

Assessment of Wastewater Treatment Plants in Jamaica by the Ministry of Health

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ABSTRACT

Background: An assessment of the complete status of wastewater treatment plants (WWTPs), effluent quality and the impact of effluent on the environment is difficult to make with current data. Therefore it is not possible to fully determine the compliance by the Government of Jamaica with the Protocol concerning Pollution from Land-Based sources and Activities in the Wider Caribbean Region (LBS Protocol) of the Cartagena Convention. The Government of Jamaica ratified the Cartagena Convention on 1987. There are presently more than 170 WTPs in Jamaica, 61 owned by the National Water Commission (NWC). Within the NWC system, plant capacities range from 0.0528 MLD (Million Litres per day) - 52.8 MLD with about 90% of plants less than 2.65 MLD. There are a variety of plants within the NWC such as Contact Stabilization, Oxidation Ditch, Aerated Lagoons and Waste Stabilization Ponds. In addition to the NWC, sewage treatment plants are owned by hotels, strata corporations and public housing development agencies. This sector is dominated by mechanical aerated plants, particularly the hotels.

Aim and Objectives: This project aimed to assess the nation's sewage treatment systems and their impact on the environment. The objectives were to assess the efficiency and the effluent water quality of Jamaica's WWTPs; Assess the environmental and health impacts of effluents on water bodies. Assess the level of compliance with the Protocol concerning Pollution from Land-Based sources and Activities in the Wider Caribbean Region; build the capacity and quality assurance systems of the Laboratory; and to identify constraints to effective wastewater treatment and recommend measures for improvement in the short, medium and long-term.

Methodology: Regional workshops were conducted to determine the number of WWTPs. This included discussing the inspection form; schedule of sampling, methodology and to obtain the GPS coordinates of the Influent and Effluent of the plant. One sampling exercise was conducted over a three-month period for each plant, and equipments and supplies were acquired. Samples were collected for testing of the effluent and receiving water bodies where applicable for the following parameters: Faecal Coliform, Biochemical Oxygen Demand (BOD₅), Chemical Oxygen Demand (COD), Nutrients (Total Nitrate and Total Phosphorus), Oil and Grease and Total Suspended Solids (TSS). These results were compared with existing government standards. The compiled data collected was placed on a national data base.

Results: To date 171 WWTPs have been Geo-referenced. The preliminary results for the effluent are as follows: 1,093 analyses (Tests) have been performed for 14 parishes. The average results of the old and new plants for BOD₅ were 32.1 and 19 mg/L; TSS 60.6 and 27.6mg/L; and COD 61.04 & 43 mg/L respectively. The average results for Total Phosphorus were 3.31mg/L; and

Total Nitrogen 15.5 mg/L, for new plants. As it relates to Faecal Coliform the values were as low as <2 MPN/100 mL and as high as ≥ 1600 MPN/100 mL. The percentages of WWTPs that obtained values within the standards for old and new plants were: BOD 44.6 and 75.8; TSS 40.54 and 58 and 75.9 COD 85 and 44.8 respectively; Total Phosphorus 81; Total Nitrogen 32; for the new plants.

Conclusion: These preliminary results revealed that there are some wastewater plants that do not meet the national standards; however more information will be gathered to influence an improvement in the efficiency of the plants and consistency in their performance. This will ensure a greater level of compliance in the promotion of healthy environmental practices.

Background:

The Ministry of Health (MOH) is the pre-eminent government organization whose mandate is to “ensure the provision of quality services and to promote healthy lifestyles and environmental practices”. The Ministry, together with its Regional Health Authorities (RHAs) and related organizations make up the public health system and are responsible for health care across the island.

One of the Programmes within the MOH to ensure the health of the population is the monitoring of the Wastewater Treatment Plants (WWTP) in Jamaica with major emphasis on the Sewage Treatment Plants (STP).

An assessment of the complete status of wastewater treatment plants (WWTPs), effluent quality and the impact of effluent on the environment is difficult to make with current data. Therefore it is not possible to fully determine the compliance by the Government of Jamaica with the Protocol concerning Pollution from Land-Based sources and Activities in the Wider Caribbean Region (LBS Protocol) of the Cartagena Convention. The Government of Jamaica ratified the Cartagena Convention on 1st April 1987 and has indicated a strong commitment to formally ratify the LBS Protocol as well.

