w.f.) means the daily rate of flow of sewage, together with infiltration if any, in a sewer in dry weather – measured after a period of 7 consecutive days of dry weather during which the rainfall has not exceeded 0.25 mm;

"**effluent**" means any liquid which flows out of a containing space, but more particularly the sewage or trade waste, partially or completely treated, which flows out of a treatment plant;

"**final settlement tank**" means a tank through which the effluent from a biological filter, or aeration tank, flows for the purpose of separating settleable solids. When used with a biological filter it is often called a humus tank;

"**greywater**" (or sullage) is all wastewater generated in households or office buildings from streams without faecal contamination, i.e. all streams except for the wastewater from toilets. Sources of greywater include, e.g. sinks, showers, baths, clothes washing or dish washing.

"**industrial effluent**" means the fluid discharge, with or without matters in suspension, resulting wholly or in part from any manufacturing process, and including farm and research institution effluents;

"**nonpoint source pollution**": water pollution affecting a water body from diffuse sources, such as polluted runoff from agricultural areas draining into it, or wind borne debris blowing out to sea.

"**outfall sewer**" means the final sewer of a system which carries the sewage to a treatment works or to a point of discharge;

"**oxidation**" means the chemical change which a substance undergoes when it takes up oxygen;

"**pumping** station" means an installation of pumps to lift sewage from a low level to a higher level;

"**Royal Commission Standard**" means a suspended solids content of not more than 30 mg/1 and a BOD of not more than 20 mg/1;

"**sedimentation tank**" means a tank in which water or sewage containing sediment is retained for a sufficient time at a sufficiently low velocity to remove part of the sediment by gravity;

"**septage**" is a term used to describe the partially treated sludge stored in a septic tank. Septage is pumped out of a septic tank or onsite sewage facility with a vacuum truck.

"**sewage**" means any water contaminated by domestic waste or trade effluents, water-borne human, domestic and farm waste. It may include effluent, subsoil or surface water;

"**sewage treatment**" means an artificial process to which sewage is subjected to remove or alter its constituents to render it less offensive or dangerous;

"**sewer**" means a pipeline to carry sewage or other wastes, and not normally flowing full;

"**sewerage**" means a system of sewers and ancillary works to convey sewage from its point or origin to a treatment works or other place of disposal;

"**sludge**" means accumulated suspended solids from sewage deposited in pipes or tanks, mixed with water to form a semi-liquid substance;

"**sullage"**: see "greywater" definition above.

"**surface water**" means natural water from the ground surface, paved areas and roofs;

"**suspended solids**" mean the solids which are suspended in a sewage or effluent.