There are presently more than 170 WTPs in Jamaica, 61 owned by the National Water Commission (NWC). Within the NWC system, plant capacities range from 0.0528 MLD (Million Litres per day) - 52.8 MLD with about 90% of plants less than 2.65 MLD. There are a variety of plants within the NWC such as Contact Stabilization, Oxidation Ditch, Aerated Lagoons and Waste Stabilization Ponds. In addition to the NWC, sewage treatment plants are owned by hotels, strata corporations and public housing development agencies. This sector is dominated by mechanical aerated plants, particularly the hotels.

Aim and Objectives:

This project aimed to assess the status and effectiveness of the nation’s sewage treatment systems and their impact on the environment.

The objectives were to:

Assess the efficiency and the effluent water quality of Jamaica’s WWTPs;

Assess the environmental and health impacts of effluents on water bodies.

Assess the level of compliance with the Protocol concerning Pollution from Land-Based sources and Activities in the Wider Caribbean Region;

Build the capacity and quality assurance systems of the Environmental Health Laboratory; and

Identify constraints to effective wastewater treatment and recommend measures for improvement in the short, medium and long-term.

Methodology:

Regional workshops were conducted to sensitize Management, the Public Health Inspectorate and the private and public stakeholders as to the project objective and their role in Project implementation as well as to verify and determine the number of WWTPs. This included

discussing the Wastewater Facility Evaluation Form (inspection form), schedule of sampling and methodology and to obtain the GPS coordinates of the Influent and Effluent of the Plants. The GPS coordinates were measured by personnel trained by the Research Unit of the MOH. Once the coordinates were taken maps were issued by the same unit.

Field and laboratory equipment and supplies were acquired. A SEALS Autoanalyzer III for the determination of low nutrients level was the major analytical instrument obtained.

One sampling exercise was conducted over a three-month period for the selected plants. Samples were collected for testing of effluent and receiving water bodies where applicable for the following parameters: pH, Residual Chlorine, Faecal Coliforms (FC), Biochemical Oxygen Demand (BOD₅), Chemical Oxygen Demand (COD), Nutrients (Total Nitrogen and Total Phosphorus), Oil and Grease and Total Suspended Solids (TSS). The effluent results were compared with existing government standards. Influent samples were also collected for plants where it was accessible. The compiled data collected is being imputed into a national database. This database can be used to generate trends in analytical results, produce graphs and the points can be activated to view pictures of the WWTPs, sample points, Inspection sheet as well as basic information about the selected plants.

Results:

To date 171 WWTPs have been Geo-referenced. The preliminary results for the effluent are as follows: 1,093 analyses (Tests) have been performed for 14 parishes. The average results of the old and new plants for BOD₅ were 32.1 and 19 mg/L; TSS 60.6 and 27.6mg/L; and COD 61.04 and 43 mg/L respectively. The average results for Total Phosphorus were 3.31mg/L; and Total Nitrogen 15.5 mg/L, for new plants. As it relates to Faecal Coliform the values were as low as <2 MPN/100 mL and as high as ≥1600 MPN/100 mL. The percentages of WWTPs that obtained values within the standards for old and new plants were: BOD 44.6 and 75.8; TSS 40.54 and 58 and 75.9 COD 85 and 44.8 respectively; Total Phosphorus 81; Total Nitrogen 32; for the new plants. Table 1 represents the total number of samples collected and the total number of analyses (tests) done by region and Table 2 shows the percent of test results that were satisfactory by region.

Table 1: Number of Samples by Plants and Total Analyses Performed

Region	Total No of Plants on record	Total No of Plants used in the Project	Total No of Analyses (Test)	Old Plants		New Plants		Irrigation	
				Plants	Test	Plants	Test	Plants	Test
SERHA	128	51	342	30	196	21	146	-	-
SRHA	52	28	186	13	86	15	100		
NERHA	62	45	294	20	133	15	106	10	55
WRHA	64	41	271	16	112	8	87	17	72
Jamaica	306	165	1,093	79	527	59	439	27	127

A total of 12 plants from the total GPS recorded plants were determine to be suitable for the project but where unable to be included for various reasons, that are further discussed. The total number of plant on record includes onsite disposal and not yet built plants.

Table 2: Percent of Tests Compliance by Region

Region	Category of Plants	Total No. of Tests	pH	Residual Chlorine, mg/L	Fecal Coliform, MPN/100mL	BOD ₅ , mg/L	COD, mg/L	TSS, mg/L	Total Phosphorus, mg/L	Total Nitrogen, mg/L	Average Compliance
SERHA	Old	196	100	22	72	40	81	57	67		57
	New	146	100	60	95	90	90	81	76	29	74
SRHA	Old	86	100	0	61	54	92	46	92	69	59
	New	100	100	50	57	60	93	60	80	33	62
NERHA	Old	133	100	50	67	53	79	47	88	54	63
	New	106	100	36	71	75	85	73	67	55	66
	Irrigation	55	100	43	50	89	89	50	N/A	N/A	64
WRHA	Old	112	100	0	79	40	93	73	80	13	54
	New	87	91	9.1	50	58	85	54	47	47	50
	Irrigation	72	100	0	22	67	78	56	N/A	N/A	45

Note: Jamaica have different standards, for Wastewater, we applying the Standards for old plants means built before 1997, for new plants the plants that are built after 1997 and the Irrigation Standards.

The Total Phosphorus and the Total Nitrogen standards for new plants were applied to the old plants to see the challenges that may be faced when these plants will be subjected to these standards.

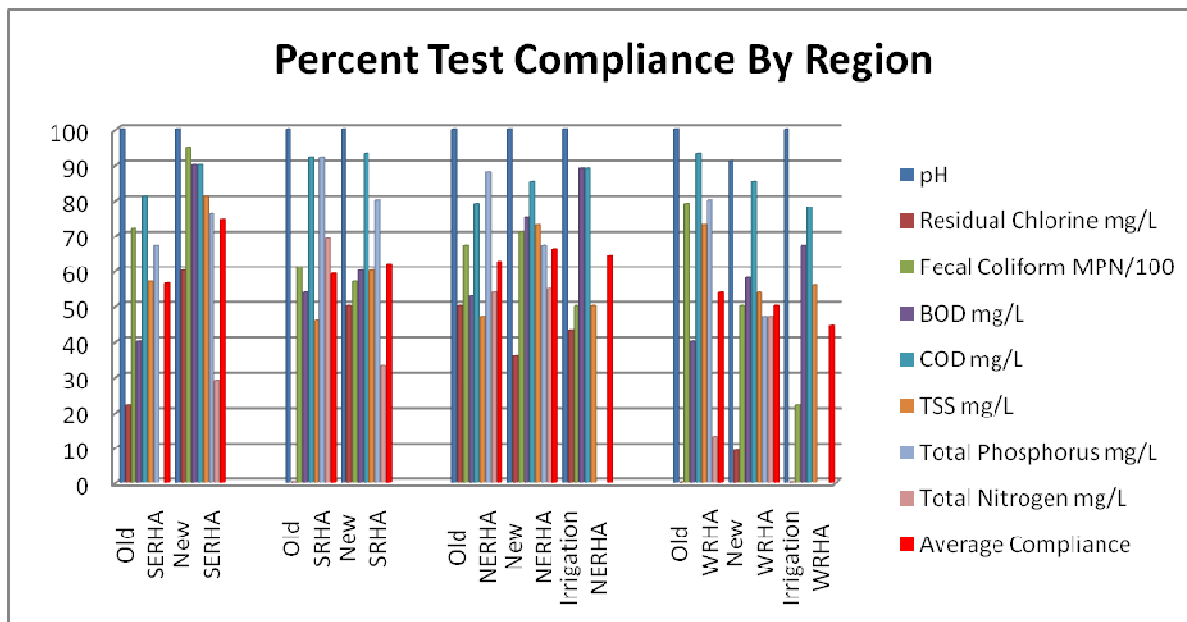


Table 3 compares the compliance of various plant types for the entire island, and these are represented in the charts below.