Attachment 2

Soil Map of St. Lucia

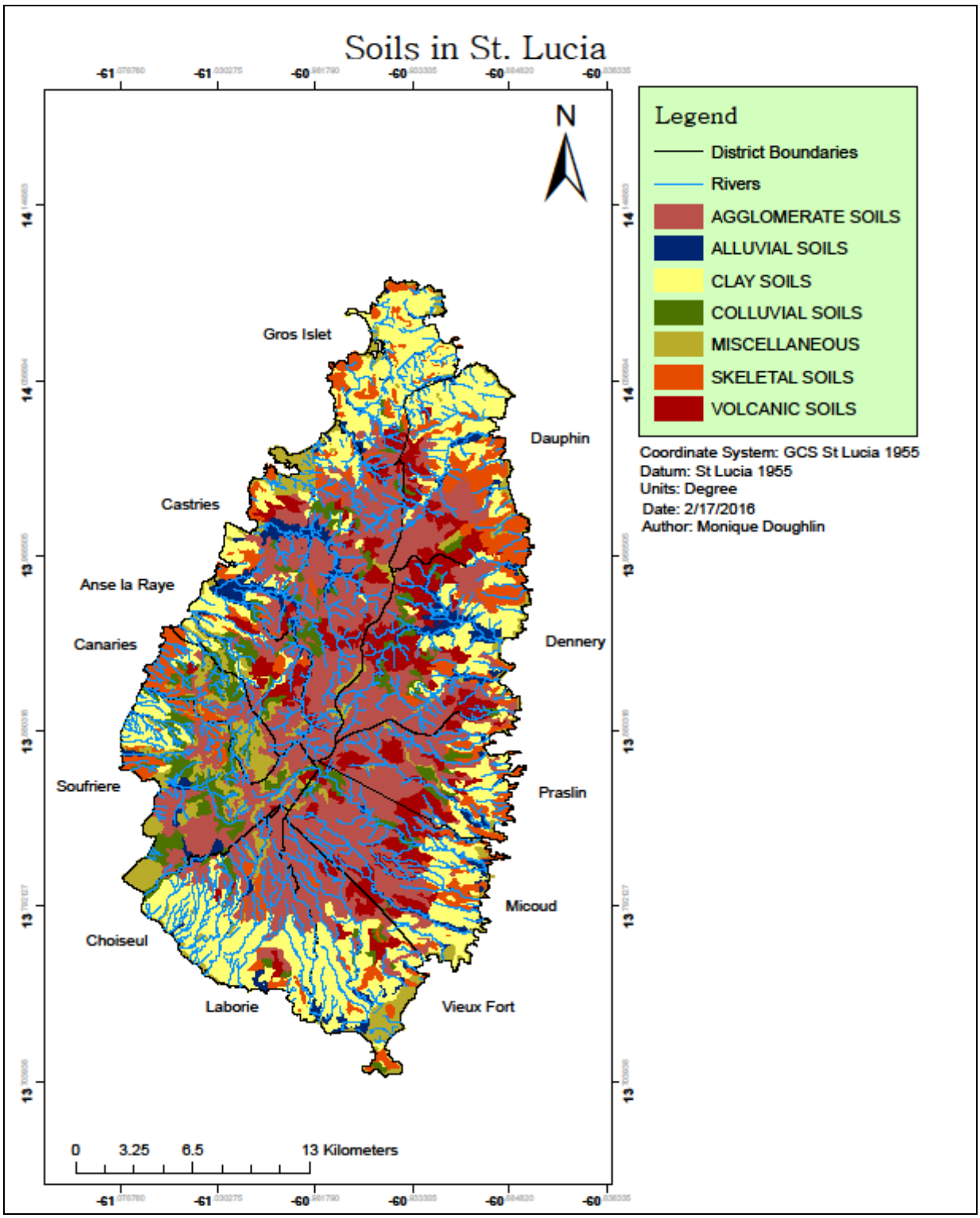

Figure 18: Soil map in St. Lucia (GCS St. Lucia 1955)

Attachment 3

Standards for sanitation systems designing, MoH

Extract of the Public health (sewage and disposal of sewage and liquid industrial waste works) regulations No 22 of 1978 (Revised in 2001) regarding sanitation system designs.

Treatment Plants

The undermentioned treatment plants shall comply with the following requirements—

1. SEPTIC TANKS

   (a) Except with the approval of the Public Health Board it shall be not less than 50 ft from any wall, spring or stream of water used or likely to be used by man for drinking or domestic purposes or for the manufacture or preparation of articles of food or drink for human consumption or for the cleaning of vessels with a view to the preparation for sale of articles and otherwise in such a position as not to render any such water liable to pollution.

   (b) The effluent from every septic tank shall discharge through a drain not less than 6 ft in length into an approved constructed effluent disposal system which shall be not less than 50 ft from any well, spring or stream of water as described in paragraph (a) above.

   (c) Shall have a minimum retention time of 24 hours and effective capacity from holding sludge for a minimum of 2–3 years based on the number of persons discharging to the tank on 1 DMF per person.

   (d) The minimum size of a septic tank should be 3,500 litres or 700 gallons.

   (e) Minimum water depth 1.5 meters (5 ft) to maximum 1.8 meters (6 ft).

   (f) Shall be provided with adequate ventilation.

   (g) The invert elevation of the inlet shall be one inch higher than the invert of the outlet pipe.

   (h) The inlet and outlet of septic tanks shall be fitted dip pipes or dip plates to prevent the disturbances of the scum during normal operation.

   (i) The dip pipes shall extend about 375 mm. (15 inches) below liquid level (below overflow level) but shall not extend more than 450 mm. (18 inches).

   (j) The last section of the outfall drain to a septic tank shall not be laid on a steep gradient, maximum velocity 0.9 m/s or (3 ft./sec.).

   (k) Septic tank construction shall be made with adequate strength to resist earth movement and to support the weight of the tank walls and contents and that the floor and walls be made water tight.