Table 3: Comparison of Plant Compliance by Type

Plant type	% Satisfactory for Select Parameters				
	FC	BOD	COD	Total Phosphorus	Total Nitrogen
Waste Stabilization ponds	60	56	100	81	53
Oxidation Ditch	57	48	88	72	34
Packaged Plant/Extended Aeration	50	38	69	69	27
Packaged Plant/Contact Stabilization	44	40	87	50	0
Sequential Batch Reactor (SBR)	86	57	100	80	20

Chart 1: Faecal Coliform Compliance by Plant Type

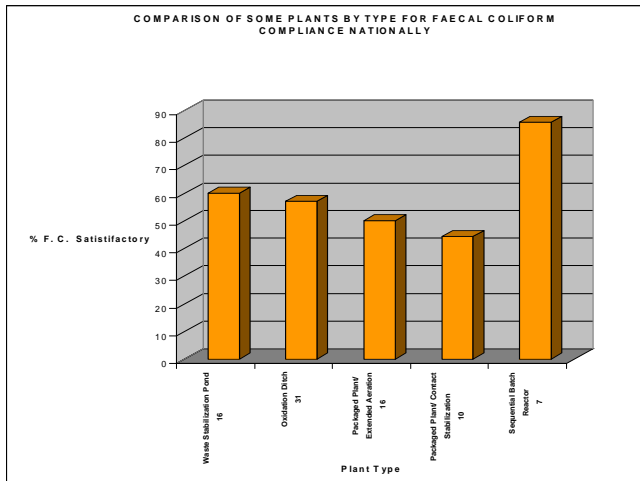


Chart 2: BOD Compliance By Plant Type

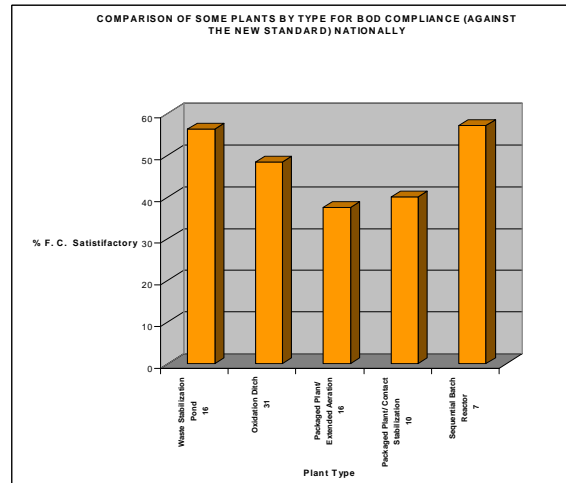


Chart 3: Total Nitrogen Compliance by Plant Type

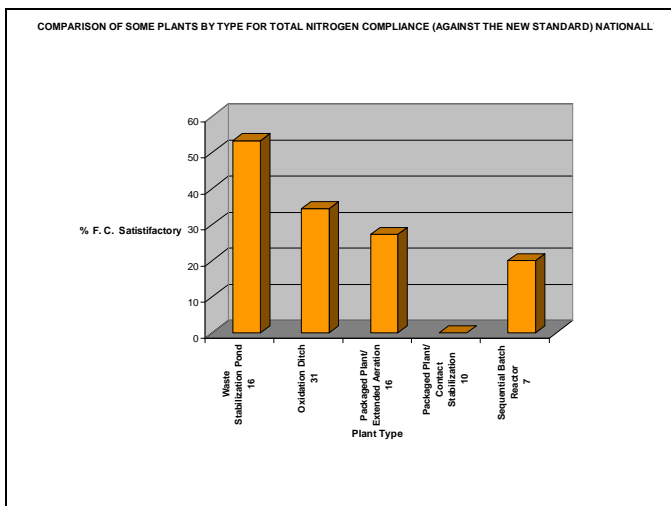


Chart 4: Total Phosphorus Compliance by Plant Type

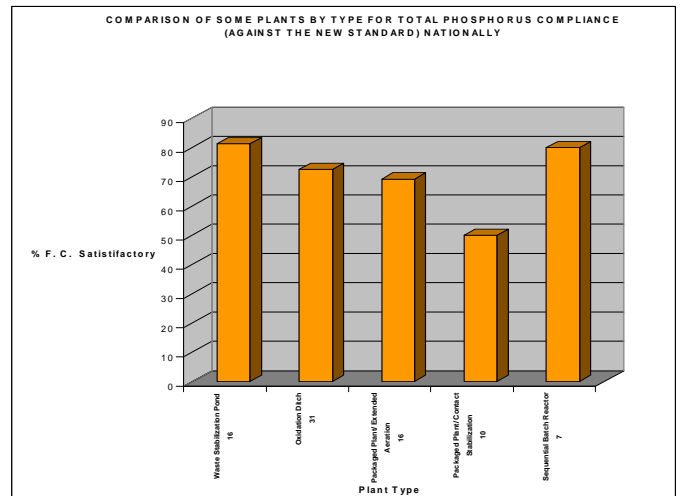


Figure 1: Distribution of Project STPs Islandwide



Figure 2: Distribution of Project Old Plants Showing Feecal Coliform Compliance

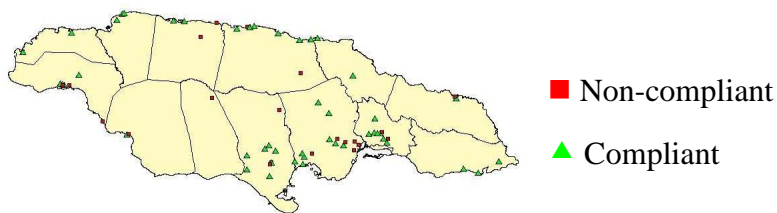
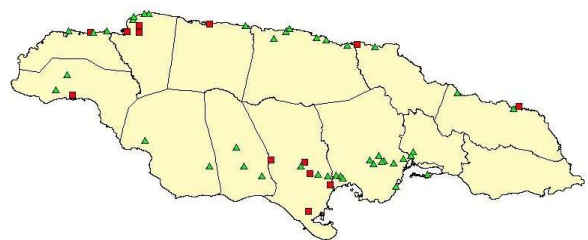


Figure 3: Distribution of Project New Plants Showing Feecal Coliform Compliance



These maps utilize the GPS coordinates collected during the project to represent the compliance of the various plants with selected parameters for old, new and irrigation plants.

Discussion:

Prior to the commencement of the sampling and testing exercise, a list of all recorded central sewage treatment plants was compiled with data gathered from the Environmental Health Unit (EHU) of the Ministry of Health (MOH), the National Environment and Planning Agency (NEPA), the Water Resources Authority (WRA) and the 13 health departments across the island. This list was then reviewed and it was determined that some plants could not be included in the project. Some of the reasons include: (1) Not being a central sewage system (2) Not being built as yet (3) not being in operation (4) not having an effluent (5) being inaccessible and (6) will shortly be connected to another central system. The shortlisted sewage treatment plants represent 96% of those eligible for the project. The primary eligibility criteria were that the plants should be central and should have a sewage effluent, whether it is being treated or not.