2. IMHOFF TANKS

   Settling compartment detention:

   2.5 to 3.0 hr. preceding bio-filters

   1.0 to 1.5 hr. preceding activated sludge.

   Sludge compartment capacity per person:

   0.07 to 0.10 m^3 for primary sludge

   0.085 to 0.11 m^3 for primary plus humus sludge.

3. SEWAGE SETTLING TANK

   (a) Sewage settling tank shall not be used for population below 100 and shall only be used for larger population and arrangements must be made for disludging and disposal of the sludge at a minimum interval of once a week.

(b) Size of settling tank shall be 5 times the width and a minimum capacity of 12 hours Dry Weather Flow (DWF).

(c) Maximum horizontal rate of flow 12 to 15 meters per hour or 40 ft to 50 ft/hour at DWF minimum of 2 tanks in parallel.

(d) Sludge pipe work shall be at a minimum diameter of 150 mm. or 6 inches.

4. SEWAGE BIOLOGICAL FILTERS

(a) Filters beds may be circular or rectangular in plan. Rectangular filters may be permitted up to a population of 50 persons.

(b) Sprinklers for biological filters (small treatment works) (300–2,000 population) shall be provided with no jets or small opening. Shall distribute effluent evenly from maximum capacity down to a mere trickle.

(c) For population over 2,000 persons sprinklers shall be of the rotating type and approved by the Public Health Board.

(d) Distributer for population over 50 persons and not more than 2,000 shall be of the rotating type with water wheels weir box and tipping trough or alternating siphon arrangement.

(e) Maximum dosage rate of BOD loading in terms of cubic meters or effluent per cubic meter of medium per day shall be 0.6 cubic meter per cubic meter/day or 0.75 cubic meter of medium per head of population for filter serving up to 10 persons for larger works BOD loading 0.06–.09 kg. BOD per cubic meter/day will be accepted. 0.08 kg. BOD per m^2 rotating disc surface area.

(f) Arrangements shall be made to dose filter frequently and continuously and in any case not less than 15 min. interval.

(g) Re-circulation of effluent shall be provided but may be allowed omission only with the permission of the Board.

(h) Depth of filter beds shall be 1.8 meters, 6 ft to 2.0 meter, 6 ft 8 inches depth of filter medium and all filtering medium must be approved by the public health officer.

(i) Filter media must be approved by Public Health Department before placed into use.

5. PACKAGE PLANTS

(a) Anaerobic-Aerobic:

18 hours anaerobic contact retention

2 hours intermediate settling retention

6 to 8 hours aeration at air input of 63 m^3/kg. BOD per day

5 hours final settling retention.

(b) *Extended Aeration:*

All plants shall be based on 3 DWF flow. Daily organic loading shall be 0.16 to 0.32 kg. BOD per cubic meter aeration tank capacity. Detention time shall be 24 to 48 hours in aeration tank and 4 to 7 hours in settling tank.

Air supplied shall be 130 to 300 cubic meter/kg. BOD loading.

Excess sludge withdrawal 9 to 10 litres per person/ week.

Excess sludge consolidation tank 6 to 8 weeks storage capacity with air bubble stirring and periodic decantation of supernatant.

(c) *Contact — stabilisation:*

Contact zone 2 hour retention giving one hour absorption period at 100 per cent recirculation or capacity of 10 m^3 per 11 to 16 kg. BOD per day.

Settling 2 hours retention.

Re-aeration 5 hours retention with air supply of 63 m^3/kg.

BOD per day.

Aerobic digester 85L/person storage capacity.

6. OXIDATION DITCH

BOD loading shall not exceed 210 mg/1 of ditch capacity per day with:

(a) A BOD/sludge loading factor near the lower end of 0.05 to 0.15 g. BOD per day per gram activated sludge.

(b) Oxygen capacity shall be twice the BOD load to be removed.

(c) Rotor shall maintain the required velocity in order that a velocity of 0.3 m/s (one foot per sec.) of sewage is maintained in ditch.

(d) Rotor shall be immersed a minimum of 50 mm. (2 inches) and maximum of 225 mm. (9 inches).

(e) A mixed liquor suspended solids shall be maintained at 4,000 to 4,500 milligrams per litre.

(f) The volume of ditch 120 to 150 cubic meter length of rotor for small unlined ditch but may exceed that for larger plants if a lining is used 300 litres per person.