An analysis of the plant compliance to test parameters by region showed the average compliance for most regions falling below 70%. The most significant public health parameter,

Faecal Coliform showed greatest compliance in the South East Region with the Southern Region showing the least.

Analysis of plant compliance by selected plant types showed that Waste Stabilization Ponds demonstrated greatest compliance, with Packaged plants (both those with Extended Aeration and Contact Stabilization) being the least compliant of those compared.

The performance of Packaged Plant/Extended Aeration is poor in relation to FC, BOD and COD. While the Batch Sequential Plants have the best performance for the same parameters.

All treatment plants have a poor performance in the removal of nitrogen. Being the worst the Packaged Plant/Contact Stabilization, Those are not removing any nitrogen. This condition may be contributing to the eutrophication conditions and hence the creation of mosquitoes breeding sites, in quiescent waters.

Maps plotted using GPS coordinates gathered during the project showed the ability to analyze plants geographically.

Limitations:

We would like to create a link to the database so that we could have views in Google Earth, however, the lack of funds is not making this possible and we are considering other options.

There was an under reporting of field pH and Residual Chlorine.

A proper assessment of the impact on the receiving waters is still pending due to the lack of collection of some receiving water samples as well as delays in setting up the Autoanalyzer.

Conclusion:

These preliminary results revealed that there are some wastewater plants that do not meet the national standards; however more information will be gathered to influence an improvement in the efficiency of the plants and consistency in their performance. This will ensure a greater level of compliance in the promotion of healthy environmental practices.

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