(g) Organic loading shall be maximum of 160 kg. BOD per day per 1,000 cubic meter of ditch (i.e. 160 milligrams per litre).

(h) Final settling retention time shall not be less than 1.5 hours and a maximum upward velocity of 0.9 to 1.2 meter/hour.

(i) Depth of ditch shall not exceed 1.0 to 1.5 meter.

7. OXIDATION PONDS

Oxidation Ponds shall comply with the following:

(a) All oxidation ponds shall be a minimum distance of 532 meters or 1,750 ft from any housing area.

(b) There shall be strict control by the owner of vegetation and embankment erosion and mosquito breeding.

(c) Arrangement shall be made *re* circulation of effluent.

(d) No pond depth shall be less than 600 mm. (2 ft) and not more than 1,500 mm. (5 ft).

(e) The loading shall be a maximum of 170 kg/ha or 6,000 to 10,000 persons per hectare 250 and 275 kg BOD hectare/day.

(f) In special cases the Public Health Board may permit loading of 450 to 550 kg/hectare per day.

8. INTERMITTENT SAND FILTERS

Application rates of 0.10 to 0.15 m3/day per m2 of surface area for secondary treatment and 0.5 to 1.0 m3 day per m2 for tertiary treatment. A minimum of 2 beds provided to allow alternate dosing.

Attachment 4

Meetings with stakeholders

Meeting with stakeholders			
Sector	**Stakeholders**	**Name**	**Position**
Sanitation service providers	R & S Company	Mr. Charlry	Manager/Driver
	Lazarus funeral home Company	Mr. O'Brian	Director
	Rockers sanitary cleaning company	Mr. Maynard	Manager
	SLECL Company	Mrs. Theodore	Office Manager
	Castries City Council	Mr. Hinds	Operations Manager
	WASCO	Mr. Sealy, Mr. Eudovique Mr. Anthony	Technical Manager, Wastewater Manager & Operations Manager
	Small sanitation providers (shops)		
Aquaculture	Taiwan fish farm (at Union)	Mr. Joseph	Operations Manager
Tourism	Jade Mountain & Chastanet resorts	Mr. Carl Hunter	Operations Manager
	SLHTA	Mr. Azeez	Chief Executive Officer
Industry	St Lucia Chamber of Commerce Industry and Agriculture	Mr. Louisy	Executive Director
	DuBoulay's Bottling Company	Mrs. Innocent-Bernard	Management Systems Manager
	Manufacturers' Association		
Livestock	Beausejour Agricultural Station	Mr. Valmont	Manager
Marinas & Harbours	IGY, Rodney Bay Marina	Mr. Devaux	Operations Manager
	Marigot Bay	Mr. Blanchard	Assistant Marina Manager
NGOs	National Trust	Mr. Tulsie Mrs. Simmons	Director Conservation Manager
	SMMA	Mr. Bobb	Executive Manager
	Soufriere Foundation	Mr. François	Chief Executive Officer
Public sector	MoSD (WRMA)	Mr. Gilliard	
	MoPD	Mr. Daniel	Chief Housing Officer
	MoA		
	MoF		PCU
	MIPST		
	MoT		Director Product Development
	MoH (EHD)	M. Vitalis	Senior Environmental Health Officer
	MoE (TVET Unit)	Mr. Samuels	Education Officer
	SLASPA (Hewanorra Airport)	Mr. Mathews	Airport Manager
	NCA	Mr. Hippolyte	General Manager
	SLBS	Mrs. Tzarmallah	Head of Standards Development
	Sir Arthur Lewis College	Mrs. Combie	Senior Lecturer
	NURC	Mr. Joseph Mrs. Frederick	Executive director Consumer Relations Officer

	Gros Islet Town Council		Gros Islet Mayor
	NEMO	Mr. Joseph	Director
	SLUSWMA	Mr. Auguste Mr. Le Floris	General Manager Deputy General Manager
Financing Agencies & International organisations	OECS		
	CWWA		
	CAWASA		
Other	Feasibility Study for Wastewater Treatment Plant and Outfall	Mr. Volkmar (Safege/Suez)	Business Development Manager Caribbean Area
		Mr. Verne	Engineering Consultants & Project Manager
	Assessment of soil/geology to inform suitable sewage and liquid waste disposal methods in settlement areas	Mrs. Soomer	Consultant

Attachment 5

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